The Atari™ Compendium
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Written by Scott Sanders

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Introduction

The following pages are a work in progress. The Atari™ Compendium (working title) is designed to be a comprehensive reference manual for Atari software and hardware designers of all levels of expertise. At the very least, it will (hopefully) be the first book available that documents *all* operating system functions, including any modifications or bugs that were associated with them, from TOS 1.00 to whatever the final release version of Falcon TOS ends up being. **GEMDOS**, **BIOS**, **XBIOS** (including sound and DSP calls), **VDI**, **GDOS**, **LINE-A, FSM**, **AES**, **MetaDOS, AHDI** and **MiNT** will be documented. Hardware information to the extent that information is useful to a software programmer will also be covered. This volume will *not* include hardware specifications used in the creation of hardware add-ons, a programming introduction designed for beginners, or an application style guide. All of the aforementioned exclusions will be created separately as demand for them arise. In addition, I also plan to market a comprehensive spiral-bound mini-reference book to complement this volume.

By providing early copies of the text of this volume I hope to accomplish several goals:

1. Present a complete, error-free, professionally written and typeset document of reference.

2. Encourage compatible and endorsed programming practices.

3. Clear up any misunderstandings or erroneous information I may have regarding the information contained within.

4. Avoid any legal problems stemming from non-disclosure or copyright questions.

A comprehensive Bibliograpy will be a part of this volume. For now you should know that I have mainly relied on five major sources of information:

1. Atari Developer Documentation, including, but not limited to, original OS docs, release notes, newsletters, and technical support.

2. Compute's AES/TOS/VDI series. This series seems to be the most complete English reference available, however, its usage is limited by the fact it is only current as of TOS 1.02

3. Lattice C Atari Library Manual and Addendum

4. Atari Profibuch - Excellent German text.

5. Developer Roundtable on GEnie and Compuserve.

How to Edit...

Below are some simple suggestions as to how to notate any changes you would like to see made. I understand you are probably just as busy as I usually am so if you can't take the time to follow these steps, ragged handwriting in the corner would be just as appreciated.

Included in your package should be seven items:

1. This introduction letter.
2. A binder.
3. Revision notes
4. Looseleaf notebook paper.
5. Two highlighter pens
6. Dividers
7. The latest revision of the text

If you are missing any items, please contact me.

Each revision will be accompanied by a set of revision notes. These will highlight what to look for, what I already know is wrong and am planning to change, and what has changed since last time.

The looseleaf notebook paper should be used to make general suggestions as to content, style (writing/typesetting), and so on....

When proofing the text use the blue highlighter to circle spelling, grammar, or style errors (any typo). The green highlighter is for blatant errors or misunderstandings where an explanation is necessary. Please notate the error and correction in the margins. If it is a very large misunderstanding beyond simply writing it down, please call me or E-Mail me.

Also, as a part of the volume will be a listing of standard conventions. The following is a brief listing of conventions used in the book:

Typestyle	**Meaning**
The quick brown fox....	Normal Text
WORD appl_init(VOID)	Function Definitions
mode, *flag*, *ap_id*	program/system variables
WORD, **TOS**, **WM_CLOSED**	macros, typedef's, define's, OS components
`typedef struct {`	Program listings/bindings
A basic explanation is listed...	Text in tables
CTRL-G	Keyboard keys
OPCODE	Headings

Any questionable stray from the conventions should be notated as a possible error.

Revision Schedule

I would like to swap edited text with new revisions about every two weeks. The final revision should be approved by November 15th to try for a release date of December 15th. This schedule is not fixed and I will be in contact to find out what's best for you.

Thank You...

Thank you for your time and effort. Your name will be credited if you desire and you should check for it in a final revision.

SCOTT D. SANDERS, OWNER
SOFTWARE DEVELOPMENT SYSTEMS

CONTENTS

FOREWORD

About eight months have passed since ***The Atari Compendium***® was first released, and I must admit to being amazed with the amount of attention the book has received from Atari developers worldwide. When I started writing the first draft of the book I didn't know enough about Atari computers to write half of the 860 pages it eventually became. The learning process that I went through to see the book to its completion was responsible for a great deal of personal growth and a greater understanding of computer science in general.

It was inevitable, of course, that there would be errors in a book this big. I didn't want to revise the book simply to correct those errors, however. I was determined to add some missing topics as well. This first revision now adds about 60 pages to the original and led me back to the on-the-job learning process and several phone calls and E-mail letters to Sunnyvale.

The ***Compendium*** now covers almost every conceivable topic a software programmer needs to know about Atari computers. You still won't find timing diagrams, pinouts, and hardware specifications simply because my level of competence in those matters is unfortunately minor. The only other topics you won't find discussed are those covered completely in separate volumes (referenced in the *Bibliography*). These include hardware-direct ACSI/SCSI/IDE programming, SCC programming, DSP programming, and direct BLiTTER chip usage. In every case except for DSP programming, almost all functions of these devices may be accessed by the average programmer through the use of OS calls, which are, of course, documented. The basics of DSP programming, like assembly or 'C' is left to the reader to explore in other books dedicated to their teaching.

New to this revision you will find an enhanced style guide and memory map (the two most popular sections of the book, it seems), information on programming **MiNT** device drivers and file systems, and a section documenting the XBRA protocol. Most importantly, though, almost every conceivable parameter and return value has been listed with a corresponding definition name. These names may be used with any language that supports constant naming, and, when used, improve program readability dramatically. The TOS.H and TOSDEFS.H include files will be available from SDS upon the release of this revision. To find out how to obtain them, be sure to send in your registration card.

I owe thanks to Mike Fulton, Eric Smith, and Jay Patton were very helpful in ensuring that the new material was correct and old errors were eliminated. Many independent readers of the book also deserve thanks for taking the time to report errors and submit their comments.

In addition, my close friends Dennis, Mike, Keith, Cathryn, Shawn, Cathy, Shaun, and Kristýna provided moral support and dragged me away from work when I needed a break badly. Also, as always, my mom supported me tremendously and continues to proudly display a plastic-wrap'd copy of the book to friends and relatives even though to her its about as useful as a phone book for some remote city in Alaska.

Thanks to you, especially, the Atari developers and users who made this book a reality. Enjoy!

—Scott D. Sanders, April 1994

— CHAPTER 1 —

INTRODUCTION TO ATARI PROGRAMMING

Atari Computer Hardware

The 260/520/1040 ST

The first Atari ST computers became available to the public in 1985. The new Atari models were the first 16-bit computers well-suited for use in the home. The availability of these computers signaled the end of the Atari 8-bit era of computers such as the 400, 800, 800XL, 1200XL, 1450XLD, 65XE, and 130XE computers.

The name 'ST' is derived from the capabilities of the Motorola 68000 processor upon which the original Atari line was based. The 68000 uses a **S**ixteen-bit data bus with a **T**hirty-two bit address bus.

16-bit computers introduced a new concept in computer technology called the operating system (OS). Atari's operating system, **T**he **O**perating **S**ystem (**TOS**), was loaded from a boot disk originally, but is now almost always installed in ROM.

A primary subsystem of **TOS** is **GEM** ('Graphics Environment Manager'), the graphical user interface used by Atari computers. **GEM**, which was developed by Digital Research, Inc., manages the graphic interface to applications and provides access to popular computing features with buzzwords such as windows, the mouse, menus, and the desktop.

GEM was originally designed for PC-compatible computers. PC-based **GEM**, however, is no longer completely compatible with Atari **GEM**. Only components of **GEM** relative to its use on the Atari will be covered in this guide. Some functions which were originally documented for Atari **GEM** yet never implemented have been included for completeness.

Other **TOS** subsystems include **GEMDOS**, the **BIOS**, and the **XBIOS**. These subsystems provide a hardware interface and management functions for the file system.

The original ST computers featured the following:

- Motorola 68000 32-bit processor running at 8MHz.
- Integrated GEM/TOS operating system.
- RAM memory storage of 256k, 512k, or 1 Mbyte (depending on model).
- Built-in MIDI, dual joystick, floppy drive, ACSI, serial, and parallel ports.
- Sophisticated DMA peripheral access.
- Yamaha 3-voice FM sound generator.
- External 128k cartridge port.
- Integrated video controller capable of generating (320x200x16), (640x200x4), and (640x400x2) video modes from as many as 512 colors.

Mega ST 2/4

Two years after the release of the original ST series Atari released the Mega ST series of computers. The Mega ST computers were shipped with **TOS** 1.02 and featured several new features as follows:

- BLiTTER chip (for faster graphics).
- Internal expansion bus.
- Separate keyboard and CPU.
- Either two or four megabytes of RAM.
- Peripheral co-processor slot (for 68881 coprocessor, etc.).

STacy

The STacy was released shortly after the Mega ST to provide a portable means of Atari computing. STacy computers were shipped with **TOS** 1.04. The STacy's design supplemented the basic features of an ST with the following:

- Integrated CPU/keyboard/carrying case.
- Monochrome LCD screen.
- Track ball for mouse control.
- Optional hard drive.

1040 STe

The 1040 STe, released in 1990, was designed to expand upon the capabilities of the 1040 ST. Many of the features added were geared towards entertainment and multimedia applications. The 1040 STe was shipped originally with **TOS** 1.06. The following features were added to those of the basic ST:

- Extended color palette to support up to 4096 colors.
- Support for horizontal and vertical fine scrolling.
- Video GENLOCK capability.
- Stereo 8-bit PCM sound.
- Two extra joystick ports with support for paddles and light pens.
- 256k Operating System in ROM.
- SIMM memory slots to upgrade memory to 4 Mb

Mega STe

Released in 1990, the Mega STe was designed to provide for more computing power than the 1040 STe and add several new hardware features. The Mega STe shipped with **TOS** 2.02, 2.05, or 2.06. It adds features to that of a 1040 STe as follows:

- Motorola 68000 32-bit processor running at 8MHz or 16MHz.

- Optional 68881 math coprocessor.
- One, two, or four megabytes of RAM memory.
- Optional internal hard drive.
- Modern case design with separate keyboard/CPU.
- Three serial ports.
- Localtalk compatible networking port.
- VME compatible expansion slot.

TT030

Also released in 1990, the TT030 computer was the first Atari computer workstation designed for high-end computer users. The TT030 workstation was shipped with **TOS** 3.01, 3.05, or 3.06. It adds the following features to that of the Mega STe:

- Motorola 68030 32-bit processor running at 32MHz with cache.
- Memory capacity of 32Mb with optional 'fast' RAM.
- Standard 68882 math coprocessor.
- Four serial ports.
- SCSI device port.
- Stereo RCA jacks for sound output.
- Extra video resolutions of (320x480x256), (640x480x16), and (1280x960x2).

ST Book

Designed to replace the STacy as the defacto portable ST computer, the ST Book brought the basic computing power of an ST to a lightweight notebook computer. This machine was only released in Europe and Atari only shipped a very small quantity. The ST Book was shipped with **TOS** 2.06. Minus the internal floppy drive, it supported features beyond that of a STacy as follows:

- Lightweight case design.
- Keyboard with integrated numeric keypad.
- Mouse 'vector' pad.
- Processor-direct expansion slot.
- External keypad port.
- Floppy drive connector.

Falcon030

The newest member of the Atari line, the Falcon030 is to become the new base model Atari system. The Falcon030 is currently shipping with **TOS** 4.04. While remaining backwardly-compatible, the Falcon030 adds many new features as follows:

- Integrated case and keyboard design.
- Motorola 68030 processor running at 16MHz with cache.
- Motorola 56001 DSP with 96k RAM.
- Standard configurations with 1, 4, or 14Mb RAM.
- Internal 2 ½" IDE hard drive optional.
- Video resolutions from 320x200 to 640x480 with a palette from 2 to 256 colors and 16-bit true color.
- Adaptable to Atari monitors, standard VGA monitors, and composite video.
- GENLOCK-ready design.
- Ports include parallel, serial, external floppy, SCSI-2, LAN, 4 joystick, MIDI in/out, microphone, headphone, and ST compatible cartridge port.
- Interior processor expansion port.
- Sound system includes standard Yamaha FM chip, connection matrix, and 8-track, 16-bit stereo record/playback.

Atari 'Clone' Computers

Atari 'clone' computers first became available in early 1994. These computers, while mostly software compatible with Atari-produced computers, contain hardware enhancements and modifications that may cause incompatibilities in software that relies on hardware access rather than the recommended method of using standardized OS calls.

The recent availability of these computers as well as enhanced graphics and peripheral boards emphasizes the value of programming using the OS whenever possible to allow software to be run on the widest variety of machine configurations.

Atari Computer Software

GEMDOS

GEMDOS consists of file system management routines that provide access to all of the basic devices supported by Atari computers. It bears resemblance to MS-DOS in its functions and opcode numbering while still maintaining some differences and advantages.

MultiTOS

MultiTOS is the first truly multi-tasking extension to **GEMDOS** supported by Atari. Based on **MiNT**, developed by Eric Smith, **MultiTOS** adds true pre-emptive multitasking, memory protection, and process control. Its methods of job control and interprocess communication will be familiar to UNIX users. With the ability to support loadable device drivers and file systems, **MultiTOS** provides a complete range of functions to complement **GEMDOS**. In its current incarnation, **MultiTOS** is an option and thus disk-based as opposed to burned in ROM.

BIOS

The ST **BIOS** ('Basic Input/Output System') comprises the lowest-level of device communication. **GEMDOS** uses the **BIOS** to accomplish many of its file system operations.

XBIOS

The **XBIOS** ('eXtended Basic Input/Output System') controls other hardware-specific features such as the floppy drive, video controller, DSP, MFP, and sound system.

Atari GEM

AES

The **AES** is responsible for window and menu control, messaging services, and object rendering and manipulation.

VDI

The **VDI** consists of a series of drivers which provide device-independent access to the display screen and external output devices such as printers and plotters through **GDOS**. All graphic primitive operations are accomplished with the **VDI**. The **AES**, for instance, uses the **VDI** to render its objects on screen.

GDOS

GDOS is a disk-loadable subsystem of the **VDI**. The term **GDOS** can refer to original **GDOS**, **FONTGDOS**, or **SpeedoGDOS**. It controls loadable device drivers and fonts. The original **GDOS** was limited to bitmap fonts and did not have the bezier capabilities of **FONTGDOS** or **SpeedoGDOS**.

FONTGDOS

FONTGDOS is essentially a newer, faster **GDOS** with bezier rendering functions present. **FONTGDOS** is otherwise completely backwardly compatible with **GDOS.**

SpeedoGDOS

SpeedoGDOS, named for the Speedo™ font format created by Bitstream, Inc., adds outline font rendering capability to the basic features of **GDOS**. **SpeedoGDOS** also includes a sophisticated caching system to promote the fastest rendering possible.

Two versions of outline **GDOS** exist. The original version (referred to as Font Scaling Module (**FSMGDOS**)), based on QMS/Imagen fonts, was never officially released. Nonetheless, a small number of users still use **FSMGDOS** and differences between them are noted.

LINE-A

LINE-A is a special set of routines that provide an assembly language interface to routines and variables belonging to the **VDI** and **XBIOS**. It is so named because instruction opcodes beginning with the hexadecimal number $A utilize a special microprocessor exception which point to the **LINE-A** routines in ROM.

LINE-A is the only operating system component that has become out of date and incompatible. Atari recommends that software developers avoid using **LINE-A** as it will be supported less and less as hardware advancements make its use more incompatible. **LINE-A** is documented briefly in this reference for completeness.

Desktop

The 'Desktop' is a independent **GEM** application burned into ROM. It facilitates program launching and file manipulation as well as providing a graphical shell for user-interaction.

XCONTROL

XCONTROL (Extensible Control Panel) is a desk accessory application that provides access to multiple modules called CPX's (Control Panel Extensions) which are used to control system configuration and other related functions. A special section in this reference discusses the creation of CPX's and the utility functions provided by the **XCONTROL** shell accessory.

Third-Party System Software

Geneva

Geneva is an alternative, **TOS**-compatible operating system developed by Gribnif Software. It functions mostly as an **AES** replacement although it supplements other areas of the OS to provide cooperative multitasking (as opposed to **MultiTOS**'s pre-emptive multitasking).

Programming for Geneva 1.0 is identical to programming for **GEM** with **AES** version 4.0. Geneva does not currently support **MiNT** extensions though Gribnif has announced plans to eliminate this incompatibility in a future version. You can detect Geneva by searching for the cookie 'Gnva' in the system cookie jar. Likewise, the presence of **MiNT** extensions can be determined by the 'MiNT' cookie.

Programmers should not rely specifically on the presence of these cookies to determine if the current OS variety supports multitasking. The **AES** *global* array contains values to help determine the possible number of concurrent processes and the **AES** version number. In addition, the **AES** call **appl_sysinfo()**, available as of **AES** 4.0, can be used to determine the presence of special **AES** features.

Geneva offers several system extensions not available under **MultiTOS**. Information on programming the Geneva OS is available in the commercial package and direct from Gribnif Software.

Programming Languages

'C'

'C' has become the default standard for Atari computer programming. Most reference books and materials illustrate OS functions using 'C' style bindings. This book is oriented towards 'C' without, hopefully, alienating developers who develop in other languages. Several different 'C'

compilers exist in the Atari domain. All have their various features and quirks which make it necessary to be familiar enough with your implementation to modify the source contained in this reference appropriately.

All 'C' bindings in this book were created for use with Lattice 'C' by Hisoft, Inc.. They should be easily convertable to other major Atari 'C' compilers.

Luckily, most 'C' compilers agree with their function naming and in most cases you can simply call the function as listed. If you have an older version compiler you may need to add some bindings using the information provided in accordance with your compiler's recommendations.

Assembly Language

For the convenience of assembly language programmers, all functions are listed with their opcode and related binding. In addition, a section provided in front of the function reference will explain the calling conventions for functions in that category.

All assembly listings in this book were created for use by the AS68 compiler included in the Atari developer's kit.

BASIC

Depending on the type of BASIC you utilize, functions may be named identically or differently from what is listed in this book. It is recommended that you seek a BASIC compiler that gives you proper access to all of the functions of the machine or familiarize yourself with a more robust language.

Other Languages

Various other languages exist in the Atari domain. Pascal, Forth, 'C++', and others have implementations that are similar in design to 'C'. You should refer to your language manual to properly utilize information found in this reference.

Conventions

Typesetting

The following table displays a list of typesetting conventions used in this book:

Style	Meaning
Normal Text	Standard body text.
BOLD TEXT	Bolded words include function names like **appl_init()** , 'C' macros, '#defined' data types like **WORD**, and operating system components such as **GEM** and **TOS**.
Italicized Text	Italicized text is used to represent

	variable names like *handle*. In addition sections of this book like ***AES** Reference Manual* will be in capitalized italic text.
| Text between vertical bars |	Vertical bars imply the absolute value of the variable or expression within. For instance: | -2 | == | 2 |
(Number 1, Number 2)	Two numbers contained within parentheses and separated by a comma indicate a coordinate point X followed by Y. For instance, (100, 100).
Number1 ^ Number 2	2 ^ 8 is the same as 2^8 or 2 to the power of 8.
`Fixed Width Text`	This style of text is used to present bindings and computer listings.
Table Text	This smaller style of text is used in tables as body text.

Functions

The function references in this guide are designed in a compatible manner for ease of reading. Each function is illustrated as follows (headings not applicable for a particular function will be omitted):

objc_draw()

⇦Function Name

WORD objc_draw(*tree, obj, depth, bx, by, bw, bh*) **⇦Definition**
OBJECT ****tree***;** **⇦Data Types**
WORD *obj, depth, bx, by, bw, bh*;

Immediately following the definition, a brief summary of the function will follow.

OPCODE The opcode related to the function will be listed in decimal and hexadecimal where appropriate.

AVAILABILITY This section will indicate any special conditions that must exist for this function to be present (i.e.: OS version, presence of **GDOS**, etc.).

PARAMETERS The meaning of each parameter to the function will be explained here. If any data

pointed to by parameters is modified it will be noted here as well.

BINDING This section will list a binding for the function in either 'C' format or assembly format, whichever is more appropriate. Please note bindings were written with ease of reading, not necessarily optimized code, in mind.

RETURN VALUE This section explains the return value of the function. This covers only that value returned on the left side of the function expression.

VERSION NOTES Under this heading, any features of a function which are only present under certain conditions are discussed.

CAVEATS Known bugs or abnormalities of a function are listed next to this heading.

COMMENTS Other useful information or hints are listed here.

SEE ALSO Functions which bear a relation to the current function or which are codependent on one another are listed here.

Data Types

Within function definitions, several data types are referenced that vary from compiler to compiler. The following provides a key to the data type used and their actual definition. Other data types will contain a structure definition or 'typedef' within the binding. Be aware that some compilers default to 16-bit integers while others use 32-bit integers.

Usage	Synonyms	Meaning
WORD	short, int, short int	16-bit signed integer
UWORD	unsigned int, unsigned short, unsigned short int	16-bit unsigned integer
LONG	long, int, long int	32-bit signed integer
ULONG	unsigned long, unsigned int, unsigned long int	32-bit unsigned integer
VOID	void	This naming is used to denote a function with no parameters or return value.
BOOLEAN	bool, boolean, short, short int, int	16-bit signed integer valid only as **TRUE** (non-zero) or **FALSE** (0)
WORD *	short *, int *, short int *	This is a pointer to a 16-bit signed integer.
UWORD *	unsigned short *, unsigned int *, unsigned short int *	This is a pointer to a 16-bit unsigned integer.
LONG *	long *, int *, long int *	This is a pointer to a 32-bit signed integer.
ULONG *	unsigned long *, unsigned int *, unsigned long int *	This is a pointer to a 32-bit unsigned integer.
VOIDP	void *, char *	This represents a pointer to an

		undefined memory type.
VOIDPP	void **, char **	This represents a pointer to a pointer of an undefined memory type.
char *	None	8-bit character string buffer
BYTE, **CHAR**	signed byte, signed char	8-bit signed byte
UBYTE, **UCHAR**	unsigned byte, unsigned char	8-bit unsigned byte
fix31	None	This type holds a 31-bit mantissa and sign bit. The value represents the number contained multiplied times 1/65536. For a complete explanation see *Chapter 7:* ***VDI***.

Numeric Values

Because different computer languages use different nomenclature to specify numbers in different bases, you will come across numbers presented in a variety of different ways within this book as follows:

Prefix	Decimal 23 as an Example	Meaning
None	22	This number is shown in decimal (base 10) format. The majority of numbers shown will be in this format for simplicity.
0x	0x16	This number is shown in hexadecimal (base 16) format. Function opcodes in assembly language and numbers used as mask values will appear mostly in this format.
$	$16	Same as above.
0	026	This number is shown in octal (base 8) format. Only in extremely specialized cases will numbers by represented in this manner.
%	%00010110	This number is shownn in binary (base 2) format. Only when dealing with hardware registers and in a few other circumstances will numbers be represented in this manner.

Constant Definitions

Modern programming practices dictate the use of named constants wherever possible in place of 'raw' values. Take for example the following call to **Devconnect()**:

In 'C':

```
Devconnect( 3, 9, 0, 0, 1 );
```

In assembly language:

```
move.w      #1,-(sp)
move.w      #0,-(sp)
move.w      #0,-(sp)
move.w      #9,-(sp)
move.w      #3,-(sp)
move.w      #$8B,-(sp)
```

```
trap        #14
lea         12(sp),sp
```

Calling the function in this format makes debugging and program maintenance more difficult because the parameters' meanings are concealed by the numeric assignments. The following code illustrates the preferred method of coding:

In 'C':

```
/* Extracted from TOSDEFS.H, included by TOS.H */
#define ADC         3
#define DMAREC      0x01
#define DAC         0x08
#define CLK_25M     0
#define CLK_COMPAT  0
#define NO_SHAKE        1

/* Program segment */
#include <TOS.H>

Devconnect( ADC, DMAREC|DAC, CLK_25M, CLK_COMPAT, NO_SHAKE );
```

In assembly language:

```
; Extracted from TOSDEFS.I

ADC         EQU     3
DMAREC      EQU     $01
DAC         EQU     $08
CLK_25M     EQU     0
CLK_COMPAT  EQU     0
NO_SHAKE    EQU     1

Devconnect  EQU     $8B

; Program Segment
            INCLUDE     "TOSDEFS.I"

            move.w      #NO_SHAKE, -(sp)
            move.w      #CLK_COMPAT,-(sp)
            move.w      #CLK_25M,-(sp)
            move.w      #DMAREC!DAC,-(sp)
            move.w      #ADC,-(sp)
            move.w      #Devconnect,-(sp)
            trap        #14
            lea         12(sp),sp
```

Unfortunately, because many function call parameters do not have standard definitions associated with them, programmers have had to create their own, which in turn makes their programs less portable, or use the 'raw' constants. In addition, some compilers do not use standardized definitions at all.

To help alleviate these difficulties, this revision of the ***Compendium*** contains named definitions for almost every possible function parameter. These definitions come from the 'C' header files TOS.H and TOSDEFS.H or the assembly include file TOSDEFS.I, both available on disk from

SDS. Every attempt has been made to ensure that these files compile with development tools in the Lattice ‘C’, Pure ‘C’, and Alcyon ‘C’ packages. Some modifications to these files may be necessary, however, due to the peculiarities of some compilers.

The ‘C’ header files consist of two parts to improve portability between compiles. The TOS.H file is a compiler dependent file used to bind the operating system calls to definitions. This file, in turn, includes the file TOSDEFS.H which should remain portable between compilers.

When choosing definitions for inclusion in the TOSDEFS files, names given by Atari were given highest precedence followed by those assigned (and kept consistent) by compiler manufacturers. Other definitions were created with simplicity and consistency in mind.

Use of the given constants will increase program code readability and provide for a higher level of portability between compilers.

– CHAPTER 2 –

GEMDOS

Overview

GEMDOS contains functions which comprise the highest level of **TOS**. In many cases, **GEMDOS** devolves into **BIOS** calls which handle lower level device access. **GEMDOS** is responsible for file, device, process, and high-level input/output management. The current revision number of **GEMDOS** is obtained by calling **Sversion()**. You should note that the **GEMDOS** version number is independent of the **TOS** version number and you should not count on any particular version of **GEMDOS** being present based on the **TOS** version present.

Much of **GEMDOS** closely resembles its CPM 68k and MS-DOS heritage. In fact, the file system and function calls are mostly compatible with MS-DOS. MS-DOS format floppy disks are readable by an Atari computer and vice-versa.

For the creation of **MultiTOS**, **GEMDOS** was merged with the **MiNT** operating environment which derives many of its calls from the UNIX operating system.

The TOS File System

GEMDOS is responsible for interaction between applications and file-based devices. Floppy and hard disk drives as well as CD-ROM, WORM, and Magneto-Optical drives are all accessed using **GEMDOS** calls.

Prior to the advent of **MultiTOS**, Atari programmers were limited to the **TOS** file system for file storage and manipulation. With the introduction of **MultiTOS**, it is now possible for developers to create custom file systems so that almost any conceivable disk format becomes accessible.

As a default, **MultiTOS** will manage files between the **TOS** file system and alternative file systems to maintain backward compatibility. Applications which wish to support extra file system features may do so. The **Pdomain()** call may be used to instruct **MultiTOS** to stop performing translations on filenames, etc. Other calls such as **Dpathconf()** can be used to determine the requirements of a particular file system.

The explanation of the file system contained herein will limit itself to the **TOS** file system.

Drive Identifiers

Each drive connected to an Atari system is given a unique alphabetic identifier which is used to identify it. Drive ‘A’ is reserved for the first available floppy disk drive (usually internal) and drive ‘B’ for the second floppy disk drive. If only one floppy drive exists, two letters will still be reserved and **GEMDOS** will treat drive ‘B’ as a pseudo-drive and request disk swaps as necessary. This feature is automatically handled by **GEMDOS** and is transparent to the application.

Drives ‘C’ through ‘P’ are available for use by hard disk drives. One letter is assigned per hard drive partition so a multiple-partition drive will be assigned multiple letters. **MultiTOS** extends drive letter assignments to ‘Z’ drive. Drive ‘U’ is a special drive reserved for **MultiTOS** and is unavailable for assignment.

The amount of free storage space remaining on a drive along with a drive’s basic configuration can be determined using the **Dfree()** call.

GEMDOS Filenames

Under **GEMDOS**, each file located on a device is given a filename upon its creation which serves to provide identification for the file. The filename has two parts consisting of a name from one to eight characters long and an optional file extension of up to three characters long. If a file extension exists, the two components are separated by a period. The extension should serve to identify the format of the data whereas the name itself should identify the data itself.

Filenames may be changed after creation with the function **Frename()**; however, under no circumstances may two files with the same filename reside in the same directory.

All **GEMDOS** functions ignore the alphabetic case of file and pathnames. The following characters are legal filename characters:

Legal **GEMDOS** Filename Characters
A-Z, a-z, 0-9
! @ # $ % ^ & ( )
+ - = ~ ` ; ’ ” ,
< > | [ ] ( ) _

GEMDOS Directories

To further organize data, **GEMDOS** provides file directories (or folders). Each drive may contain any number of directories which, in turn, may contain files and additional directories. This organization creates a tree-like structure of files and folders. A file’s location in this tree is called the path.

Directory names follow the same format as **GEMDOS** filenames with a maximum filename length of 8 characters and an optional 3 character extension. The first directory of a disk which contains all subdirectories and files is called the root directory.

The **Dcreate()** and **Ddelete()** system calls are used to create and delete subdirectories.

Two special, system-created subdirectories are present in some directories. A subdirectory with the name ‘..’ (two periods) refers to the parent of the current directory. The ‘..’ subdirectory is present in every subdirectory.

A subdirectory with the name ‘.’ refers to the current directory. There is a ‘.’ subdirectory in every directory.

GEMDOS Path Specifications

To access a file, a complete path specification must be composed of the drive letter, directory name(s), and filename. A file named 'TEST.PRG' located in the 'SYSTEM' directory on drive 'C' would have a path specification like the following:

```
C:\SYSTEM\TEST.PRG
```

The drive letter is the first character followed by a colon. Each directory and subdirectory is surrounded by backslashes. If 'TEST.PRG' were located in the root directory of 'C' the path specification would be:

```
C:\TEST.PRG
```

The drive letter and colon may be omitted causing **GEMDOS** to reference the default drive as follows:

```
\TEST.PRG
```

A filename by itself will be treated as the file in the default directory and drive. The current **GEMDOS** directory and drive may be found with the functions **Dgetpath()** and **Dgetdrv()** respectively. They may be changed with the functions **Dsetpath()** and **Dsetdrv()**.

Wildcards

The **GEMDOS** functions **Fsfirst()** and **Fsnext()** are used together to enumerate files of a given path specification. These two functions allow the use of wildcard characters to expand their search parameters.

The '?' character is used to represent exactly one unknown character. The '*' character is used to represent any number of unknown characters. The following table gives some examples of the uses of these characters.

Filename	Found	Not Found
.	All files	None
*.GEM	TEST.GEM ATARI.GEM	TEST.G ATARI.IMG
A?ARI.?	ATARI.O ADARI.C	ADARI.IMG ATARI.GEM
ATARI.???	ATARI.GEM ATARI.IMG	ATARI.O ATARI.C

Disk Transfer Address (DTA)

When using **Fsfirst()** and **Fsnext()** to build a list of files, **TOS** uses the Disk Transfer Address (DTA) to store information about each file found. The format for the DTA structure is as follows:

```
typedef struct
{
   BYTE     d_reserved[21];  /* Reserved - Do Not Change */
   BYTE     d_attrib;        /* GEMDOS File Attributes */
   UWORD    d_time;          /* GEMDOS Time */
   UWORD    d_date;          /* GEMDOS Date */
   LONG     d_length;        /* File Length */
   char     d_fname[14];     /* Filename */
} DTA;
```

When a process is started, its DTA is located at a point where it could overlay potentially important system structures. To avoid overwriting memory a process wishing to use **Fsfirst()** and **Fsnext()** should allocate space for a new DTA and use **Fsetdta()** to instruct the OS to use it. The original location of the DTA should be saved first, however. Its location can be found with the call **Fgetdta()**. At the completion of the operation the old address should be replaced with **Fsetdta()**.

File Attributes

Every **TOS** file contains several attributes which define it more specifically. File attributes are specified when a file is created with **Fcreate()** and can be altered later with **Fattrib()**.

The 'read-only' attribute bit is set to prevent modification of a file. This bit should be set at the user's discretion and not cleared unless the user explicitly requests it.

If the 'hidden' attribute is set, the file will not be listed by the desktop or file selector. These files may still be accessed in a normal manner but will not be present in an **Fsfirst()** or **Fsnext()** search unless the correct **Fsfirst()** bits are present.

The 'system' attribute is unused by **TOS** but remains for MS-DOS compatibility.

The 'volume label' attribute should be present on a maximum of one file per drive. The file which has it set should be in the root directory and have a length of 0. The filename indicates the volume name of the drive.

The 'archive' attribute is a special bit managed by **TOS** which indicates whether a file has been written to since it was last backed up. Any time a **Fcreate()** call creates a file or **Fwrite()** is used on a file, the Archive bit is set. This enables file backup applications to know which files have been modified since the last backup. They are responsible for clearing this bit when backing up the file.

File Time/Date Stamp

When a file is first created a special field in its directory entry is updated to contain the date and time of creation. **Fdatime()** can be used to access or modify this information as necessary.

File Maintenance

New files should be created with **Fcreate()**. When a file is successfully created a positive file handle is returned by the call. That handle is what is used to identify the file for all future operations until the file is closed. After a file is closed its handle is invalidated.

Files which are already in existence should be opened with **Fopen()**. As with **Fcreate()**, this call returns a positive file handle upon success which is used in all subsequent **GEMDOS** calls to reference the file.

Each process is allocated an OS dependent number of file handles. If an application attempts to open more files than this limit allows, the open or create call will fail with an appropriate error code. File handles may be returned to the system by closing the open file with **Fclose()**.

Fopen() may be used in read, write, or read/write mode. In read mode, **Fread()** may be used to access existing file contents. In write mode, any original information in the file is not cleared but the data may be overwritten with **Fwrite()**. In read/write mode, either call may be used interchangeably.

Every file has an associated file position pointer. This pointer is used to determine the location for the next read or write operation. This pointer is expressed as a positive offset from the beginning of the file (position 0) which is set upon first creating or opening a file. The pointer may be read or modified with the function **Fseek()**.

Existing files may be deleted with the **GEMDOS** call **Fdelete()**.

File/Record Locking

File and record locking allow portions or all of a file to be locked against access from another computer over a network or another process in the same system.

All versions of **TOS** have the ability to support file and record locking but not all have the feature installed. If the '_FLK' cookie is present in the system cookie jar then the **Flock()** call is present. This call is used to create locks on individual sections (usually records) in a file.

Locking a file in use, when possible, is recommended to prevent other processes from modifying the file at the same time.

Special File Handles

Several special file handles are available for access through the standard **Fopen()/Fread()/Fwrite()** calls. They are as follows:

Name	Handle	Filename	Device
GSH_BIOSCON	0xFFFF	CON:	Console (screen). Special characters such as the carriage return, etc. are interpreted.
GSH_BIOSAUX	0xFFFE	AUX:	Modem (serial port). This is the ST-compatible port for machines with more than one.
GSH_BIOSPRN	0xFFFD	PRN:	Printer (attached to the Centronics Parallel port).
GSH_BIOSMIDIIN	0xFFFC		Midi In
GSH_BIOSMIDIOUT	0xFFFB		Midi Out

GSH_CONIN	0x00	—	Standard Input (usually directed to **GSH_BIOSCON**)
GSH_CONOUT	0x01	—	Standard Output (usually directed to **GSH_BIOSCON**)
GSH_AUX	0x02	—	Auxillary (usually directed to **GSH_BIOSAUX**)
GSH_PRN	0x03	—	Printer (usually directed to **GSH_BIOSPRN**)
None	0x04	—	Unused
None	0x05	—	Unused
None	0x06 and up	User-Specified	User Process File Handles

These files may be treated like any other **GEMDOS** files for input/output and locking. Access to these devices is also provided with **GEMDOS** character calls (see later in this chapter).

File Redirection

Input and output to a file may be redirected to an alternate file handle. For instance you may redirect the console output of a **TOS** process to the printer.

File redirection is handled by the use of the **Fforce()** call. Generally you will want to make a copy of the file handle with **Fdup()** prior to redirecting the file so that it may be restored to normal operation when complete.

Memory Management

Atari systems support two kinds of memory. Standard RAM (sometimes referred to as 'ST RAM') is general purpose RAM that can be used for any purpose including video and DMA. Current Atari architecture limits the amount of standard RAM a system may have to 14MB.

Alternative RAM (sometimes referred to as 'TT RAM') can be accessed faster than standard RAM but is not suitable for video memory or DMA transfers.

The **Malloc()** and **Mxalloc()** calls allocate memory blocks from the system heap. **Malloc()** chooses the type of memory it allocates based on fields in the program header (see later in this chapter). **Mxalloc()** allows the application to choose the memory type at run-time.

MultiTOS uses memory protection to prevent an errant process from damaging another. It is possible with **Mxalloc()** to dynamically set the protection level of an allocated block.

Memory allocated with either **Malloc()** or **Mxalloc()** may be returned to the system with **Mfree()**. Memory allocated by a process is automatically freed when the process calls **Pterm()**.

GEMDOS Processes

The **GEMDOS** call **Pexec()** is responsible for launching executable files. The process which calls **Pexec()** is called the parent and the file launched becomes the child. Each process may

have more than one child process. Depending on the mode used with **Pexec()**, the child may share data and address space and/or run concurrently (under **MultiTOS**) with the parent. **GEMDOS** executable files (**GEM** and **TOS** applications or desk accessories) contain the following file header:

Name	Offset	Contents
PRG_magic	0x00	This **WORD** contains the magic value (0x601A).
PRG_tsize	0x02	This **LONG** contains the size of the TEXT segment in bytes.
PRG_dsize	0x06	This **LONG** contains the size of the DATA segment in bytes.
PRG_bsize	0x0A	This **LONG** contains the size of the BSS segment in bytes.
PRG_ssize	0x0E	This **LONG** contains the size of the symbol table in bytes.
PRG_res1	0x12	This **LONG** is unused and is currently reserved.
PRGFLAGS	0x16	This **LONG** contains flags which define certain process characteristics (as defined below).
ABSFLAG	0x1A	This **WORD** flag should be non-zero to indicate that the program has no fixups or 0 to indicate it does. Since some versions of **TOS** handle files with this value being non-zero incorrectly, it is better to represent a program having no fixups with 0 here and placing a 0 longword as the fixup offset.
Text Segment	0x1C	This area contains the program's TEXT segment. A process is started by JMP'ing to **BYTE** 0 of this segment with the address of your processes basepage at 4(sp).
Data Segment	***PRG_tsize*** + 0x1C	This area contains the program's DATA segment (if one exists).
Symbol Segment	***PRG_tsize*** + ***PRG_dsize*** + 0x1C	This area contains the program's symbol table (if there is one). The symbol table area is used differently by different compiler vendors. Consult them for the format.
Fixup Offset	***PRG_tsize*** + ***PRG_dsize*** + ***PRG_ssize*** + 0x1C	This **LONG** indicates the first location in the executable (as an offset from the beginning) containing a longword needing a fixup. A 0 means there are no fixups.

Fixup Information	***PRG_tsize*** + ***PRG_dsize*** + ***PRG_ssize*** + 0x20	This area contains a stream of **BYTE**s containing fixup information. Each byte has a significance as follows: **Value** — **Meaning** 0 — End of list. 1 — Advance 254 bytes. 2-254 (even) — Advance this many bytes and fixup the longword there.

PRGFLAGS is a bit field defined as follows:

Definition	Bit(s)	Meaning
PF_FASTLOAD	0	If set, clear only the BSS area on program load, otherwise clear the entire heap.
PF_TTRAMLOAD	1	If set, the program may be loaded into alternative RAM, otherwise it must be loaded into standard RAM.
PF_TTRAMMEM	2	If set, the program's **Malloc()** requests may be satisfied from alternative RAM, otherwise they must be satisfied from standard RAM.
—	3	Currently unused.
See left.	4 & 5	If these bits are set to 0 (**PF_PRIVATE**), the processes' entire memory space will be considered private (when memory protection is enabled). If these bits are set to 1 (**PF_GLOBAL**), the processes' entire memory space will be readable and writable by any process (i.e. global). If these bits are set to 2 (**PF_SUPERVISOR**), the processes' entire memory space will only be readable and writable by itself and any other process in supervisor mode. If these bits are set to 3 (**PF_READABLE**), the processes' entire memory space will be readable by any application but only writable by itself.
—	6-15	Currently unused.

When a process is started by **GEMDOS**, it allocates all remaining memory, loads the process into that memory, and JMP's to the first byte of the application's TEXT segment with the address of the program's basepage at 4(sp). An application should use the basepage information to decide upon the amount of memory it actually needs and **Mshrink()** to return the rest to the system. The exception to this is that desk accessories are only given as much space as they need (as indicated by their program header) and their stack space is pre-assigned.

The following code illustrates the proper way to release system memory and allocate your stack (most 'C' startup routines do this for you):

```
stacksize    =   $2000            ; 8K

                 .text

_start:
         move.l   4(sp),a0        ; Obtain pointer to basepage
         move.l   a0,basepage     ; Save a copy
         move.l   $18(a0),a1      ; BSS Base address
         adda.l   $1C(a0),a1      ; Add BSS size
         adda.l   #stacksize,a1       ; Add stack size

         move.l   a1,sp           ; Move your stack pointer to
                                  ; your new stack.

         suba.l   basepage,a1     ; TPA size
         move.l   a1,-(sp)
         move.l   basepage,-(sp)
         clr.w    -(sp)
         move.w   #$4a,-(sp)      ; Mshrink()
         trap     #1
         lea      12(sp),sp       ; Fix up stack
                                  ; and fall through to main
_main:
       ...

                 .bss

basepage:        ds.l    1

                 .end
```

The **GEMDOS BASEPAGE** structure has the following members:

Name	Offset	Meaning
p_lowtpa	0x00	This **LONG** contains a pointer to the Transient Program Area (TPA).
p_hitpa	0x04	This **LONG** contains a pointer to the top of the TPA + 1.
p_tbase	0x08	This **LONG** contains a pointer to the base of the text segment
p_tlen	0x0C	This **LONG** contains the length of the text segment.
p_dbase	0x10	This **LONG** contains a pointer to the base of the data segment.
p_dlen	0x14	This **LONG** contains the length of the data segment.
p_bbase	0x18	This **LONG** contains a pointer to the base of the BSS segment.
p_blen	0x1C	This **LONG** contains the length of the BSS segment.
p_dta	0x20	This **LONG** contains a pointer to the processes' DTA.

p_parent	0x24	This **LONG** contains a pointer to the processes' parent's basepage.
p_reserved	0x28	This **LONG** is currently unused and is reserved.
p_env	0x2C	This **LONG** contains a pointer to the processes' environment string.
p_undef	0x30	This area contains 80 unused, reserved bytes.
p_cmdlin	0x80	This area contains a copy of the 128 byte command line image.

Processes terminate themselves with either **Pterm0()**, **Pterm()**, or **Ptermres()**. **Ptermres()** allows a segment of a file to remain behind in memory after the file itself terminates (this is mainly useful for TSR utilities).

The Atari Extended Argument Specification

When a process calls **Pexec()** to launch a child, the child may receive a command line up to 125 characters in length. The command line does not normally contain information about the process itself (what goes in *argv*[0] in 'C'). The Atari Extended Argument Specification (ARGV) allows command lines of any length and correctly passes the child the command that started it. The ARGV specification works by passing the command tail in the child's environment rather than in the command line buffer.

Both the parent and child have responsibilities when wanting to correctly handle the ARGV specification. If a process wishes to launch a child with a command line of greater than 125 characters it should follow these steps:

1. Allocate a block of memory large enough to hold the existing environment, the string 'ARGV=' and its terminating **NULL**, a string containing the complete path and filename of the child process and its terminating **NULL**, and a string containing the child's command line arguments and its terminating **NULL**.
2. Next, copy these elements into the reserved block in the order given above.
3. Finally, call **Pexec()** with this environment string and a command line containing a length byte of 127 and the first 125 characters of the command line with a terminating **NULL**.

For a child to correctly establish that a parent process is using ARGV it should check for the length byte of 127 and the ARGV variable. Some parents may assign a value to ARGV (found between the 'ARGV=' and the terminating **NULL** byte). It should be skipped over and ignored. If a child detects that its parent is using ARGV, it then has the responsibility of breaking down the environment into its components to properly obtain its command line elements.

It should be noted that many compilers include ARGV parsing in their basic startup stubs. In addition, applications running under **MultiTOS** should use the **AES** call **shel_write()** as it automatically creates an ARGV environment string.

GEMDOS Vectors

GEMDOS reserves eight system interrupt vectors (of which only three are used) for various system housekeeping. The **BIOS** function **Setexc()** should be used to redirect these vectors when necessary. The **GEMDOS** vectors are as follows:

Name	Setexc() Vector Number	Usage
VEC_TIMER	0x0100	Timer Tick Vector: This vector is jumped through 50 times per second to maintain the time-of-day clock and accomplish other system housekeeping. A process intercepting this vector does not have to preserve any registers but should jump through the old vector when completed. Heavy use of this vector can severly affect system performance. Return from this handler with RTS.
VEC_CRITICALERR	0x0101	Critical Error Handler: This vector is used by the **BIOS** to service critical alerts (an **Rwabs()** disk error or media change request). When called, the **WORD** at 4(sp) is a **GEMDOS** error number. On return, D0.L should contain 0x0001000 to retry the operation, 0 to ignore the error, or 0xFFFFFFxx to return an error code (xx). D3-D7 and A3-A6 must be preserved by the handler. Return from this handler with RTS.
VEC_PROCTERM	0x0102	Process Terminate Vector: This vector is called just prior to the termination of a process ended with CTRL-C. Return from this handler with RTS.
—	0x103-0x0107	Currently unused.

MiNT

MiNT is Now TOS (**MiNT**) is the extension to **GEMDOS** that allows **GEMDOS** to multitask under **MultiTOS**. **MiNT** also provides memory protection (on a 68030 or higher) to protect an errant process from disturbing another.

Processes

MiNT assigns each process a process identifier and a process priority value. The identifier is used to distinguish the process from others in the multitasking environment. **Pgetpid()** is used to obtain the **MiNT** ID of the process and **Pgetppid()** can be used to obtain the ID of the processes' parent.

MiNT also supports networking file systems that support the concept of user and process group control. The **Pgetpgrp()**, **Psetpgrp()**, **Pgetuid()**, **Psetuid()**, **Pgeteuid()**, and **Pseteuid()** get and set the process, user, and effective user ID for a process.

MiNT has complete control over the amount of time allocated to individual processes. It is possible, however, to set a process 'delta' value with **Pnice()** or **Prenice()** which will be used by **MiNT** to decide the amount of processor time a process will get per timeslice. **Syield()** can be used to surrender the remaining portion of a timeslice.

Information about a processes' resource usage can be obtained by calling **Prusage()**. These values can be modified with **Psetlimit()**. System configuration capabilities may be obtained with **Sysconf()**.

Each process can have a user-defined longword value assigned to itself with **Pusrval()**.

The functions **Pwait()**, **Pwait3()**, and **Pwaitpid()** attempt to determine the exit codes of stopped child processes.

Threads

It is possible under **MiNT** to split a single process into 'threads'. These threads continue execution independently as unique processes. The **Pfork()** and **Pvfork()** calls are used to split a process into threads.

The original process that calls **Pfork()** or **Pvfork()** is considered the parent and the newly created process is considered the child.

Child processes created with **Pfork()** share the TEXT segment of the parent, however they are given a copy of the DATA and BSS segments. Both the parent and child execute concurrently.

Child processes created with **Pvfork()** share the entire program code and data space including the processor stack. The parent process is suspended until the child exits or calls **Pexec()**'s mode 200.

Child processes started with either call may make **GEM** calls but a child process started with **Pfork()** must call **appl_init()** to force **GEM** to uniquely recognize it as an independent process. This is not necessary with **Pvfork()** because all program variables are shared.

The following is a simple example of using a thread in a **GEM** application:

```
VOID
UserSelectedPrint( VOID )
{
       /* Prevent the user from editing buffer being printed. */
       LockBufferFromEdits();

       if( Pfork() == 0)
       {
            /* Child enters here */

            appl_init();                  /* Required for GEM threads. */

            DisplayPrintingWindow();      /* Do our task. */
            PrintBuffer();

            /* Send an AES message to the parent telling it to unlock buffer. */
            SendCompletedMessageToParent();

            /* Cleanup and exit thread. */
            appl_exit();
```

```
            Pterm( 0 );
        }

        /* Parent returns and continues normal execution. */
}
```

File System Extensions

MiNT provides several new file and directory manipulation functions that work with **TOS** and other loadable file systems. The **Fcntl()** function performs a large number of file-based tasks many of which apply to special files like terminal emulators and 'U:\' files. **Fxattr()** is used to obtain a file's extended attributes. Some extended attributes are not relevant to the **TOS** file system and will not return meaningful values (see the ***Function Reference*** for details).

Fgetchar() and **Fputchar()** can be used to get and put single characters to a file. **Finstat()** and **Foutstat()** are used to determine the input or output status of a file. **Fselect()** is used to select from a group of file handles those ready to be read from or written to (often used for pipes).

Flink(), **Fsymlink()**, and **Freadlink()** are used to create hard and symbolic links to another file. Links are not supported by all file systems (see the entries for these functions for more details).

Some file systems may support the concept of file ownership and access permissions (**TOS** does not). The **Fchown()** and **Fchmod()** calls are used to adjust the ownership flags and access permissions of a file. **Pumask()** can be used to set the minimum access permissions assigned to each subsequently created file.

Fmidipipe() is used to redirect the file handles used for MIDI input and output.

MiNT provides four new functions for directory enumeration (they provide similar functionality to **Fsfirst()** and **Fsnext()** with a slightly easier interface). **Dopendir()** is used to open a directory for enumeration. **Dreaddir()** steps through each entry in a directory. **Drewinddir()** resets the file pointer to the beginning of the directory. **Dclosedir()** closes a directory.

Dlock() allows disk-formatters and other utilities which require exclusive access to a drive the ability to lock a physical device from other processes.

Dgetcwd() allows a process to obtain the current **GEMDOS** working directory for any process in the system (including itself).

Dcntl() performs device and file-system specific operations (consult the ***Function Reference*** for more details).

Pseudo Drives

MiNT creates a pseudo drive 'U:' which provides access to device drivers, processes, and other system resources. In addition to creating a directory on drive U: for each system drive, **MiNT** may create any of the following directories at the ROOT of the drive:

Folder Name	Contents

\DEV	Loaded devices
\PIPE	System pipes
\PROC	System processes
\SHM	Shared memory blocks

Drive directories on 'U:' act as if they were accessed by their own drive letter. Folder 'U:\C\' contains the same files and folders as 'C:\'.

The 'U:\PROC' Directory

Each system process has a file entry in the 'U:\PROC' directory. The filename given a process in this directory is the basename for the file (without extension) with an extension consisting of the **MiNT** process identifier. The MINIWIN.PRG application might have an entry named 'MINIWIN.003'.

The file size listed corresponds to the amount of memory the process is using. The time and date stamp contains the length of time the process has been executing as if it were started on Jan. 1st, 1980 at midnight. The file attribute bits tell special information about a process as follows:

Name	Attribute Byte	Meaning
PROC_RUN	0x00	The process is currently running.
PROC_READY	0x01	The process is ready to run.
PROC_TSR	0x02	The process is a TSR.
PROC_WAITEVENT	0x20	The process is waiting for an event.
PROC_WAITIO	0x21	The process is waiting for I/O.
PROC_EXITED	0x22	The process has been exited but not yet released.
PROC_STOPPED	0x24	The process was stopped by a signal.

Loadable Devices

MiNT contains a number of built-in devices and also supports loadable device drivers. Current versions of **MiNT** may contain any of the following devices:

Device Filename	Device
CENTR	Centronics Parallel Port
MODEM1	Modem Port 1
MODEM2	Modem Port 2
SERIAL1	Serial Port 1
SERIAL2	Serial Port 2
MIDI	MIDI ports
PRN	PRN: device (usually the Centronics Parallel Port)
AUX	AUX: device (usually the RS232 Port)
CON	Current Terminal
TTY	Current Terminal (same as CON)
STDIN	Current File Handle 0 (standard input)
STDOUT	Current File Handle 1 (standard output)
STDERR	Current File Handle 2 (standard error)
CONSOLE	Physical Console (keyboard/screen)

MOUSE	Mouse (system use only)
NULL	NULL device
AES_BIOS	**AES BIOS** Device (system use only)
AES_MT	**AES** Multitasking Device (system use only)

Each of these devices is represented by a filename (as shown in the table above) in the 'U:\DEV\' directory. Using standard **GEMDOS** calls (ex: **Fread()** and **Fwrite()**) on these files yields the same results as accessing the device directly. New devices, including those directly accessible by the **BIOS**, may be added to the system with the **Dcntl()** call using a parameter of **DEV_INSTALL**, **DEV_NEWBIOS**, or **DEV_NEWTTY**. See the **Dcntl()** call for details.

MiNT versions 1.08 and above will automatically load device drivers with an extension of '.XDD' found in the root or '\MULTITOS' directory. '.XDD' files are special device driver executables which are responsible for installing one (or more) new devices. **MiNT** will load the file and JSR to the first instruction in the TEXT segment (no parameters are passed). The device driver executable should not attempt to **Mshrink()** or create a stack (one has already been created).

The '.XDD' may then either install its device itself with **Dcntl()** and return **DEV_SELFINST** (1L) in register D0 or return a pointer to a **DEVDRV** structure to have the **MiNT** kernel install it (the 'U:\DEV\' filename will be the same as the first eight characters of the '.XDD' file). If for some reason, the device can not be initialized, 0L should be returned in D0.

When creating a new **MiNT** device with **Dcntl(DEV_INSTALL**, *devname*, &*dev_descr* **)** the structure **dev_descr** contains a pointer to your **DEVDRV** structure defined as follows:

```
typedef struct devdrv
{
       LONG (*open)( FILEPTR *f );
       LONG (*write)( FILEPTR *f, char *buf, LONG bytes );
       LONG (*read)( FILEPTR *f, char *buf, LONG bytes );
       LONG (*lseek)( FILEPTR *f, LONG where, LONG whence );
       LONG (*ioctl)( FILEPTR *f, WORD mode, VOIDP buf );
       LONG (*datime)( FILEPTR *f, WORD *timeptr, WORD rwflag );
       LONG (*close)( FILEPTR *f, WORD pid );
       LONG (*select)( FILEPTR *f, LONG proc, WORD mode );
       LONG (*unselect)( FILEPTR *f, LONG proc, WORD mode );
       LONG reserved[3];
} DEVDRV;
```

Each of the assigned members of this structure should point to a valid routine that provides the named operation on the device. The routine must preserve registers D2-D7 and A2-A7 returning its completion code in D0. No operating system **TRAP**s should be called from within these routines, however, using the vector tables provided in the **kerinfo** structure returned from the **Dcntl()** call, **GEMDOS** and **BIOS** calls may be used. The specific function that each routine is responsible for is as follows:

Member	Meaning
open	This routine is called by the **MiNT** kernel after a **FILEPTR** structure has been created for a file determined to be associated with the device. The routine should perform whatever initialization is necessary and exit with a standard **GEMDOS** completion code. This routine is responsible for validating the sharing mode and other file flags to verify that the file may be legally opened and should respond with an appropriate error code if necessary.
write	This routine should write *bytes* number of **BYTE**s from *buf* to the file specified in **FILEPTR**. If the file pointer has the **O_APPEND** bit set, the kernel will perform an *lseek()* call to the end of the file prior to calling this function. If the *lseek()/write()* series of calls does not guarantee that data will be written at the end of a file associated with your device, this function must ensure that the data specified is actually written at the end of the file. This function should return with a standard **GEMDOS** error code or the actual number of **BYTE**s written to the file when complete.
read	This routine should read *bytes* number of **BYTE**s from the file specified in **FILEPTR** and place them in the buffer *buf*. This function should return with a standard **GEMDOS** error code or the actual number of bytes read by the routine.
lseek	This routine should move the file position pointer to the appropriate location in the file as specified by the parameter *where* in relation to the seek mode *whence*. Seek modes are the same as with **Fseek()**. The routine should return a **GEMDOS** error code or the absolute new position from the start of the file if successful.
ioctl	This routine is called from the system's perspective as **Fcntl()** and is used to perform file system/device specific functions. At the very least, your device should support **FIONREAD**, **FIONWRITE**, and the file/record locking modes of **Fcntl()**. The *arg* parameter of **Fcntl()** is passed as *buf*.
datime	This routine is used to read or modify the date/time attributes of a file. *timeptr* is a pointer to two **LONG**s containing the time and date of the file respectively. These **LONG**s should be used to set the file date and time if *rwflag* is non-zero or filled in with the file's creation date and time if *rwflag* is 0. This function should return with a standard **GEMDOS** error code or **E_OK** (0) if successful.
close	This routine is used by the kernel to close an open file. Be aware that if *f->links* is non-zero, additional processes still have valid handles to the file. If *f->links* is 0 then the file is really being closed. *pid* specifies the process closing the file and may not necessarily be the same as the process that opened it. Device drivers should set the **O_LOCK** bit on f->flag when the **F_SETLK** or **F_SETLKW** *ioctl()* call is made. This bit can be tested for when a file is closed and all locks on all files associated with the same physical file owned by process *pid* should be removed. If the file did not have any locks created on it by process *pid,* then no locks should be removed. This routine should return with a standard **GEMDOS** error code or **E_OK** (0) if successful.
select	This routine is called when a call to **Fselect()** names a file handled by this device. If *mode* is **O_RDONLY** then the select is for reading, otherwise, if *mode* is **O_WRONLY** then it is for writing. If the user **Fselect()**'s for both reading and writing then two calls to this function will be made. The routine should return 1L if the device is ready for reading or writing (as appropriate) or it should return 0L and arrange to 'wake up' process *proc* when I/O becomes possible. This is usually accomplished by calling the *wakeselect()* member function of the kernel structure. Note that the value in *proc* is not the same as a **PID** and is actually a pointer to a **PROC** structure private to the **MiNT** kernel.
unselect	This routine is called when a device waiting for I/O should no longer be waited for. The *mode* and

	proc parameters are the same as with **select()**. As with **select()**, if neither reading nor writing is to be waited for, two calls to this function will be made. This routine should return a standard **GEMDOS** error code or **E_OK** (0) if successful.

The **FILEPTR** structure pointed to by a parameter of each of the above calls is defined as follows:

```
typedef struct fileptr
{
        WORD            links;
        UWORD           flags;
        LONG            pos;
        LONG            devinfo;
        fcookie             fc;
        struct devdrv   *dev;
        struct fileptr  *next;
} FILEPTR;
```

The members of **FILEPTR** have significance as follows:

Member	Meaning
links	This member contains a value indicating the number of copies of this file descriptor currently in existence.
flags	This member contains a bit mask which indicates several attributes (logically OR'ed together) of the file as follows: **Name** — **Mask** — **Meaning** **O_RDONLY** 0x0000 File is read-only. **O_WRONLY** 0x0001 File is write-only. **O_RDWR** 0x0002 File may be read or written. **O_EXEC** 0x0003 File was opened to be executed. **O_APPEND** 0x0008 Writes start at the end of the file. **O_COMPAT** 0x0000 File-sharing compatibility mode. **O_DENYRW** 0x0010 Deny read and write access. **O_DENYW** 0x0020 Deny write access. **O_DENYR** 0x0030 Deny read access. **O_DENYNONE** 0x0040 Allow reads and writes. **O_NOINHERIT** 0x0080 Children cannot use this file. **O_NDELAY** 0x0100 Device should not block for I/O on this file. **O_CREAT** 0x0200 File should be created if it doesn't exist. **O_TRUNC** 0x0400 File should be truncated to 0 **BYTE**s if it already exists. **O_EXCL** 0x0800 Open should fail if file already exists. **O_TTY** 0x2000 File is a terminal. **O_HEAD** 0x4000 File is a pseudo-terminal "master." **O_LOCK** 0x8000 File has been locked.
pos	This field is initialized to 0 when a file is created and should be used by the device driver to store the file position pointer.
devinfo	This field is reserved for use between the file system and the device driver and may be used as desired. The exception to this is if the file is a TTY, in which case *devinfo* must be a pointer to a *tty* structure.
fc	This is the file cookie for the file as follows: `typedef struct f_cookie`

	{ FILESYS *fs; UWORD dev; UWORD aux; LONG index; } fcookie; *fs* is a pointer to the file system structure responsible for this device. *dev* is a **UWORD** giving a useful device ID (such as the **Rwabs()** device number). The meaning of *aux* is file system dependent. *index* should be used by file systems to provide a unique means of identifying a file.
dev	This is a pointer to the **DEVDRV** structure of the device driver responsible for this file.
next	This pointer may be used by device drivers to link copies of duplicate file descriptors to implement file locking or sharing code.

Upon successful return from the **Dcntl()** call, a pointer to a **kerinfo** structure will be returned. The **kerinfo** structure is defined below:

```
typedef LONG (*Func)();

struct kerinfo
{
        WORD      maj_version;
        WORD      min_version;
        UWORD     default_mode;
        WORD      reserved1;

        Func      *bios_tab;
        Func      *dos_tab;

        VOID      (*drvchng)( UWORD dev );

        VOID      (*trace)( char *, ... );
        VOID      (*debug)( char *, ... );
        VOID      (*alert)( char *, ... );
        VOID      (*fatal)( char *, ... );

        VOIDP     (*kmalloc)( LONG size );
        VOID      (*kfree)( VOIDP memptr );
        VOIDP     (*umalloc)( LONG size );
        VOID      (*ufree)( LONG memptr );

        WORD      (*strnicmp)( char *str1, char *str2, WORD maxsrch );
        WORD      (*stricmp)( char *str1, char *str2 );
        char *    (*strlwr)( char *str );
        char *    (*strupr)( char *str );
        WORD      (*sprintf)( char *strbuf, const char *fmtstr, ... );

        VOID      (*millis_time)( ULONG ms, WORD *td );
        LONG      (*unixtim)( UWORD time, UWORD date );
        LONG      (*dostim)( LONG unixtime );

        VOID      (*nap)( UWORD n );
        VOID      (*sleep)( WORD que, WORD cond );
        VOID      (*wake)( WORD que, WORD cond );
        VOID      (*wakeselect)( LONG proc );

        WORD      (*denyshare)( FILEPTR *list, FILEPTR *f );
        LOCK *    (*denylock)( LOCK *list, LOCK *new );
```

```
        LONG      res2[9];
};
```

The members of the **kerinfo** structure are defined as follows:

Member	Meaning
maj_version	This **WORD** contains the kernel version number.
min_version	This **WORD** contains the minor kernel version number.
default_mode	This **UWORD** contains the default access permissions for a file.
reserved1	Reserved.
bios_tab	This is a pointer to the **BIOS** function jump table. Calling *bios_tab*[0x00]() is equivalent to calling **Getmpb()** and is the only safe way from within a device driver or file system.
dos_tab	This is a pointer to the **GEMDOS** function jump table. Calling *dos_tab*[0x3D]() is equivalent to calling **Fopen()** and is the only safe way from within a device driver or file system.
drvchng	This function should be called by a device driver if a media change was detected on the device during an operation. The parameter *dev* is the **BIOS** device number of the device.
trace	This function is used to send information messages to the kernel for debugging purposes.
debug	This function is used to send error messages to the kernel for debugging purposes.
alert	This function is used to send serious error messages to the kernel for debugging purposes.
fatal	This function is used to send fatal error messages to the kernel for debugging purposes.
kmalloc	Use this internal heap memory management function to allocate memory.
kfree	Use this internal heap memory management function to free memory allocated with *kmalloc*().
umalloc	Use this internal heap memory management function to allocate memory and attach it to the current process. The memory will be released automatically when the current process exits.
ufree	Use this internal heap memory management function to allocate memory allocated with *ufree*().
strnicmp	This function compares *maxsrch* characters of *str1* to *str2* and returns a negative value if *str1* is lower than *str2*, a positive value if *str1* is higher than *str2*, or 0 if they are equal.
stricmp	This function compares two **NULL** terminated strings, *str1* to *str2,* and returns a negative value if *str1* is lower than *str2*, a positive value if *str1* is higher than *str2*, or 0 if they are equal.
strlwr	This function converts all alphabetic characters in *str* to lower case.
strupr	This function converts all alphabetic characters in *str* to upper case.
sprintf	This function is the same as the 'C' library sprintf() function except that it will only convert **SPRINTF_MAX** characters (defined in TOSDEFS.H).
millis_time	This function converts the millisecond time value in *ms* to a **GEMDOS** time in *td*[0] and date in *td*[1].
unixtim	This function converts a **GEMDOS** time and date in a UNIX format **LONG**.
dostim	This function converts a UNIX format **LONG** time/date value into a **GEMDOS** time/date value. The return value contains the time in the upper **WORD** and the date in the lower **WORD**.
nap	This function causes a delay of *n* milliseconds.
sleep	This function causes the current process to sleep, placing it on the system que *que* until condition *cond* is met.
wake	This function causes all processes in que *que*, waiting for condition *cond*, to be woken.
wakeselect	This function wakes a process named by the code *proc* currently doing a select operation.
denyshare	This function determines whether the sharing mode of *f* conflicts with any of the files given in the linked list *list.*
denylock	This function determines whether a new lock *new* conflicts with any existing lock in the linked list *list*. The **LOCK** structure is used internally by the kernel and is defined as follows:

	`typedef struct ilock`
	`{`
	`  FLOCK  l;`
	`  struct ilock  *next;`
	`  LONG  reserved[4];`
	`} LOCK;`
	
	l is the structure actually containing the lock data (as defined in **Fcntl()**). *next* is a pointer to the next **LOCK** structure in the linked list or **NULL** if this is the last lock. *reserved* is a pointer to four **LONG**s currently reserved.

res2	These longwords are reserved for future expansion.

Loadable File Systems

MiNT supports loadable file systems to provide support for those other than **TOS** (such as POSIX, HPFS, ISO 9660 CD-ROM, etc.) The **MiNT** kernel will automatically load file system '.XFS' executables found in the \MULTITOS or root directory. As of **MiNT** version 1.08, it is also possible to have a TSR program install a file system with the **Dcntl()** call.

When the file system is executed by **MiNT** (i.e. not via **Dcntl()**), **MiNT** creates an 8K stack and shrinks the TPA so a call to **Mshrink()** is not necessary. The first instruction of the code segment of the file is JSR'ed to with a pointer to a **kerinfo** (as defined above) structure at 4(sp). The file system should use this entry point to ensure that it is running on the minimum version of **MiNT** needed and that any other aspects of the system are what is required for the file system to operate.

It is not necessary to scan existing drives to determine if they are compatible with the file system as that is accomplished with the file system *root()* function (defined below). If the file system needs to make **MiNT** aware of drives that would not be automatically recognized by the system, it should update the longword variable *_drvbits* at location 0x04F2 appropriately.

If the file system was unable to initialize itself or the host system is incapable of supporting it, the entry stub should return with a value of 0L in d0. If the file system installs successfully, it should return a pointer to a **FILESYS** (defined below) structure in d0. A file system should never call **Pterm()** or **Ptermres()**.

All file system functions, including the entry stub, must preserve registers d2-d7 and a2-a7. Any return values should be returned in d0. Function arguments are passed on the stack. The following listing defines the **FILESYS** structure:

```
typedef struct filesys
{
        struct filesys     *next;
        LONG               fsflags;
        LONG               (*root)( WORD drv, fcookie *fc );
        LONG               (*lookup)( fcookie *dir, char *name, fcookie *fc );
        LONG               (*creat)( fcookie *dir, char *name, UWORD mode, WORD
        attrib,
                                     fcookie *fc );
        DEVDRV             *(*getdev)( fcookie *fc, LONG *devspecial );
```

```
        LONG            (*getxattr)( fcookie *file, XATTR *xattr );
        LONG            (*chattr)( fcookie *file, WORD attr );
        LONG            (*chown)( fcookie *file, WORD uid, WORD gid );
        LONG            (*chmode)( fcookie *file, WORD mode );
        LONG            (*mkdir)( fcookie *dir, char *name, UWORD mode );
        LONG            (*rmdir)( fcookie *dir, char *name );
        LONG            (*remove)( fcookie *dir, char *name );
        LONG            (*getname)( fcookie *relto, fcookie *dir, char *pathname
        );
        LONG            (*rename)( fcookie *olddir, fcookie *oldname,
                                   fcookie *newdir, fcookie *newname );
        LONG            (*opendir)( DIR *dirh, WORD tosflag );
        LONG            (*readdir)( DIR *dirh, char *name, WORD namelen,
                                   fcookie *fc );
        LONG            (*rewinddir)( DIR *dirh );
        LONG            (*closedir)( DIR *dirh );
        LONG            (*pathconf)( fcookie *dir, WORD which );
        LONG            (*dfree)( fcookie *dir, long *buf );
        LONG            (*writelabel)( fcookie *dir, char *name );
        LONG            (*readlabel)( fcookie *dir, char *name );
        LONG            (*symlink)( fcookie *dir, char *name, char *to );
        LONG            (*readlink)( fcookie *file, char *buf, short buflen );
        LONG            (*hardlink)( fcookie *fromdir, char *fromname,
                                   fcookie *todir, char *toname );
        LONG            (*fscntl)( fcookie *dir, char *name, WORD cmd, LONG arg
        );
        LONG            (*dskchng)( WORD dev );
        LONG            zero;
} FILESYS;
```

The members of the **FILESYS** structure are interpreted by **MiNT** as follows:

Member	Meaning
next	This member is a pointer to the next **FILESYS** structure in the kernel's linked list. It should be left as **NULL**.
fsflags	This is a bit mask of flags which define attributes of the file system as follows: **Name** / **Mask** / **Meaning** **FS_KNOPARSE** 0x01 Kernel shouldn't do directory parsing (common for networked file systems). **FS_CASESENSITIVE** 0x02 File system names are case-sensitive (common for Unix compatible file systems). **FS_NOXBIT** 0x04 Files capable of being read are capable of being executed (present in most file systems).
root	This function is called by the kernel to retrieve a file cookie for the root directory of the drive associated with **BIOS** device *dev*. When initializing, the kernel will query each file system, in turn, to determine which file system should handle a particular drive. If your file system recognizes the drive specified by *dev* it should fill in the **fcookie** structure as appropriate and return **E_OK**. If the drive is not compatible with your file system, return an appropriate negative **GEMDOS** error code (usually **EDRIVE**).

<table>
<tr><td>lookup</td><td>This function should translate a file name into a cookie. If the FS_KNOPARSE bit of fsflags is not set, name will be the name of a file in the directory specified by the fcookie dir. If the FS_KNOPARSE bit was set, name will be a path name relative to the specified directory dir.

If the file is found, the fcookie structure fc should be filled in with appropriate details and either E_OK or EMOUNT (if name is '..' and dir specifies the root directory) should be returned, otherwise an appropriate error code (like EFILNF) should be returned.

A lookup() call with a NULL name or with a name of '.' should always succeed and return a cookie representing the current directory. When creating a file cookie, symbolic links should never be followed.</td></tr>
<tr><td>creat</td><td>This function is used by the kernel to instruct the file system to create a file named name in the directory specified by dir with attrib attributes (as defined by Fattrib()) and mode permissions as follows:

<table>
<tr><th>Name</th><th>Mask</th><th>Permission</th></tr>
<tr><td>S_IXOTH</td><td>0x0001</td><td>Execute permission for all others.</td></tr>
<tr><td>S_IWOTH</td><td>0x0002</td><td>Write permission for all others.</td></tr>
<tr><td>S_IROTH</td><td>0x0004</td><td>Read permission for all others.</td></tr>
<tr><td>S_IXGRP</td><td>0x0008</td><td>Execute permission for processes with same group ID.</td></tr>
<tr><td>S_IWGRP</td><td>0x0010</td><td>Write permission for processes with same group ID.</td></tr>
<tr><td>S_IRGRP</td><td>0x0020</td><td>Read permission for processes with same group ID.</td></tr>
<tr><td>S_IXUSR</td><td>0x0040</td><td>Execute permission for processes with same user ID.</td></tr>
<tr><td>S_IWUSR</td><td>0x0080</td><td>Write permission for processes with same user ID.</td></tr>
<tr><td>S_IRUSR</td><td>0x0100</td><td>Read permission for processes with same user ID.</td></tr>
<tr><td>S_ISVTX</td><td>0x0200</td><td>Unused</td></tr>
<tr><td>S_ISGID</td><td>0x0400</td><td>Alter effective group ID when executing this file.</td></tr>
<tr><td>S_ISUID</td><td>0x0800</td><td>Alter effective user ID when executing this file.</td></tr>
<tr><td>S_IFCHR</td><td>0x2000</td><td>File is a BIOS special file.</td></tr>
<tr><td>S_IFDIR</td><td>0x4000</td><td>File is a directory.</td></tr>
<tr><td>S_IFREG</td><td>0x8000</td><td>File is a regular file.</td></tr>
<tr><td>S_IFIFO</td><td>0xA000</td><td>File is a FIFO.</td></tr>
<tr><td>S_IMEM</td><td>0xC000</td><td>File is a memory region.</td></tr>
<tr><td>S_IFLNK</td><td>0xE000</td><td>File is a symbolic link.</td></tr>
</table>

If the file is created successfully, the fcookie structure fc should be filled in to represent the newly created file and E_OK should be returned. On an error, an appropriate GEMDOS error code should be returned.</td></tr>
<tr><td>getdev</td><td>This function is used by the kernel to identify the device driver that should be used to do file I/O on the file named by fc. The function should return a pointer to the device driver and place a user-defined value in the longword pointed to by devspecial. If the function fails, the function should return and place a negative GEMDOS error code in the longword pointed to by devspecial.</td></tr>
<tr><td>getxattr</td><td>This function should fill in the XATTR structure pointed to by xattr with the extended attributes of file fc. If the function succeeds, the routine should return E_OK, otherwise a negative GEMDOS error code should be returned.</td></tr>
<tr><td>chattr</td><td>This function is called by the kernel to instruct the file system to change the attributes of file fc to those in attr (with only the low eight bits being signifigant). The function should return a standard GEMDOS error code on exit.</td></tr>
<tr><td>chown</td><td>This function is called by the kernel to instruct the file system to change the file fc's group and user ownership to gid and uid respectively. The kernel checks access permissions prior to calling this function so the file system does not have to.</td></tr>
</table>

chmode	This function is called by the kernel to instruct the file system to change the access permissions of file *fc* to those in *mode*. The *mode* parameter passed to this function will never contain anything but access permission information (i.e. no file type information will be contained in *mode*). The call should return a standard **GEMDOS** error code on exit.
mkdir	This function should create a new subdirectory called *name* in directory *dir* with access permissions of *mode*. The file system should ensure that directories such as '.' and '..' are created and that a standard **GEMDOS** error code is returned.
rmdir	This function should remove the directory whose name is *name* and whose cookie is pointed to by *dir*. This call should allow the removal of symbolic links to directories and return a standard **GEMDOS** error code.
remove	This function should delete the file named *name* that resides in directory *dir*. If more than one 'hard' link to this file exists, then only this link should be destroyed and the file contents should be left untouched. Symbolic links to file *fc*, however, should be removed. This function should not allow the deletion of directories and should return with a standard **GEMDOS** error code.
getname	This function should fill in the buffer pointed to by *pathname* with as many as **PATH_MAX** (128) characters of the path name of directory *dir* expressed relatively to directory *relto*. If relto and dir point to the same directory, a **NULL** string should be returned. For example, if *relto* points to directory "\FOO" and *dir* points to directory "\FOO\BAR\SUB" then *pathname* should be filled in with "\BAR\SUB".
rename	This function should rename the file *oldname* which resides in directory *olddir* to the new name *newname* which resides in *newdir*. The file system may choose to support or not support cross-directory renames. The function should return a standard **GEMDOS** error code. If no renames at all are supported then **EINVFN** should be returned.

opendir	This function opens directory *dirh* for reading. The parameter *tosflag* is a copy of the *flags* member of the **DIR** structure as defined below:
	
	`typedef struct dirstruct`
	`{`
	`  fcookie  fc;  /* Directory cookie */`
	`  UWORD  index;  /* Index of current entry */`
	`  UWORD  flags;  /* TOS_SEARCH (1) or 0 */`
	`  char  fsstuff[60]; /* File system dependent */`
	`} DIR;`
	
	If *tosflags* (*dirstruct.flags*) is contains the mask **TOS_SEARCH** the file system is responsible for parsing the names into something readable by **TOS** domain applications. The file system should initialize the *index* and *fsstuff* members of *dirh* and return an appropriate **GEMDOS** error code.

readdir	This function should read the next filename from directory *dirh*. The **fcookie** structure *fc* should be filled in with the details of this file. If *dirh->flags* does not contain the mask **TOS_SEARCH** then the filename should be copied into the buffer pointed to by *name*. If *dirh->flags* does contain the mask **TOS_SEARCH** then the first four bytes of *name* should be treated as a longword and filled in with an index value uniquely identifying the file and the filename should be copied starting at *&name[4]*. In either case, if the filename is longer than *namelen*, rather than filling in the buffer *name*, the function should return with **ENAMETOOLONG**. If this is the last file in the directory, **ENMFIL** should be returned, otherwise return **E_OK**.
rewinddir	This function should reset the members of *dirh* so that any internal pointers point at the first file of directory *dirh*. This function should return a standard **GEMDOS** error code.
closedir	This function should clear any allocated memory and clean up any structures used by the search on *dirh*. This function should return a standard **GEMDOS** error code.

pathconf	This function should return information about the directory *dir* based on mode *mode*. For *mode* values and return values, see **Dpathconf()**.
dfree	This function should return free space information about the drive directory *dir* is located on. The format of the buffer pointed to by *buf* is the same as is used by **Dfree()**.This function should return a standard **GEMDOS** error code.
writelabel	This function is used to change the volume name of a drive which contains the directory *dir*. The new name *name* should be used to write (or rename the volume label). If the write is actually an attempt to rename the label and the file system does not support this function then **EACCDN** should be returned. If the file system does not support the concept of volume labels then **EINVFN** should be returned. Otherwise, a return value of **E_OK** is appropriate.
readlabel	This function should copy the volume label name of the drive on which directory *dir* is contained in the buffer *name*. If *namelen* is less than the size of the volume name, **ENAMETOOLONG** should be returned. If the concept of volume names is not supported by the file system, **EINVFN** should be returned. If no volume name was ever created, **EFILNF** should be returned. Upon successful error of the call, **E_OK** should be returned.
symlink	This function should create a symbolic link in directory *dir* named *name*. The symbolic link should contain the **NULL** terminated string in *to*. If the file system does not support symbolic links it should return **EINVFN**, otherwise a standard **GEMDOS** error code should be returned.
readlink	This function should copy the contents of symbolic link *file* into buffer *buf*. If the length of the contents of the symbolic link is greater than *buflen*, **ENAMETOOLONG** should be returned. If the file system does not support symbolic links, **EINVFN** should be returned. In all other cases, a standard **GEMDOS** error code should be returned.
hardlink	This function should create a 'hard' link called *toname* residing in *todir* from the file named *fromname* residing in *fromdir*. If the file system does not support hard links, **EINVFN** should be returned. Otherwise, a standard **GEMDOS** error code should be returned.
fscntl	This function performs a file system specific function on a file whose name is *name* that resides in directory *dir*. The *cmd* and *arg* functions parallel those of **Dcntl()**. In most cases, this function should simply return **EINVFN**. If your file system wishes to expose special features to the user through **Dcntrl()** then your file system should handle them here as it sees fit.
dskchng	This function is used by the kernel to confirm a 'media change' state reported by **Mediach()**. If the file system agrees that a media change has taken place, it should invalidate any appropriate buffers, free any allocated memory associated with the device, and return 1. The kernel will then invalidate any open files and relog the drive with the *root()* functions of each installed file system. If a media change has not taken place, simply return a value of 0.
zero	This member is reserved for future expansion and must be set to 0L.

MiNT Interprocess Communication

Pipelines

A pipeline is a special file used for data communication in which the data being read or written is kept in memory. Pipes are created by **Fcreate()**'ing a file in the special directory 'U:\PIPE'. A process which initially opens a pipe is considered the 'server.' Processes writing to or reading from the open pipe are called 'clients.' Both servers and clients may read to and write from the pipe.

Fcreate()'s *attr* byte takes on a special meaning with pipes as follows:

Name	Bit	Meaning
FA_UNIDIR	0x01	If this bit is set, the pipe will be unidirectional (the server can only write, the client can only read).
FA_SOFTPIPE	0x02	Setting this bit causes reads when no one is writing to return **EOF** and writes when no one is reading to raise the signal **SIGPIPE**.
FA_TTY	0x04	Setting this bit will make the pipe a pseudo-TTY, i.e. any characters written by the server will be interpreted (CTRL-C will cause a **SIGINT** signal to be generated to all clients).

Fpipe() can also be used to create pipes quickly with the **MiNT** kernel resolving any name conflicts. A pipe is deleted when all processes that had obtained a handle to it **Fclose()** it.

A single process may serve as both the client and the server if it maintains two handles (one obtained from **Fopen()** and one from **Fcreate()**). In addition, child processes of the server may inherit the file handle, and thus the server end of the pipe.

A special system call, **Salert()**, sends a string to a pipe called 'U:\PIPE\ALERT'. If a handler is present that reads from this pipe, an alert with the text string will be displayed.

Signals

Signals are messages sent to a process that interrupt normal program flow in a way that may be defined by the receiving application. Signals are sent to a process with the function **Pkill()**. The call is named **Pkill()** because the default action for most signals is the termination of the process. If a process expects to receive signals it should use **Psignal()**, **Psigsetmask()**, **Psigblock()**, or **Psigaction()** to modify that behavior by installing a handler routine, ignoring the signal, or blocking the signal completely.

Signal handlers should return by executing a 680x0 RTS instruction or by calling **Psigreturn()**. Current signals sent and recognized by **MiNT** processes are as follows:

Signal	Number	Meaning
SIGNULL	0	This signal is actually a dead signal since it has no effect and is never delivered. Its only purpose is to determine if a child process has exited. A **Pkill()** call with this signal number will return successfully if the process is still running or fail if not.
SIGHUP	1	This signal indicates that the terminal connected to the process is no longer valid. This signal is sent by window managers to processes when the user has closed your window. The default action for this signal is to kill the process.
SIGINT	2	This signal indicates that the user has interrupted the process with CTRL-C. The default action for this signal is to kill the process.
SIGQUIT	3	This signal is sent when the user presses CTRL-\. The default action for this signal is to kill the process.

SIGILL	4	This signal is sent after a 680x0 Illegal Instruction Exception has occurred. The default action for this signal is to kill the process. Catching this signal is unrecommended.
SIGTRAP	5	This signal is sent after each instruction is executed when the system is in single-step trace mode. Debuggers should catch this signal, other processes should not.
SIGABRT	6	This signal is sent when something has gone wrong internally and the program should be aborted immediately. The default action for this signal is to kill the process. It is unrecommended that you catch this signal.
SIGPRIV	7	This signal is sent to a process that attempts to execute an instruction that may only be executed in supervisor mode while in user mode. The default action for this signal is to kill the process.
SIGFPE	8	This signal is sent when a division by 0 or floating-point exception occurs. The default action for this signal is to kill the process.
SIGKILL	9	This signal forcibly kills the process. There is no way to catch or ignore this signal.
SIGBUS	10	This signal is sent when a 680x0 Bus Error Exception occurs. The default action for this signal is to kill the process.
SIGSEGV	11	This signal is sent when a 680x0 Address Error Exception occurs. The default action for this signal is to kill the process.
SIGSYS	12	This signal is sent when an argument to a system call is bad or out of range and the call doesn't have a way to report errors. For instance, **Super(**0L**)** will send this signal when already in supervisor mode. The default action for this signal is to kill the process.
SIGPIPE	13	This signal is sent when a pipe you were writing to has no readers. The default action for this signal is to kill the process.
SIGALRM	14	This signal is sent when an alarm sent by **Talarm()** is triggered. The default action for this signal is to kill the process.
SIGTERM	15	This signal indicates a 'polite' request for the process to cleanup & exit. This signal is sent when a process is dragged to the trashcan on the desktop. The default action for this signal is to kill the process.
SIGSTOP	17	This signal is sent to a process to suspend it. It cannot be caught, blocked, or ignored. This signal is usually used by debuggers.
SIGTSTP	18	This signal is sent when the user presses CTRL-Z requesting that the process suspend itself. The default action for this signal is to suspend the process until a **SIGCONT** signal is caught.
SIGCONT	19	This signal is sent to restart a process stopped with **SIGSTOP** or **SIGTSTP**. The default action for this signal is to resume the process.

SIGCHLD	20	This signal is sent when a child process has exited or has been suspended. As a default, this signal causes no action.
SIGTTIN	21	This signal is sent when a process attempts to read from a terminal in a process group other than its own. The default action is to suspend the process.
SIGTTOU	22	This signal is sent when a process attempts to write to a terminal in a process group other than its own. The default action is to suspend the process.
SIGIO	23	This signal is sent to indicate that I/O is possible on a file descriptor. The default action for this signal is to kill the process.
SIGXCPU	24	This signal is sent when the maximum CPU time allocated to a process has been used. This signal will continue to be sent to a process until it exits. The default action for this signal is to kill the process.
SIGXFSZ	25	This signal is sent to a process when it attempts to modify a file in a way that causes it to exceed the processes' maximum file size limit. The default action for this signal is to kill the process.
SIGVTALRM	26	This signal is sent to a process which has exceed its maximum time limit. The default action for this signal is to kill the process.
SIGPROF	27	This signal is sent to a process to indicate that its profiling time has expired. The default action for this signal is to kill the process.
SIGWINCH	28	This signal indicates that the size of the window in which your process was running has changed. If the process cares about window size it can use **Fcntl()** to obtain the new size. The default action for this signal is to do nothing.
SIGUSR1	29	This signal is one of two user-defined signals. The default action for this signal is to kill the process.
SIGUSR2	30	This signal is one of two user-defined signals. The default action for this signal is to kill the process.

Memory Sharing

With the enforcement of memory protection under **MultiTOS**, the availability of shared memory blocks is important for applications wishing to share blocks of memory. A shared memory block is opened by **Fcreate()**'ing a file in the directory 'U:\SHM'. After that, a memory block allocated with **Malloc()** or **Mxalloc()** may be attached to the file with **Fcntl(** *handle*, *memptr*, **SHMSETBLK)**.

Any process which uses **Fopen()** and **Fcntl()** with a parameter of **SHMGETBLK** can now read that memory as if it were a disk file. After a process obtains the address of a shared memory block with **SHMGETBLK** the memory is guaranteed to be valid until it calls **Mfree()** on that block even if it **Fclose()**'s the original file handle.

Note that the address returned by **Fcntl()** may be different in different processes. Because of this, data in shared memory blocks should not contain absolute pointers.

When a process is finished with a shared memory block, it should **Mfree()** the address returned by the **Fcntl()** call. A shared memory block is also deleted by the **Fdelete()** call if the file is currently unopened by any other processes.

Other Methods of Communication

Psemaphore() can be used to create named flags which can synchronize the behavior of multiple applications (if adhered to). **Pmsg()** is used to send simple messages between two processes.

MiNT Debugging

MiNT allows a processes' TEXT, DATA, and BSS space to be read and written to with standard **GEMDOS** file commands by opening the process on 'U:\PROC\' A file named "TEST" with a **MiNT** identification of 10 could be opened by specifying the name as 'U:\PROC\TEST.10' or 'U:\PROC\.10'. Opening a file to 'U:\PROC\.-1' will open your own process whereas opening a file to 'U:\PROC\.-2' will open your parent process.

Tracing

A process may be setup for tracing in a number of ways. A child process may be started in trace mode by OR'ing 0x8000 with the **Pexec()** mode number in a **Pexec()** call. A process may also trace another process by opening it as described above and using the **Fcntl()** call with a parameter of **PTRACESFLAGS**. Processes may start tracing on themselves if their parent is prepared for it.

When in trace mode, the process being traced halts and generates a **SIGCHLD** signal to its tracer after every instruction (unless this action is modified). The example below shows how to obtain the process ID of the stopped child and the signal that caused the child to stop.

```
#define WIFSTOPPED(x)     (((int)((x) & 0xFF)==0x7F) && ((int)(((x)>>8)&0xFF)!=0))
#define WSTOPSIG(x)       ((int)(((x)>>8) & 0xFF))

void
HandleSignal( LONG signo )
{
       WORD pid;
       WORD childsignal;
       ULONG r;

       if( signo == SIGCHLD )
       {
             r = Pwait3( 0x2, 0L );
             if( WIFSTOPPED( r ) )
             {
                      pid = r >> 16;
                      childsignal = WSTOPSIG( r );
             }
       }
}
```

After reception of this signal, the child process may be restarted with **Fcntl()** using either the **PTRACEGO**, **PTRACEFLOW**, or **PTRACESTEP** commands. Setting **PTRACEFLOW** or

PTRACESTEP causes a **SIGTRAP** signal to be raised on the next program flow change (ex: BRA or JMP) or the instruction respectively.

Modifying the Process Context

A processes' registers may be modified during tracing using the method as illustrated in the following example:

```
struct context
{
	LONG	regs[15];		// Registers d0-d7, a0-a6
	LONG	usp;			// User stack pointer
	WORD	sr;			// Status register
	LONG	pc;			// Program counter
	LONG	ssp;			// Supervisor stack pointer
	LONG	tvec;			// GEMDOS terminate vector
	char	fstate[216];		// Internal FPU state
	LONG	fregs[3*8];		// Registers FP0-FP7
	LONG	fctrl[3]		// Registers FPCR/FPSR/FPIAR

	// More undocumented fields exist here
} c;

void
ModifyContext( LONG handle )
{
	LONG curprocaddr, ctxtsize;

	Fcntl( handle, &curprocaddr, PPROCADDR );
	Fcntl( handle, &ctxtsize, PCTXTSIZE );

	curprocaddr -= 2 * ctxtsize;

	Fseek( curprocaddr, handle, SEEK_SET );
	Fread( handle, (LONG)sizeof(struct context), &c );

	/* Modify context c here */

	Fseek( curprocaddr, handle, SEEK_SET );
	Fwrite( handle, (LONG)sizeof(struct context), &c );
}
```

MiNT Debugging Keys

MiNT may be programmed to output special debugging messages to the debugging device through the use of special system keys. The supported system keys are shown in the table below:

Key Combination	Meaning
CTRL-ALT-F1	Increase the system debugging level by one.
CTRL-ALT-F2	Decrease the system debugging level by one.
CTRL-ALT-F3	Cycle the **BIOS** output device number used for system debugging messages. This key cycles **BIOS** devices in the order 1-6-7-8-9-2.
CTRL-ALT-F4	Restore debugging output to the console device.
CTRL-ALT-F5	Output a memory usage map to the debugging device.
CTRL-ALT-F6	Output a list of all system processes to the debugging device.

CTRL-ALT-F7	Toggles debug 'logging' off and on. When debug logging is on, a 50-line buffer is maintained which contains recent debugging messages. Each time a new debugging message is output, the entire 50 line buffer is output as well.
CTRL-ALT-F8	Outputs the 50-line debug log to the debugging device.
CTRL-ALT-F9	Outputs the system memory map to the debugging device. The memory protection flags of each page are shown.
CTRL-ALT-F10	Outputs an extended system memory map to the debugging device. The memory protection status, owner's PID, and format of each memory block are output to the debugging device.

CTRL-ALT-F1 and CTRL-ALT-F2 alter the current system debugging level. **MiNT** supports four debugging levels as follows:

Level	Meaning
0	Only fatal OS errors are reported to the debugging device (this is the default mode).
1	Processor exceptions are output to the debugging device.
2	Processor exceptions and failed system calls are output to the debugging device.
3	Constant **MiNT** status reports, processor exceptions, and failed system calls are output to the debugging device.

The MINT.CNF File

MultiTOS looks for an ASCII text file upon bootup called 'MINT.CNF' which may be used to execute commands or set **MiNT** variables. The following table illustrates what commands are recognized in the 'MINT.CNF' file:

Command	Example	Meaning
cd	`cd c:\multitos`	Change the **GEMDOS** working directory.
echo	`echo "Atari Computer Booting..."`	Echo a string to the screen.
ren	`ren c:\test.prg c:\test.app`	Rename a file.
sln	`sln c:\level1\level2\level3 u:\deep`	Create a symbolic link on drive 'U:'.
alias	`alias x: u:\proc`	Create an alias drive.
exec	`exec c:\sam.prg`	Execute a program.

The following **MiNT** variables may be set in the 'MINT.CNF' file:

Variable	Meaning
INIT	Execute the named **TOS** program. For example: `INIT=c:\multitos\sam.prg`
GEM	Execute the named **GEM** program. For example: `GEM=c:\multitos\miniwin.app`
CON	Redirect console input and output to the named file. For example: `CON=u:\dev\modem1`
PRN	Redirect printer output to the named file. For example: `PRN=c:\spool.txt`
DEBUG_LEVEL	Set the **MiNT** debugging level (default is 0). For example: `DEBUG_LEVEL=1`
DEBUG_DEVNO	Set the **BIOS** device number that **MiNT** will send debugging messages to. For example: `DEBUG_DEVNO=1`
SLICES	Set the number of 20ms time slices given to an application at a time (the default is 2). For example: `SLICES=3`
MAXMEM	Set the maximum amount of memory (in kilobytes) any application can be allocated (the default is unlimited). For example: `MAXMEM=8192`
BIOSBUF	Enable/Disable **Bconout()** optimizations. The parameter should be 'Y' to enable or 'N' to disable these optimizations. For example: `BIOSBUF=Y`

GEMDOS Character Functions

GEMDOS provides a number of functions to communicate on a character basis with the default system devices. Because of irregularities with these calls in some **TOS** versions, usage of the **BIOS** functions is usually recommended instead (the **BIOS** does not support redirection, however).

The **GEMDOS** character functions are illustrated in the table below:

Device:	Input	Output	Status
con:	**Cconin()** - Character **Cnecin()** - No Echo **Cconrs()** - String	**Cconout()** - Character **Cconws()** - String	**Cconis()** - Input **Cconos()** - Output
prn:	None	**Cprnout()**	**Cprnos()**

aux:	**Cauxin()**	**Cauxout()**	**Cauxis()** - Input **Cauxos()** - Output
N/A	**Crawio()** and **Crawcin()**	**Crawio()**	**Cconis()** - Input **Cconos()** - Output

GEMDOS Time & Date Functions

GEMDOS provides four functions for the manipulation of time. **Tsetdate()** and **Tsettime()** set the date and time respectively. **Tgetdate()** and **Tgettime()** get the date and time respectively.

As of **TOS** 1.02, the **GEMDOS** time functions also update the **BIOS** time.

GEMDOS Function Calling Procedure

GEMDOS system functions are called via the TRAP #1 exception. Function arguments are pushed onto the current stack in reverse order followed by the function opcode. The calling application is responsible for correctly resetting the stack pointer after the call.

GEMDOS may utilize registers D0-D2 and A0-A2 as scratch registers and their contents should not be depended upon at the completion of a call. In addition, the function opcode placed on the stack will be modified.

The following example for **Super()** illustrates calling **GEMDOS** from assembly language:

```
clr.l       -(sp)
move.w      #$20,-(sp)
trap        #1
addq.l      #4,sp
```

'C' compilers often provide a reusable interface to **GEMDOS** that allows new **GEMDOS** calls to be added with a macro as in the following example:

```
#define Super( a )  gemdos( 0x20, a )
```

The gemdos() function used in the above macro can be written in assembly language as follows:

```
                .globl      _gemdos

                .text
_gemdos:
                move.l      (sp)+, t1sav     ; Save return address
                trap        #1               ; Call GEMDOS
                move.l      t1sav,-(sp)      ; Restore return address
                rts

                .bss

t1sav:          ds.l        1                ; Return address storage

                .end
```

GEMDOS is not guaranteed to be re-entrant and therefore should not be called from an interrupt handler.

GEMDOS Function Reference

Cauxin()

WORD Cauxin(VOID)

Cauxin() waits for the next available data byte from **GEMDOS** handle 2 (normally device 'aux:') and when available, returns it in the low byte of the returned **WORD**.

OPCODE 3 (0x03)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w   #$3,-(sp)
trap     #1
addq.l   #2,sp
```

RETURN VALUE The **WORD** value contains the retrieved byte in the lower eight bits. The contents of the upper 8 bits are currently undefined.

CAVEATS This function can cause flow control problems.

When using this function while its handle is redirected, an end-of-file condition will hang the system. **GEMDOS** version 0.30 and all **MiNT** versions correct this bug. **MiNT** returns **MINT_EOF** (0xFF1A) when the end-of-file is reached.

In addition, if this handle is redirected to something other than 'aux:', an end-of-file will hang the system. Besides these known bugs, this function is used by many 'C' compilers to redirect standard error messages. It is therefore advisable to use **Bconin()** instead.

SEE ALSO **Cauxis()**, **Cauxout()**, **Bconin()**

Cauxis()

WORD Cauxis(VOID)

Cauxis() indicates whether **GEMDOS** handle 2 (normally device 'aux:') has at least one character waiting.

OPCODE 18 (0x12)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$12,-(sp)
```

```
trap        #1
addq.l      #2,sp
```

RETURN VALUE The return value will be **DEV_READY** (-1) if at least one character is available for reading or **DEV_BUSY** (0) if not.

CAVEATS When using this function while its handle is redirected, an end-of-file condition will hang the system. **GEMDOS** version 0.30 and all **MiNT** versions correct this bug. **MiNT** returns **MINT_EOF** (0xFF1A) when the end-of-file is reached.

In addition, some 'C' compilers use this handle as a standard error device. It is therefore advisable to use **Bconstat()**.

SEE ALSO **Cauxin()**, **Cauxout()**, **Cauxos()**, **Bconstat()**

Cauxos()

WORD Cauxos(VOID)

Cauxos() indicated whether **GEMDOS** handle 2 (normally device 'aux:') is ready to receive characters.

OPCODE 19 (0x13)

AVAILABILITY All **GEMDOS** versions

BINDING

```
move.w      #$13,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE A value of **DEV_READY** (-1) is returned if the output device is ready to receive characters or **DEV_BUSY** (0) if it is not.

CAVEATS This function actually returns the status of whatever device **GEMDOS** handle 2 is redirected to. In addition, some 'C' compilers use this handle as a standard error device. It is therefore recommended that **Bcostat()** be used instead.

SEE ALSO **Cauxin()**, **Cauxis()**, **Cauxout()**, **Bcostat()**.

Cauxout()

VOID Cauxout(*ch*)
WORD *ch*;

Cauxout() outputs a character to **GEMDOS** handle 2, normally the 'aux:' device.

OPCODE 4 (0x04)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *ch* is a **WORD** value, however, only the lower eight bits are sent. The upper eight bits must be 0.

BINDING

```
move.w      #ch,-(sp)
move.w      #4,-(sp)
trap        #1
addq.l      #4,sp
```

CAVEATS This function can cause flow control to fail when **GEMDOS** handle 2 is directed to 'aux:'.

In addition, some 'C' compilers use this function as a standard error device. It is therefore recommended that **Bconout()** be used in place of this function.

SEE ALSO **Cauxin()**, **Cauxis()**, **Cauxos()**, **Bconout()**

Cconin()

LONG Cconin(VOID)

Cconin() reads a character (waiting until one is available) from **GEMDOS** handle 0 (normally 'con:').

OPCODE 1 (0x01)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #1,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE The **LONG** value returned is a bit array arranged as follows:

Bits 31-24	Bits 23-16	Bits 15-8	Bits 7-0
Shift key status (see below)	Keyboard scancode	Unused (0)	ASCII code of character

The ASCII code of the character will be 0 if a non-ascii keyboard key is struck.

CAVEATS When using this function while its handle is redirected, an end-of-file condition will hang the system. **GEMDOS** version 0.30 and all **MiNT** versions correct this bug. **MiNT** returns **MINT_EOF** (0xFF1A) when the end-of-file is reached.

COMMENTS The shift key status will only be returned when bit 3 of the system variable *conterm* (char *(0x484)) is set. This is normally not enabled.

If the handle has been redirected, the inputted character will appear in the lower 8 bits of the return value.

SEE ALSO **Cconis()**, **Cconout()**, **Cconrs()**, **Cnecin()**, **Crawin(), Bconin()**

Cconis()

WORD Cconis(VOID)

Cconis() verifies that a character is waiting to be read from **GEMDOS** handle 0 (normally 'con:').

OPCODE 11 (0xB)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$0B,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Cconis()** returns a **DEV_READY** (-1) if a character is available or **DEV_BUSY** (0) if not.

SEE ALSO **Cconin()**, **Bconstat()**

Cconos()

WORD Cconos(VOID)

Cconos() checks to see whether a character may be output to **GEMDOS** handle 1 (normally 'con:').

OPCODE 16 (0x10)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$10,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE This function returns **DEV_READY** (-1) if at least one character may be sent or **DEV_BUSY** (0) if not.

SEE ALSO **Cconout(), Bcostat()**

Cconout()

VOID Cconout(*ch*)
WORD *ch*;

Cconout() outputs one character via **GEMDOS** handle 1 (normally 'con:').

OPCODE 2 (0x02)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *ch* is a **WORD** value, however, only the lower eight bits are sent through the output stream. The upper eight bits must be 0.

BINDING

```
move.w      ch,-(sp)
move.w      #2,-(sp)
trap        #1
addq.l      #4,sp
```

CAVEATS With **GEMDOS** versions below 0.15, this handle should not be redirected to a write-only device as the call attempts to read from the output stream to process special keys.

COMMENTS No line feed translation is done at the time of output. To start a new line, ASCII 13

and ASCII 10 must both be sent.

SEE ALSO **Cconin()**, **Bconout()**

Cconrs()

VOID Cconrs(*str*)
char **str*;

Cconrs() reads a string from the standard input stream (**GEMDOS** handle 0) and echoes it to the standard output stream (**GEMDOS** handle 1).

OPCODE 10 (0x0A)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *str* should be a character pointer large enough to hold the inputted string. On function entry, *str[0]* should be equal to the maximum number of characters to read.

BINDING

```
pea         str
move.w      #$0A,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE On return, the string buffer passed as a parameter will be filled in with the inputted characters. *str[1]* will contain the actual number of characters in the buffer. (char *) &*str[2]* is the pointer to the start of the actual string in memory.

Cconrs() will not terminate unless CTRL-C is pressed, the buffer is full or either RETURN or CTRL-J is pressed.

CAVEATS **GEMDOS** versions below 0.15 echoes the input to the console even if output has been redirected elsewhere.

COMMENTS The string **Cconrs()** creates is not null-terminated. The following keys *are* processed by the function:

Key	Translation
RETURN	End of input. Do not place RETURN in in buffer.
CTRL-J	End of line. Do not place CTRL-J in buffer.
CTRL-H	Kill last character.
DELETE	Kill last character.
CTRL-U	Echo input line and start over.

CTRL-X	Kill input line and start over.
CTRL-R	Echo input line and continue.
CTRL-C	Exit program.

When the input stream is redirected, **Cconrs()** returns 0 in *str[1]* when the end-of-file marker is reached.

SEE ALSO **Cconin()**, **Cconws()**

Cconws()

VOID Cconws(*str*)
char ***str*;

Cconws() writes a string to **GEMDOS** handle 1 (normally 'con:').

OPCODE 9 (0x09)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *str* is a pointer to a null-terminated character string to be written to the output stream.

BINDING

```
pea         str
move.w      #$09,-(sp)
trap        #1
addq.l      #6,sp
```

CAVEATS With **GEMDOS** versions below 0.15, this handle should not be redirected to a write-only device as the call attempts to read from the output stream to process special keys.

COMMENTS No line feed translation is performed on outputted characters so both an ASCII 13 and ASCII 10 must be sent to force a new line. In addition, the system checks for special keys so a CTRL-C embedded in the string will terminate the process.

SEE ALSO **Cconout()**, **Cconrs()**

Cnecin()

WORD Cnecin(VOID)

Cnecin() is exactly the same as **Cconin()** except that the character fetched from the input stream is not echoed.

OPCODE 8 (0x08)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS None.

BINDING

```
move.w      #8,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE The **LONG** value returned is a bit array arranged as follows:

Bits 31-24	Bits 23-16	Bits 15-8	Bits 7-0
Shift key status (see below)	Keyboard scancode	Unused (0)	ASCII code of character

The ASCII code of the character will be 0 if a non-ascii keyboard key is struck.

CAVEATS When using this function while its handle is redirected, an end-of-file condition will hang the system. **GEMDOS** version 0.30 and all **MiNT** versions correct this bug. **MiNT** returns **MINT_EOF** (0xFF1A) when the end-of-file is reached.

COMMENTS The shift key status will only be returned when bit 3 of the system variable *conterm* (char *(0x484)) is set. This is normally not enabled.

If the handle has been redirected, the inputted character will appear in the lower 8 bits of the return value.

SEE ALSO **Cconin()**, **Bconin()**

Cprnos()

WORD Cprnos(VOID)

Cprnos() returns the status of **GEMDOS** handle 3 (normally ‘prn:’).

OPCODE 17 (0x11)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS None.

BINDING

```
move.w      #$11,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Cprnos()** returns a **DEV_READY** (-1) if the output stream is ready to receive a character or **DEV_BUSY** (0) if not.

SEE ALSO **Cprnout()**, **Bcostat()**

Cprnout()

WORD Cprnout(*ch*)
WORD *ch*;

Cprnout() sends one character to **GEMDOS** handle 3 (normally 'prn:').

OPCODE 5 (0x05)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *ch* is a **WORD** value, however, only the lower 8 bits are sent to the output stream. The upper eight bits should be 0.

BINDING

```
move.w      ch,-(sp)
move.w      #$5,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Cprnout()** returns a non-zero value if the function successfully wrote the character to the printer or 0 otherwise.

COMMENTS No input translation is performed with this call. Therefore, you must send an ASCII 13 and ASCII 10 to force a new line.

SEE ALSO **Bconout()**

Crawcin()

LONG Crawcin(VOID)

Crawcin() is similar to **Cconout()**, however it does not process any special keys and does not echo the inputted character.

OPCODE 7 (0x07)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$07,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE The **LONG** value returned is a bit array arranged as follows:

Bits 31-24	Bits 23-16	Bits 15-8	Bits 7-0
Shift key status (see below)	Keyboard scancode	Unused (0)	ASCII code of character

The ASCII code of the character will be 0 if a non-ascii keyboard key is struck.

CAVEATS When using this function while its handle is redirected, an end-of-file condition will hang the system. **GEMDOS** version 0.30 and all **MiNT** versions correct this bug. **MiNT** returns **MINT_EOF** (0xFF1A) when the end-of-file is reached.

COMMENTS The shift key status will only be returned when bit 3 of the system variable *conterm* (char *(0x484)) is set. This is normally not enabled.

If the handle has been redirected, the inputted character will appear in the lower 8 bits of the return value.

Under normal circumstances, when **GEMDOS** handle 0 is being read from, no special system keys, including CTRL-C, are checked.

SEE ALSO **Cconin()**, **Crawio()**, **Bconin()**

Crawio()

LONG Crawio(*ch*)
WORD *ch*;

Crawio() combines console input and output in one function.

OPCODE 6 (0x06)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *ch* is a **WORD** value, however, only the lower eight bits are meaningful and the upper eight bits should be set to 0. If *ch* is 0x00FF on input, **Crawio()** returns the character read from **GEMDOS** handle 0 (normally 'con:').

BINDING

```
move.w      ch,-(sp)
move.w      #6,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE If *ch* is 0x00FF upon entry, **Crawio()** returns a bit array arranged as follows:

Bits 31-24	Bits 23-16	Bits 15-8	Bits 7-0
Shift key status (see below)	Keyboard scancode	Unused (0)	ASCII code of character

The ASCII code of the character will be 0 if a non-ascii keyboard key is struck.

If no character was waiting in the input stream, **Crawio()** returns a 0.

CAVEATS When using this function while its handle is redirected, an end-of-file condition will hang the system. **GEMDOS** version 0.30 and all **MiNT** versions correct this bug. **MiNT** returns **MINT_EOF** (0xFF1A) when the end-of-file is reached.

Due to the definition of this call it is impossible to write 0x00FF to the output stream or read a zero from this call.

COMMENTS The shift key status will only be returned when bit 3 of the system variable *conterm* (char *(0x484)) is set. This is normally not enabled.

If the handle has been redirected, the inputted character will appear in the lower 8 bits of the return value.

Under normal circumstances, when **GEMDOS** handle 0 is being read from, no special system keys, including CTRL-C, are checked.

SEE ALSO **Cconout()**, **Cconin()**, **Bconout()**, **Bconin()**

Dclosedir()

LONG Dclosedir(***dirhandle*** **)**
LONG ***dirhandle*****;**

Dclosedir() closes the specified directory.

OPCODE 299 (0x12B)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *dirhandle* is a valid directory handle which specifies the directory to close.

BINDING

```
move.l      dirhandle,-(sp)
move.w      #$12B,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Dclosedir()** returns **E_OK** (0) if successful or **EIHNDL** (-37) if the directory handle was invalid.

SEE ALSO **Dopendir(), Dreaddir(), Drewinddir()**

Dcntl()

LONG Dcntl(***cmd, name, arg*** **)**
WORD ***cmd*****;**
char ****name***;**
LONG ***arg*****;**

Dcntl() performs file system specific operations on directories or files.

OPCODE 304 (0x130)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS The only two built-in file systems that support **Dcntl()** calls are 'U:\' and 'U:\DEV.' *cmd* specifies what operation to perform and affects the meaning of *name* and *arg*. Valid *cmd* arguments for 'U:\' are

cmd	Meaning

FS_INSTALL (0xF001)	This mode installs a new file system. *name* must be 'U:\' and *arg* should point to a *fs_descr* structure as follows:
	
	`struct fs_descr`
	`{`
	`  FILESYS  *file_system;`
	`  WORD  dev_no;`
	`  LONG  flags;`
	`  LONG  reserved[4];`
	`};`
	
	If this call is successful, a pointer to a **kerinfo** structure is returned, otherwise the return value is **NULL**. The file system itself is not accessible until this call is made and it is mounted with **FS_MOUNT**.

FS_MOUNT (0xF002)	This mode mounts an instance of an installed file system. *name* should be in the format 'U:\???' where '???' is the name which the file system will be accessed by. *arg* should point to the *fs_descr* structure as above. If the file system is mounted correctly, the *dev_no* field will be updated to reflect the instance number of the mount (file systems may be mounted multiple times).
FS_UNMOUNT (0xF003)	This mode unmounts an instance of a file system. *name* is the name of the file system in the form 'U:\???' where '???' is the name of the file system instance. *arg* should point to the file system *fs_descr* structure.
FS_UNINSTALL (0xF004)	This mode uninstalls a file system identified by the *fs_descr* structure passed in *arg*. A file system can only be sucessfully uninstalled after all instances of it have been unmounted. *name* should be 'U:\'.

Valid *cmd* arguments for 'U:\DEV' are:

cmd	Meaning

DEV_INSTALL (0xDE02)	This command attempts to install a device driver. *name* should be in the format 'U:\DEV\???' where '???' is the name of the device to install. *arg* is a pointer to a *dev_descr* structure as follows:
	
	`struct dev_descr`
	`{`
	`  /* Pointer to a device driver structure */`
	`  DEVDRV *driver;`
	`  /* Placed in aux field of file cookies */`
	`  WORD dinfo;`
	`  /* 0 or O_TTY (0x2000) for TTY */`
	`  WORD flags;`
	`  /* If O_TTY is set, points to tty struct */`
	`  struct tty *tty;`
	`  /* Reserved for future expansion */`
	`  LONG reserved[4];`
	`}`
	
	If the device is successfully installed, **Dcntl()** will return a pointer to a **kerinfo** structure which contains information about the kernel. On failure, **Dcntl()** will return **NULL**. See the section on loadable file systems earlier in this chapter for more information.

DEV_NEWTTY (0xDE00)	This command identifies a **BIOS** terminal device whose name is *name* (in the form 'U:\DEV\DEVNAME' and whose device number is *arg*. This call simply makes the **MiNT** kernel aware of the device. It should have been previously installed by **Bconmap()**. Any attempt to access the device prior to installing it with the **BIOS** will result in an **EUNDEV** (-15) unknown device error. If the device is installed, **Dcntl()** returns a 0 or positive value. A negative return code signifies failure.
DEV_NEWBIOS (0xDE01)	This command is the same as **DEV_NEWTTY** except that it is designed for devices which must have their data transmitted raw (SCSI devices, for example).

BINDING

```
move.l      arg,-(sp)
pea         name
move.w      cmd,-(sp)
move.w      #$130,-(sp)
trap        #1
lea         12(sp),sp
```

VERSION NOTES The **FS_** group of *cmd* arguments are only available as of **MiNT** version 1.08.

Due to a bug in **MiNT** versions 1.08 and below, calling this function with a parameter of **DEV_NEWBIOS** will not have any effect.

RETURN VALUE See above.

SEE ALSO **Bconmap(), Fcntl()**

Dcreate()

LONG Dcreate(***path*** **)**
char ****path*;**

Dcreate() creates a **GEMDOS** directory on the specified drive.

OPCODE 57 (0x39)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *path* is a pointer to a string containing the directory specification of the directory to create. *path* should *not* contain a trailing backslash. Below are some examples and their results.

path	Result
C:\ONE\ATARI	Creates a folder named “ATARI” as a subdirectory of “ONE” on drive ‘C:’.
\ONE\ATARI	Creates a folder named “ATARI” as a subdirectory of “ONE” on the current **GEMDOS** drive.
ATARI	Creates a folder named “ATARI” as a subdirectory of the current **GEMDOS** path on the current **GEMDOS** drive.

BINDING

```
pea         path
move.w      #$39,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE Upon return one of three codes may result:

E_OK (0) :	Operation successful
EPTHNF (-34):	Path not found
EACCDN (-36):	Access denied

CAVEATS Prior to **GEMDOS** version 0.15 **GEMDOS** did not detect if the creation of a subdirectory failed and could therefore leave partially created directories on disk.

SEE ALSO **Ddelete()**

Ddelete()

LONG Ddelete(***path*** **)**
char ****path*;**

Ddelete() removes a directory on the specified drive.

OPCODE 58 (0x3A)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *path* contains the directory specification of the directory you wish to remove. *path* should *not* contain a trailing backslash. For valid examples of *path*, see the entry for **Dcreate()**.

BINDING

```
pea         path
move.w      #$3A,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE Upon return one of four codes may result:

E_OK (0) :	Operation successful
EPTHNF (-34):	Path not found
EACCDN (-36):	Access denied
EINTRN (-65):	Internal error

CAVEATS Prior to **GEMDOS** version 0.15 a **Ddelete()** on a directory recently created will fail but a second attempt will not.

COMMENTS The directory being deleted must be empty or the call will fail.

SEE ALSO **Dcreate()**

Dfree()

LONG Dfree(***buf, drive*** **)**
DISKINFO ****buf*;**
WORD ***drive***;

Dfree() returns information regarding the storage capacity/current usage of the specified drive.

OPCODE 54 (0x36)

AVAILABILITY

All **GEMDOS** versions.

PARAMETERS

buf is a **DISKINFO** pointer which will be filled in on function exit. **DISKINFO** is defined as:

```
typedef struct
{
       /* No. of Free Clusters */
       ULONG b_free;

       /* Clusters per Drive */
       ULONG b_total;

       /* Bytes per Sector */
       ULONG b_secsize;

       /* Sectors per Cluster */
       ULONG b_clsize;
} DISKINFO;
```

drive is a **WORD** which indicates the drive to perform the operation on. A value of **DEFAULT_DRIVE** (0) indicates the current **GEMDOS** drive. A value of 1 indicates drive 'A:', a 2 indicates 'B:', etc...

BINDING

```
move.w      drive,-(sp)
pea         info
move.w      #$36,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE

Upon return, a value of 0 indicates success. Otherwise, a negative **GEMDOS** error code is returned.

CAVEATS

Prior to **GEMDOS** version 0.15 this function is very slow when used on a hard disk.

COMMENTS

To obtain the free number of bytes on a disk, use the formula (*info.b_free* * *info.b_secsize* * *info.b_clsize*). To obtain the total number of bytes available on a disk, use the formula (*info.b_total* * *info.b_secsize* * *info.b_clsize*).

Dgetcwd()

LONG Dgetcwd(***path, drv, size*** **)**
char ****path*;**
WORD ***drv, size***;

Dgetcwd() returns the processes' current working directory for the specified drive.

OPCODE 315 (0x13B)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.96 exists.

PARAMETERS *path* is a pointer to a buffer with room for at least *size* characters into which will be copied the complete working path of drive *drv*.

BINDING

```
pea         path
move.w      size,-(sp)
move.w      drv,-(sp)
move.w      #$13B,-(sp)
trap        #1
add.l       #10,sp
```

RETURN VALUE **Dgetcwd()** returns 0 if successful or a **GEMDOS** error code otherwise.

SEE ALSO **Dgetpath(), Dgetdrv()**

Dgetdrv()

WORD Dgetdrv(VOID)

Dgetdrv() returns the current **GEMDOS** drive code.

OPCODE 25 (0x19)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$19,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Dgetdrv()** returns the current **GEMDOS** drive code. Drive 'A:' is represented by a return value of 0, 'B:' by a return value of 1, and so on.

SEE ALSO **Dsetdrv()**

Dgetpath()

LONG Dgetpath(***buf, drive*** **)**
char ****buf*;**
WORD ***drive***;

Dgetpath() returns the current **GEMDOS** path specification.

OPCODE 71 (0x47)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *buf* is a pointer to a character buffer which will contain the current **GEMDOS** path specification on function exit. *drive* is the number of the drive whose path you want returned. *drive* should be **DEFAULT_DRIVE** (0) for the current **GEMDOS** drive, 1 for drive 'A:', 2 for drive 'B:', and so on.

BINDING

```
move.w      drive,-(sp)
pea         buf
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Dgetpath()** will return one of two errors on function exit:

E_OK (0):	Operation successful
EDRIVE (-49):	Invalid drive specification

COMMENTS As there is no way to specify the buffer size to this function you should allow at least 128 bytes of buffer space. This will allow for up to 8 folders deep. Newer file systems (CD-ROM drives) may demand up to 200 bytes.

SEE ALSO **Dsetpath()**

Dlock()

LONG Dlock(***mode, drv*** **)**
WORD ***mode, drv***;

Dlock() locks a **BIOS** disk device against **GEMDOS** usage.

OPCODE 309 (0x135)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.93 exists.

PARAMETERS Setting *mode* to **DRV_LOCK** (1) places a lock on **BIOS** device *drv* whereas a *mode* setting of **DRV_UNLOCK** (0) unlocks *drv*.

BINDING

```
move.w      drv,-(sp)
move.w      move,-(sp)
move.w      #$135,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Dlock()** returns 0 if successful or a negative **GEMDOS** error code otherwise.

COMMENTS Locking a device provides a method for device formatters to prevent other processes from simultaneously attempting to access a drive. If a process which locked a device terminates, that device is automatically unlocked.

BIOS device numbers and **GEMDOS** drive letters do not necessarily have a one to one correspondence. To lock a **GEMDOS** drive use **Fxattr()** to determine the device number of the drive you wish to lock.

SEE ALSO **Fxattr()**

Dopendir()

LONG Dopendir(***name, flag*** **)**
char ****name*;**
WORD ***flag***;

Dopendir() opens the specified directory for reading.

OPCODE 296 (0x128)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *name* is a pointer to a null-terminated directory specification of the directory to open. *name* should not be contain a trailing backslash.

flag determines whether to open the file in normal or compatibility mode. A value of **MODE_NORMAL** (0) for *flag* signifies normal mode whereas a value of **MODE_COMPAT** (1) signifies compatibility mode.

Compatibility mode forces directory searches to be performed much like **Fsfirst()** and **Fsnext()** (restricting filenames to the **DOS** 8 + 3 standard in uppercase). In normal mode, filenames returned by **Dreaddir()** will be in the format native to the

file system and a **UNIX** style file index will be returned.

BINDING

```
move.w      flag,-(sp)
pea         name
move.w      #$128,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Dopendir()** returns a **LONG** directory handle (which may be positive or negative) if successful. A negative **GEMDOS** error code will be returned if the call fails.

CAVEATS Failure to properly close directory handles may cause the system to eventually run out of handles which will cause the **OS** to fail.

COMMENTS Negative directory handles and negative **GEMDOS** error codes may be differentiated by checking for 0xFF in the high byte. Returned values with 0xFF in the high byte are errors.

SEE ALSO **Dclosedir(), Dreaddir(), Drewinddir()**

Dpathconf()

LONG Dpathconf(***name, mode*** **)**
char ****name*;**
WORD ***mode***;

Dpathconf() returns information regarding limits and capabilities of an installed file system.

OPCODE 292 (0x124)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *name* specifies the file system you wish information about. *mode* dictates the return value as follows:

Name	*mode*	Return Value
DP_INQUIRE	-1	Returns the maximum legal value for the mode parameter in **Dpathconf()**.
DP_IOPEN	0	Retuns the possible maximum number of open files at one time. If **UNLIMITED** (0x7FFFFFFF) is returned, then the number of open files is limited only by available memory.
DP_MAXLINKS	1	Returns the maximum number of links to a file. If **UNLIMITED** (0x7FFFFFFF) is returned, then the number of links to a file is limited only by available memory.

DP_PATHMAX	2	Returns the maximum length of a full path name in bytes. If **UNLIMITED** (0x7FFFFFFF) is returned, then the maximum size of a pathname is unlimited.
DP_NAMEMAX	3	Returns the maximum length of a file name in bytes. If **UNLIMITED** (0x7FFFFFFF) is returned, then the maximum length of a filename is unlimited.
DP_ATOMIC	4	Returns the number of bytes that can be written per write operation. If **UNLIMITED** (0x7FFFFFFF) is returned, then the number of bytes that can be written at once is limited only by available memory.
DP_TRUNC	5	Returns a code indicating the type of filename truncation as follows: **DP_NOTRUNC (0)** File names are not truncated. If a file name in any system call exceeds the filename size limit then an **ERANGE** (-64) range error is returned. **DP_AUTOTRUNC (1)** File names are truncated automatically to the maximum allowable length. **DP_DOSTRUNC (2)** File names are truncated to the **DOS** standard (maximum 8 character node with 3 character extension).
DP_CASE	6	Returns a code which indicates case sensitivity as follows: **DP_SENSITIVE (0)** File system is case-sensitive. **DP_NOSENSITIVE (1)** File system is not case-sensitive (file and path names are always converted to upper-case). **DP_SAVEONLY (2)** File system is not case-sensitive, however, file and path names are saved in their original case. Ex: A file called 'Compendi.um' will appear as 'Compendi.um' but may be referenced as 'compendi.um' or 'COMPENDI.UM'.

BINDING

```
move.w      mode,-(sp)
pea         name
move.w      #$124,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE See above.

SEE ALSO **Sysconf()**

Dreaddir()

LONG Dreaddir(*len, dirhandle, buf*)
WORD *len*;
LONG *dirhandle*;
char **buf*;

Dreaddir() enumerates the contents of the specified directory.

OPCODE

297 (0x129)

AVAILABILITY

Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS

Dreaddir() fetches information about the next file contained in the directory specified by *dirhandle*. *len* specifies the length of the buffer pointed to by *buf* which should be enough to hold the size of the filename, **NULL** byte, and index (if in normal mode).

BINDING

```
pea         buf
move.l      dirhandle
move.w      len
move.w      #$129,-(sp)
trap        #1
lea         12(sp),sp
```

RETURN VALUE

Dreaddir() returns a 0 if the operation was successful, **ERANGE** (-64) if the buffer was not large enough to hold the index and name, or **ENMFIL** (-47) if there were no more files to read.

COMMENTS

In normal mode, **Dreaddir()** returns a 4-byte file index in the first four bytes of *buf*. The filename then follows starting at the fifth byte of *buf*. The file index is present to prevent confusion under some file systems when two files of the same name exist. In some file systems this is legal, however, in all file systems, the 4-byte index will be unique.

When in compatibility mode, the filename begins at &*buf[0]*.

SEE ALSO

Dopendir(), Dclosedir(), Drewinddir()

Drewinddir()

LONG Drewinddir(*handle*)
LONG *handle*;

Drewinddir() rewinds the specified directory pointer to its first file.

OPCODE 298 (0x12A)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *handle* specifies the directory handle of the directory to rewind.

BINDING

```
move.l      handle,-(sp)
move.w      #$12A,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Drewinddir()** returns a 0 if successful or a negative **GEMDOS** error code otherwise.

SEE ALSO **Dopendir(), Dreaddir(), Drewinddir()**

Dsetdrv()

LONG Dsetdrv(*drive*)
WORD *drive*;

Dsetdrv() sets the current **GEMDOS** drive and returns a bitmap of mounted drives.

OPCODE 14 (0x0E)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *drive* is the code of the drive to set as the default **GEMDOS** disk drive. Calling the function as:

```
bmap = Dsetdrv(Dgetdrv());
```

will return the bitmap of mounted drives without changing the current **GEMDOS** drive.

BINDING

```
move.w      drive,-(sp)
```

```
move.w      #$0E,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Dsetdrv()** returns a **LONG** bit array that indicates which drives are mounted on the system. Bit 0 indicates drive 'A:', bit 1 drive 'B:', etc.

SEE ALSO **Dgetdrv()**

Dsetpath()

LONG Dsetpath(***path*** **)**
char ****path*;**

Dsetpath() sets the path of the current **GEMDOS** drive.

OPCODE 59 (0x3B)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *path* is a pointer to a character buffer containing the new path specification for the current **GEMDOS** drive.

BINDING

```
pea         path
move.w      #$3B,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Dsetpath()** returns one of two return codes on function exit:

E_OK (0):	Operation successful
EPTHNF (-34):	Path not found

CAVEATS You may specify a drive letter and colon in the input path specification to set the path of a particular drive but this feature is unstable in all versions of **GEMDOS** and may confuse drive assignments. It is therefore advised that this feature be avoided.

SEE ALSO **Dgetpath()**

Fattrib()

LONG Fattrib(*fname, flag, attr*)
char ****fname*;**
WORD *flag, attr*;

Fattrib() reads or modifies the attribute bits of a **GEMDOS** file.

OPCODE 67 (0x43)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *fname* is a pointer to a null-terminated string which contains the **GEMDOS** filename of the file to manipulate. *flag* should be set to **FA_INQUIRE** (0) to read the file's attributes and **FA_SET** (1) to set them. If you are setting attributes, *attr* contains the file's new attributes.

BINDING

```
move.w      attr,-(sp)
move.w      flag,-(sp)
pea         fname
move.w      #$43,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE If reading the attributes, **Fattrib()** returns a bit array of attributes as defined below. If setting the attributes, **Fattrib()** returns the file's old attributes. In any case, a negative return code indicates that a **GEMDOS** error occurred.

Name	Bit	Meaning
FA_READONLY	0	Read-only flag
FA_HIDDEN	1	Hidden file flag
FA_SYSTEM	2	System file flag
FA_VOLUME	3	Volume label flag
FA_DIR	4	Subdirectory
FA_ARCHIVE	5	Archive flag
—	6...	Currently reserved

CAVEATS **GEMDOS** versions below 0.15 did not set the archive bit correctly. The archive bit is now correctly set by **TOS** when a file is created or written to.

Fchmod()

LONG Fchmod(***name*****,** ***mode*** **)**
char ****name***;**
WORD ***mode*****;**

Fchmod() alters file access permissions of the named file.

OPCODE 306 (0x132)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *name* specifies a valid **GEMDOS** file specification of the file whose access permissions you wish to modify. *mode* is a bit mask composed by OR'ing together values defined as follows:

Name	Mask	Meaning
S_IRUSR	0x100	Read permission for the owner of the file.
S_IWUSR	0x80	Write permission for the owner of the file.
S_IXUSR	0x40	Execute permission for the owner of the file.
S_IRGRP	0x20	Read permission for members of the same group the file belongs to.
S_IWGRP	0x10	Write permission for members of the same group the file belongs to.
S_IXGRP	0x08	Execute permission for members of the same group the file belongs to.
S_IROTH	0x04	Read permission for all others.
S_IWOTH	0x02	Write permission for all others.
S_IXOTH	0x01	Execute permission for all others.

BINDING

```
move.w      mode,-(sp)
pea         name
move.w      #$132,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Fchmod()** returns **E_OK** (0) if successful or a negative **GEMDOS** error code otherwise.

CAVEATS Not all file systems support all bits. Unrecognized bits will be ignored.

COMMENTS Only the owner of a file may change a file's permission status.

'Execute' status refers to the permission to search the named directory for a file name or component.

SEE ALSO **Fattrib(), Fxattr()**

Fchown()

LONG Fchown(*name, uid, gid*)
char ****name*;**
WORD *uid, gid*;

Fchown() changes a file's ownership.

OPCODE 305 (0x131)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *name* specifies the file whose ownership status you wish to change. *uid* sets the new owner and *gid* sets the new group.

BINDING

```
move.w      gid,-(sp)
move.w      uid,-(sp)
pea         name
move.w      #$131,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE **Fchown()** returns 0 if the operation was successful or a negative **GEMDOS** error code otherwise.

CAVEATS Most file systems don't understand the concept of file ownership (including **TOS**).

COMMENTS *uid* may only be modifies if the caller's uid is 0. *gid* may only be changed to the group id of a group the caller belongs to.

SEE ALSO **Fchmod(), Fxattr()**

Fclose()

LONG Fclose(*handle*)
WORD *handle*;

Fclose() closes the file specified.

OPCODE 62 (0x3E)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *handle* is a valid **WORD** file handle which will be closed as a result of this call.

BINDING

```
move.w      handle,-(sp)
move.w      #$3E,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Fclose()** returns **E_OK** (0) if the file was closed successfully or **EIHNDL** (-37) if the handle given was invalid.

CAVEATS Calling this function with an invalid file handle will crash the system on **GEMDOS** versions below 0.15. In addition, **GEMDOS** versions below 0.15 will become confused if you close a standard **GEMDOS** handle (0-5).

COMMENTS As of **GEMDOS** version 0.15, closing a standard **GEMDOS** handle (0-5) will simply reset it to its default **BIOS** state.

SEE ALSO **Fcreate()**, **Fopen()**

Fcntl()

LONG Fcntl(***handle, arg, cmd*** **)**
WORD ***handle*****;**
LONG ***arg*****;**
WORD ***cmd*****;**

Fcntl() performs a command on the specified file.

OPCODE 260 (0x104)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *handle* specifies the **GEMDOS** file handle of the file on which the operation specified by *cmd* will affect. *arg* varies with each command. Valid commands are:

cmd	Meaning
F_DUPFD (0x0000)	Duplicate the given file handle. **Fcntl()** will return a file handle in the range *arg* – 32. If no file handles exist within that range, an error will be returned.
F_GETFD (0x0001)	Return the inheritance flag for the specified file. A value of 1 indicates that child processes started with **Pexec()** will inherit this file handle, otherwise a value of 0 is returned. *arg* is ignored.

F_SETFD (0x0002)	Set the inheritance flag for the named file. *arg* specifies if child processes started with **Pexec()** will inherit the file handle. A value of 0 indicates that they will not. A value of 1 indicates that they will. **GEMDOS** handles 0-5 default to a value of 1whereas other handles default to a value of 0.
F_GETFL (0x0003)	Return the file descriptor flags for the specified file. These are the same flags passed to **Fopen()**. *arg* is ignored.
F_SETFL (0x0004)	Set the file decriptor flags for the specified file to *arg*. Only user-modifyable bits are considered. All others should be 0. It is not possible to change a file's read/write mode or sharing modes with this call. Attempts to do this will fail without returning an error code.

F_GETLK (0x0004)	Test for the presence of a lock on the specified file. arg is a pointer to a **FLOCK** structure defined as follows:
	
	`typedef struct flock`
	`{`
	`  /* Type of lock`
	`  0 = Read-only lock`
	`  1 = Write-only lock`
	`  2 = Read/Write lock */`
	`  WORD l_type;`
	`  /* 0 = offset from beginning of file`
	`  1 = offset from current position`
	`  2 = offset from end of file */`
	`  WORD l_whence;`
	`  /* Offset to start of lock */`
	`  LONG l_start;`
	`  /* Length of lock (0 for rest of file) */`
	`  LONG l_len;`
	`  /* Process ID maybe filled in by call */`
	`  WORD l_pid;`
	`} FLOCK;`
	
	If a prior lock exists which would prevent the specified lock from being applied, the interfering lock is copied into the structure with the process ID of the locking process. Otherwise, **Fcntl()** returns **F_UNLCK** (3).

F_SETLK (0x0005)	Set or remove an advisory lock on the specified file. *arg* points to a **FLOCK** structure as defined above. Setting *l_type* to **F_RDLOCK** or **F_WRLCK** will cause a lock to be set. Setting *l_type* to **F_UNLCK** wil attempt to remove the specified lock. When locking and unlocking FIFO's, *l_whence*, *l_start*, and *l_len* should be 0. The command returns 0 if successful or a negative **GEMDOS** error code otherwise.
F_SETLKW (0x0007)	The calling procedure is the same as above, however, if other processes already have a conflicting lock set, it will suspend the calling process until the lock is freed.
FSTAT (0x4600)	Get the extended attributes for a file. *arg* points to a **XATTR** structure which is filled in with the file's extended attributes. If successful, the function returns 0, otherwise a negative **GEMDOS** error code is returned. See **Fxattr()** for an explanation of the **XATTR** structure.

FIONREAD (0x4601)	Return an estimate of the number of bytes available for reading from the specified file without causing the process to block (wait for more input) in the **LONG** pointed to by *arg*.
FIONWRITE (0x4602)	Return an estimate of the number of bytes that may be written from the specified file without causing the process to block in the **LONG** pointed to by *arg*.
SHMGETBLK (0x4D00)	Returns the address of a memory block associated with the file. arg should be **NULL** for future compatibility. Note: Different processes may receive different addresses for a shared block.
SHMSETBLK (0x4D01)	*arg* points to a block of memory (previously allocated) which is to be associated with the file. The file must have been created at 'U:\SHM\' or the call will fail.
PPROCADDR (0x5001)	Return the address of the specified processes' control structure (opened as a file) in *arg*. See the discussion of **MiNT** processes for information about this structure.
PBASEADDR (0x5002)	Return the address of the specified processes' **GEMDOS** basepage (opened as a file) in *arg*,
PCTXTSIZE (0x5003)	Return the length of the specified processes' context structure (opened as a file) in *arg*. Seeking to the offset returned by **PPROCADDR** minus this number and reading this many bytes will yield the current user context of the process. Seeking back this many bytes more and reading will yield the last system context of the process. This structure is volatile and is likely to change from one **MiNT** version to the next.
PSETFLAGS (0x5004)	*arg* is a pointer to a **LONG** from which the processes' memory allocation flags (***PRGFLAGS***) will be set.
PGETFLAGS (0x5005)	*arg* is a pointer to a **LONG** into which the processes' memory allocation flags (***PRGFLAGS***) will be placed.
PTRACEGFLAGS (0x5006)	*arg* points to a **WORD** which will be filled in with the trace flags of a process. Setting bit #0 of *arg* causes the parent process to receive signals destined for the child. See the discussion on program debugging for more information.
PTRACESFLAGS (0x5007)	*arg* points to a **WORD** which will be used to set the trace flags of a process. See the discussion on program debugging for more information.
PTRACEGO (0x5008)	This call restarts a process which was stopped because of a signal. *arg* points to a **WORD** which contains 0 to clear all of the child processes' pending signals or the signal value to send to the process.
PTRACEFLOW (0x5009)	This call restarts a process in a special tracing mode in which the process is stopped and a **SIGTRACE** signal is generated whenever program flow changes (ex: JSR/BSR/JMP/BEQ). *arg* should be set to 0 to clear all of the pending signals of the process being traced or a signal value which is to be sent to the child.
PTRACESTEP (0x500A)	This call restarts a process and allows it to execute one instruction before a **SIGTRAP** instruction is generated.

PLOADINFO (0x500C)

arg points to a structure as follows:

```
struct ploadinfo
{
       WORD      fnamelen;
       char *    cmdlin;
       char *    fname;
};
```

cmdlin should point to a 128 byte character buffer into which the processes' command line will be copied.

fname should point to a buffer *fnamelen* bytes long into which the complete path and filename of the process' parent will be copied. If the buffer is too short the call will return **ENAMETOOLONG**.

TIOCGETP (0x5400)

Get terminal parameters from the TTY device with the specified file handle. *arg* is a pointer to an **sgttyb** structure which is filled in by this command.

```
struct sgttyb
{
   /* Reserved */
   char sg_ispeed;
   /* Reserved */
   char sg_ospeed;
   /* Erase character */
   char sg_erase;
   /* Line kill character */
   char sg_kill;
   /* Terminal control flags */
   WORD sg_flags;
};
```

TIOCSETP (0x5401)

Set the terminal parameters of the TTY device specified. *arg* is a pointer to an **sgyttb** structure as defined above. You should first get the terminal control parameters, modify what you wish to change, and then set them with this call.

TIOCGETC (0x5402)

Get the terminal control characters of the TTY device specified. *arg* is a pointer to a **tchars** structure filled in by this call which is defined as follows:

```
struct tchars
{
   /* Raises SIGINT */
   char t_intrc;
   /* Raises SIGKILL */
   char t_quitc;
   /* Starts terminal output */
   char t_startc;
   /* Stops terminal output */
   char t_stopc;
   /* Marks end of file */
   char t_eofc;
   /* Marks end of line */
   char t_brkc;
};
```

TIOCSETC (0x5403)

Set the terminal control characters of the TTY device specified. *arg* is a pointer to a **tchars** structure as defined above. Setting any structure element to 0 disables that feature.

TIOCGLTC (0x5404)	Get the extended terminal control characters from the TTY device specified. *arg* is a pointer to a **ltchars** structure which is filled in by this call defined as follows:
	
	`struct ltchars`
	`{`
	`  /* Raise SIGTSTP now */`
	`  char t_suspc;`
	`  /* Raise SIGTSTP when read */`
	`  char t_dsuspc;`
	`  /* Redraws the input line */`
	`  char t_rprntc;`
	`  /* Flushes output */`
	`  char t_flushc;`
	`  /* Erases a word */`
	`  char t_werasc;`
	`  /* Quotes a character */`
	`  char t_lnextc;`
	`};`

TIOCSLTC (0x5405)	Set the extended terminal control characters for the TTY device specified from the **ltchars** structure pointed to by *arg*.
TIOCGPGRP (0x5406)	Return the process group ID for the TTY specified in the **LONG** pointed to by *arg*.
TIOCSPGRP (0x5407)	Set the process group ID of the TTY specified in the **LONG** pointed to by *arg*.
TIOCSTOP (0x5409)	Stop terminal output (as if the user had pressed CTRL-S). *arg* is ignored.
TIOCSTART (0x540A)	Restart output to the terminal (as if the user had pressed CTRL-Q) if it had been previously stopped with CTRL-S or a **TIOCSTOP** command. *arg* is ignored.

TIOCGWINSZ (0x540B)	Get information regarding the window for this terminal. *arg* points to a **winsize** structure which is filled in by this command.
	
	`struct winsize`
	`{`
	`  /* # of Text Rows */`
	`  WORD ws_row;`
	`  /* # of Text Columns */`
	`  WORD ws_column;`
	`  /* Width of window in pixels */`
	`  WORD ws_xpixel;`
	`  /* Height of window in pixels */`
	`}`

TIOCSWINSZ (0x540C)	Change the extents of the terminal window for the specified TTY. *arg* points to a **winsize** structure which contains the new window information. It is up to the window manager to modify the window extents and raise the **SIGWINCH** signal if necessary.

<table>
<tr><td>TIOCGXKEY
(0x540D)</td><td>Return the current definition of a system key. arg points to a structure xkey as follows:

<pre>struct xkey
{
        WORD xk_num;
        char xk_def[8];
};</pre>
xk_def will be filled in with the NULL terminated name associated with the key specified in xk_num as follows:

<table><tr><th>xk_num</th><th>Key</th></tr><tr><td>0-9</td><td>F1-F10</td></tr><tr><td>10-19</td><td>F11-F20</td></tr><tr><td>20</td><td>Cursor up</td></tr><tr><td>21</td><td>Cursor down</td></tr><tr><td>22</td><td>Cursor right</td></tr><tr><td>23</td><td>Cursor left</td></tr><tr><td>24</td><td>Help</td></tr><tr><td>25</td><td>Undo</td></tr><tr><td>26</td><td>Insert</td></tr><tr><td>27</td><td>Clr/Home</td></tr><tr><td>28</td><td>Shift+Cursor up</td></tr><tr><td>29</td><td>Shift+Cursor down</td></tr><tr><td>30</td><td>Shift+Cursor right</td></tr><tr><td>31</td><td>Shift+Cursor left</td></tr></table></td></tr>
<tr><td>TIOCSXKEY
(0x540E)</td><td>Set the current definition of a system key. arg must point to an xkey structure (as defined above). xk_num and xk_def are used to set the text associated with a system key.

If a terminal recognizes special keys (by having its XKEY bit set in the sg_flags field of its sgttyb structure) then setting a system key will cause the text specified by xk_def to be sent to a process whenever the key is struck. Note: this works only if the terminal is reading characters using Fread().</td></tr>
<tr><td>TIOCIBAUD
(0x5412)</td><td>Read/Write the input baud rate for the specified terminal device. If arg points to a LONG then the input baud rate will be set to that value. If arg is 0, the DTR on the terminal will be dropped (if this feature is supported). If arg is negative, the baud rate will not be changed. The old baud rate is returned in the value pointed to by arg.

If the terminal does not support separate input and output baud rates then this call will set both rates.</td></tr>
<tr><td>TIOCOBAUD
(0x5413)</td><td>Read/Write the output baud rate for the specified terminal device. If arg points to a LONG then the output baud rate will be set to that value. If arg is 0, the DTR on the terminal will be dropped (if this feature is supported). If arg is negative, the baud rate will not be changed. The old baud rate is returned in the value pointed to by arg.

If the terminal does not support separate input and output baud rates then this call will set both rates.</td></tr>
<tr><td>TIOCCBRK
(0x5414)</td><td>Clear the break condition on the specified device. arg is ignored.</td></tr>
<tr><td>TIOCSBRK
(0x5415)</td><td>Set the break condition on the specified device. arg is ignored.</td></tr>
</table>

TIOCGFLAGS (0x5416)	Return the current stop bit/data bit configuration for the terminal device in the lower 16 bits of the **LONG** pointed to by *arg*. See the entry for **TIOCSFLAGS** for the flags required to parse *arg*.
TIOCSFLAGS (0x5417)	Set the current stop bit/data bit configuration for the terminal device. The new configuration is contained in *arg*. Valid mask values for *arg* are as follows: **Name** **Mask** **Meaning** **TF_1STOP** 0x0001 1 stop bit **TF_15STOP** 0x0002 1.5 stop bits **TF_2STOP** 0x0003 2 stop bits **TF_8BIT** 0x0000 8 data bits **TF_7BIT** 0x0004 7 data bits **TF_6BIT** 0x0008 6 data bits **TF_5BIT** 0x000C 5 data bits
TCURSOFF (0x6300)	Hide the cursor on the selected terminal device. *arg* is ignored.
TCURSON (0x6301)	Show the cursor on the selected terminal device. *arg* is ignored.
TCURSBLINK (0x6302)	Enable cursor blinking on the selected terminal device. *arg* is ignored.
TCURSSTEADY (0x6303)	Disable cursor blinking on the selected terminal device. *arg* is ignored.
TCURSSRATE (0x6304)	Set the cursor blink rate to the **WORD** pointed to by *arg*.
TCURSGRATE (0x6305)	Return the current cursor blink rate in the **WORD** pointed to by *arg*.

BINDING

```
move.w      cmd,-(sp)
move.l      arg,-(sp)
move.w      handle,-(sp)
move.w      #$260,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE Unless otherwise noted, **Fcntl()** returns a 0 if the operation was successful or a negative **GEMDOS** error code otherwise.

SEE ALSO **Flock(), Fopen(), Fxattr(), Pgetpgrp(), Psetpgrp()**

Fcreate()

LONG Fcreate(*fname*, *attr*)
char **fname*;
WORD *attr*;

Fcreate() creates a new file (or truncates an existing one) with the specified name and attributes.

OPCODE 60 (0x3C)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *fname* is a character pointer to the **GEMDOS** file specification of the file to create or truncate. *attr* is a bit array which specifies the attributes of the new file. Valid mask values are given below:

Name	Bit	Meaning
FA_READONLY	0	Read-only file
FA_HIDDEN	1	Hidden file
FA_SYSTEM	2	System file
FA_VOLUME	3	Volume label
—	4	Reserved
FA_ARCHIVE	5	Archive bit

BINDING

```
move.w      attr,-(sp)
pea         fname,-(sp)
move.w      #$3C,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Fcreate()** returns a **LONG** value. If the **LONG** is negative, it should be interpreted as a **GEMDOS** error. Possible errors are **EPTHNF** (-34), **ENHNDL** (-35) , or **EACCDN** (-36).

If positive, the **WORD** portion of the returned **LONG** should be regarded as the file handle.

CAVEATS With **GEMDOS** version 0.13, creating a read-only file returns a read-only file handle which is of little use. **GEMDOS** versions below 0.15 incorrectly allow more than one volume label per disk.

COMMENTS **GEMDOS** versions 0.15 and above automatically set the archive bit. You may set it yourself on versions below 0.15.

SEE ALSO **Fopen()**, **Fclose()**

Fdatime()

LONG Fdatime(***timeptr, handle, flag*** **)**
DATETIME ****timeptr*;**
WORD ***handle, flag*****;**

Fdatime() reads or modifies a file's time and date stamp.

OPCODE 87 (0x57)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *timeptr* is a pointer to a **DATETIME** structure which is represented below. *handle* is a valid **GEMDOS** file handle to the file to modify. *flag* is **FD_INQUIRE** (0) to fill *timeptr* with the file's date/timestamp and **FD_SET** (1) to change the file's date/timestamp to the contents of *timeptr*.

```
typedef struct
{
        unsigned hour:5;
        unsigned minute:6;
        unsigned second:5;
        unsigned year:7;
        unsigned month:4;
        unsigned day:5;
} DATETIME;
```

BINDING

```
move.w      flag,-(sp)
move.w      handle,-(sp)
pea         timeptr
move.w      #$57,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE **Fdatime()** returns a 0 if the date/time was successfully read/modified. Otherwise, it returns a negative **GEMDOS** error code.

CAVEATS **GEMDOS** versions below 0.15 yielded very unpredictable results with this call and should therefore be avoided.

COMMENTS *timeptr.second* should be multiplied times two to obtain the actual value. *timeptr.year* is expressed as an offset from 1980.

Fdelete()

LONG Fdelete(*fname*)
char **fname*;

Fdelete() deletes the specified file.

OPCODE 65 (0x41)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *fname* is the **GEMDOS** file specification of the file to be deleted.

BINDING

```
pea         fname
move.w      #$41,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Fdelete()** returns **E_OK** (0) if the operation was successful or a negative **GEMDOS** error code if it fails.

CAVEATS Do not attempt to delete a file that is currently open or unpredictable results will occur.

COMMENTS **Ddelete()** must be used to delete subdirectories.

SEE ALSO **Ddelete()**

Fdup()

LONG Fdup(*shandle*)
WORD *shandle*;

Fdup() duplicates a standard file handle (0-5) and assigns it a new handle (>6).

OPCODE 69 (0x45)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *shandle* is the standard **GEMDOS** handle to be duplicated.

BINDING

```
move.w      shandle,-(sp)
move.w      #$45,-(sp)
trap        #1
```

```
addq.l      #4,sp
```

RETURN VALUE **Fdup()** returns a normal **GEMDOS** file handle in the lower **WORD** of the returned **LONG**. If the **LONG** return value is negative then it should be treated as a **GEMDOS** error code.

COMMENTS This function is generally used to save a standard file handle so that an **Fforce()** operation may be undone.

SEE ALSO **Fforce()**

Fforce()

LONG Fforce(***shandle, nhandle*** **)**
WORD ***shandle, nhandle*****;**

Fforce() is used to redirect the standard input or output from a **GEMDOS** standard handle to a specific handle created by the application.

OPCODE 70 (0x46)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *shandle* is a standard **GEMDOS** handle to be redirected. *nhandle* is the new handle you wish to direct it to. Valid values for *shandle* and *nhandle* are as follows:

Name	Handle	GEMDOS Filename	Meaning
GSH_CONIN	0	con:	Standard input (defaults to whichever **BIOS** device is mapped to **GEMDOS** handle -1)
GSH_CONOUT	1	con:	Standard output (defaults to whichever **BIOS** device is mapped to **GEMDOS** handle -1)
GSH_AUX	2	aux:	Currently mapped serial device (defaults to whichever **BIOS** device is mapped to **GEMDOS** handle -2)
GSH_PRN	3	prn:	Printer port (defaults to whichever **BIOS** device is currently mapped to **GEMDOS** handle -3).
—	4	None	Reserved
—	5	None	Reserved
GSH_BIOSCON	-1	None	Refers to **BIOS** handle 2. This handle may only be redirected under the presence of **MiNT**. Doing so redirects output of the **BIOS**.

GSH_BIOSAUX	-2	None	Refers to **BIOS** handle 1. This handle may only be redirected under the presence of **MiNT**. Doing so redirects output of the **BIOS**.
GSH_BIOSPRN	-3	None	Refers to **BIOS** handle 0. This handle may only be redirected under the presence of **MiNT**. Doing so redirects output of the **BIOS**.
GSH_MIDIIN **GSH_MIDIOUT**	-4 -5	None	**GEMDOS** handles -4 and -5 refer to **MIDI** input and output respectively. Redirecting these handles will affect **BIOS** handle 3. These special handles exist only with the presence of **MiNT**.

BINDING

```
move.w      nhandle,-(sp)
move.w      shandle,-(sp)
move.w      #$46,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Fforce()** returns **E_OK** (0) if no error occurred or **EIHNDL** (-37) if a bad handle is given.

CAVEATS Prior to **GEMDOS** versions 0.15, handles forced to the printer would not work properly.

COMMENTS This function is often used to redirect the input or output of a child process. It should be used in conjunction with **Fdup()** to restore the standard handle before process termination. In addition, you should be aware that any file handle redirected to a standard handle ('con:' for example) will be closed when the child exits and should not be closed by the parent.

Standard **GEMDOS** file handles which have been redirected will revert to their original mapping upon **Fclose()**.

SEE ALSO **Fdup()**

Fgetchar()

LONG Fgetchar(***handle, mode*** **)**
WORD ***handle, mode*****;**

Fgetchar() reads a character from the specified handle.

OPCODE 263 (0x107)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *handle* is a valid **GEMDOS** handle to read from. If *handle* is a TTY then *mode* (a bit mask) has meaning as follows:

Name	*mode*	Meaning
TTY_COOKED	0x01	Cooked mode. Special control characters such as CTRL-C and CTRL-Z are checked and acted upon. In addition, flow control with CTRL-S and CTRL-Q is activated.
TTY_ECHO	0x02	Echo mode. Characters read are echoed back to the TTY.

BINDING

```
move.w      mode,-(sp)
move.w      handle,-(sp)
move.w      #$107,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Fgetchar()** returns the character read in the low byte of the returned **LONG**. If the device is a terminal where scan codes are available, the **LONG** will be mapped in the same manner as **Bconin()**. If an end-of-file is reached, the value 0xFF1A will be returned.

SEE ALSO **Bconin(), Fputchar(), Fread()**

Fgetdta()

DTA *Fgetdta(VOID)

Fgetdta() returns current **DTA** (Disk Transfer Address)

OPCODE 47 (0x2F)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS None.

BINDING

```
move.w      #$2F,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Fgetdta()** returns a pointer to the current Disk Transfer Address. The structure **DTA** is defined as:

```
typedef struct
{
        BYTE          d_reserved[21];
        BYTE          d_attrib;
        UWORD     d_time;
```

```
        UWORD    d_date;
        LONG         d_length;
        char         d_fname[14];
} DTA;
```

COMMENTS When an application starts, its **DTA** overlaps the command line string in the processes' basepage. Any use of the **Fsfirst()** or **Fsnext()** call without first reallocating a new **DTA** will cause the processes' command line to be corrupted.

To prevent this, you should use **Fsetdta()** to define a new **DTA** structure for your process prior to using **Fsfirst()** or **Fsnext()**. Be careful to avoid assigning your **DTA** to a local or automatic variable without setting it to its original value before the variable goes out of scope.

SEE ALSO **Fsetdta(), Fsfirst(), Fsnext()**

Finstat()

LONG Finstat(*handle*)
WORD *handle*;

Finstat() determines the input status of a file.

OPCODE 261 (0x105)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *handle* specifies the **GEMDOS** file handle of the file to return information about.

BINDING

```
move.w      handle,-(sp)
move.w      #$105,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Finstat()** returns 0 or a positive number of characters waiting to be read if successful. A negative **GEMDOS** error code is returned otherwise.

CAVEATS Currently **Finstat()** always returns 0 for disk files.

SEE ALSO **Cauxis(), Cconis(), Fcntl(), Foutstat()**

Flink()

LONG Flink(*oldname, newname*)
char **oldname, *newname*;

Flink() creates a new name for the specified file. After the call the file may be referred to by either name. An **Fdelete()** call on one filename will not affect the other.

OPCODE 301 (0x12D)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *oldname* points to the **GEMDOS** path specification of the currently existing file and *newname* specifies the name of the alias to create.

BINDING

```
pea         newname
pea         oldname
move.w      #$12D,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE **Flink()** returns a 0 if successful or a negative **GEMDOS** error code otherwise.

CAVEATS Not all file systems support 'hard links'.

COMMENTS The filenames given must reside on the same physical device.

SEE ALSO **Frename(), Fsymlink()**

Flock()

LONG Flock(*handle, mode, start, length*)
WORD *handle,mode*;
LONG *start,length*;

Flock() sets or removes a lock on a portion of a file which prevents other processes from accessing it.

OPCODE 92 ($5C)

AVAILABILITY Only present when '**_FLK**' cookie exists.

PARAMETERS *handle* specifies the **GEMDOS** handle of the file. *mode* is **FLK_LOCK** (0) to create a lock and **FLK_UNLOCK** (1) to remove it. *start* specifies the byte offset from the beginning of the file which indicates where the lock starts. *length* specifies the length of the lock in bytes.

BINDING

```
move.l      length,-(sp)
move.l      start,-(sp)
move.w      mode,-(sp)
move.w      handle,-(sp)
trap        #1
lea         12(sp),sp
```

RETURN VALUE **Flock()** returns **E_OK** (0) if the call was successful, **ELOCKED** (-58) if an overlapping section of the file was already locked, **ENSLOCK** (-59) if a matching lock was not found for removal, or another **GEMDOS** error code as appropriate.

COMMENTS To remove a lock, you must specify identical *start* and *length* parameters as you originally set.

MiNT allows locks to be set on devices by locking their entry in 'U:\DEV\' as shown in the example below:

```
handle = Fopen( "U:\DEV\MODEM1", 3 );
if( handle < 0)
      return ERR_CODE;      /* Unable to open. */

retcode = Flock( (WORD)handle, 0, 0, 0 );        /* Lock
*/
if( retcode != E_OK )
      return FILE_IN_USE;   /* File is already locked */

/*
 * Now do device input/output.
 */

Flock( (WORD)handle, 1, 0, 0 );     /* Unlock */
Fclose( (WORD)handle );
```

SEE ALSO **Fopen(), Fwrite(), Fread()**

Fmidipipe()

LONG Fmidipipe(***pid, in, out*** **)**
WORD ***pid, in, out*****;**

Fmidipipe() is used to change the file handles used for MIDI input and output.

OPCODE 294 (0x126)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *pid* is the process id of the process whose MIDI devices you wish to alter. If *pid* is 0, then the current process will be modified. *in* specifies the **GEMDOS** file handle of the device to handle MIDI input. *out* specifies the **GEMDOS** file handle of the device to handle MIDI output.

BINDING

```
move.w      out,-(sp)
move.w      in,-(sp)
move.w      pid,-(sp)
move.w      #$126,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Fmidipipe()** returns a 0 if successful or a negative **GEMDOS** error code otherwise.

COMMENTS An **Fmidipipe(** 0, *in*, *out* **)** call is essentially the same as:

```
Fforce( -4, in);
Fforce( -5, out);
```

After this call, any **Bconin()** calls to MIDI device 5 will translate to a one character read from handle *in*. Likewise any **Bconout()** calls to MIDI device 5 will translate to a one character write to handle *out*.

SEE ALSO **Fdup(), Fforce()**

Fopen()

LONG Fopen(***fname*, *mode*** **)**
char ****fname*;**
WORD ***mode***;

Fopen() opens the **GEMDOS** file specified.

OPCODE 61 ($3D)

AVAILABILITY All **GEMDOS** versions. *mode* bits pertaining to file sharing/record locking are only valid when the '**_FLK**' cookie is present.

PARAMETERS *fname* is the **GEMDOS** file specification of the file to be opened. *mode* specifies the mode the file is to be placed into once opened. *mode* is a bit array which may be formed by using the bit masks given as follows:

Bit 7	Bits 6-4	Bit 3	Bits 2-0
Inheritance flag	Sharing mode	Reserved	Access code

Bits 0-2 specify the file access code as follows:

Bit 2	Bit 1	Bit 0	File Access Codes
0	0	0	Read only access (**S_READ**)
0	0	1	Write only access (**S_WRITE**)
0	1	0	Read/Write access (**S_READWRITE**)

Bit 3 is reserved and should always be 0. Bits 4-6 specify the file sharing mode of the file to be opened as follows:

Bit 6	Bit 5	Bit 4	File Sharing Codes
0	0	0	Compatibility Mode (**S_COMPAT**). If the file's read-only bit is set, then this is the same as Deny Writes, otherwise it is the same as Deny Read/Writes.
0	0	1	Deny Read/Writes (**S_DENYREADWRITE**)
0	1	0	Deny Writes (**S_DENYWRITE**)
0	1	1	Deny Reads (**S_DENYREAD**)
1	0	0	Deny None (**S_DENYNONE**)

Bit 7 (**S_INHERIT**) is the file's inheritance flag. If this flag is not set, a child process will inherit any open file handles and has the same access as the parent. If this flag is set, a child must re-open any files it wishes to use and must face the same sharing restrictions other processes must share.

BINDING

```
move.w      mode,-(sp)
pea         fname
move.w      #$3D,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE

Upon return, if the longword is positive, the lower **WORD** contains the new handle of the open file, otherwise the negative **LONG** should be regarded as a **GEMDOS** error code.

COMMENTS

Bits 7-3 of *mode* should be set to 0 unless the '**_FLK**' cookie is present indicating the presence of the file sharing/record locking extensions to **GEMDOS**.

SEE ALSO

Fclose(), Fcreate()

Foutstat()

LONG Foutstat(*handle*)
WORD *handle*;

Foutstat() determines the output status of a file.

OPCODE 262 (0x106)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *handle* specifies the **GEMDOS** file handle of the file to return information about.

BINDING

```
move.w      handle,-(sp)
move.w      #$106,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Foutstat()** returns a 0 or positive number indicating the number of characters which may be written to the specified file without blocking. If an error occurred, **Foutstat()** returns a negative **GEMDOS** error code.

CAVEATS Currently this function always returns 1 for disk files.

SEE ALSO **Cconos(), Cauxos(), Cprnos(), Fcntl(), Finstat()**

Fpipe()

LONG Fpipe(*fhandle*)
WORD *fhandle[2]*;

Fpipe() creates a pipe named 'SYS$PIPE.xxx' (where 'xxx' is a three digit integer) on 'U:\PIPE\' and returns two file handles to it, one for reading and one for writing.

OPCODE 256 (0x100)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *fhandle* is a pointer to an array of two **WORD**s. If the functions is successful, *fhandle[0]* will contain an open **GEMDOS** file handle to the pipe which may be used for reading only. *fhandle[1]* will contain an open **GEMDOS** file handle to the pipe which may be used for writing only.

BINDING

```
pea         fhandle
move.w      #$100,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE

Fpipe() returns **E_OK** (0) if successful or a negative **GEMDOS** error code otherwise.

CAVEATS

No more than 999 pipes created with **Fpipe()** may be in use at once.

COMMENTS

This function is normally used by shells who wish to redirect the input and output of their child processes. Prior to lauching a child process, the shell redirects its input and output (as necessary) to the read and write ends of the newly created pipe.

Fputchar()

LONG Fputchar(***handle, lchar, mode*** **)**
WORD ***handle*****;**
LONG ***lchar*****;**
WORD ***mode*****;**

Fputchar() writes a character to the specified file.

OPCODE

264 (0x108)

AVAILABILITY

This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS

handle specifies the handle of the file to write a character to.

If the file specified by *handle* is a pseudo-terminal then all four bytes of *lchar* are written (it should be formatted as a character read from **Bconin()**), otherwise only the low byte of *lchar* is transmitted.

mode is only valid if *handle* refers to a terminal device. If *mode* is **TTY_COOKED** (0x0001) then control characters (which could cause **SIGINT** or **SIGTSTP** signals to be raised) passed through this function will be interpreted and acted upon. Setting *mode* to 0 will cause control characters to have no special effect.

BINDING

```
move.w      mode,-(sp)
move.l      lchar,-(sp)
move.w      handle,-(sp)
move.w      #$108,-(sp)
trap        #1
```

```
lea         10(sp),sp
```

RETURN VALUE **Fputchar()** returns 4L if the character was output to a terminal, 1L if the character was output to a non-terminal, 0L if the character could not be written (possibly because of flow control), **EIHNDL** (-37) if the handle was invalid, or a negative **BIOS** error code if an error occurred during I/O.

SEE ALSO **Cconout(), Cauxout(), Crawio(), Cprnout(), Bconout(), Fgetchar(), Fwrite()**

Fread()

LONG Fread(***handle, length, buf*** **)**
WORD ***handle*****;**
LONG ***length*****;**
VOIDP ***buf*****;**

Fread() reads binary data from a specified file from the current file pointer.

OPCODE 63 (0x3F)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *handle* is the **GEMDOS** file handle of the file to read from. *length* specifies the number of bytes of data to read. *buf* is a pointer to a buffer (at least *length* bytes long) where the read data will be stored.

BINDING

```
pea         buf
move.l      length,-(sp)
move.w      handle,-(sp)
move.w      #$3F,-(sp)
trap        #1
lea         12(sp),sp
```

RETURN VALUE **Fread()** returns either a positive amount indicating the number of bytes actually read (this number may be smaller than length if an **EOF** is hit) or a negative **GEMDOS** error code.

CAVEATS **Fread()** will crash the system if given a parameter of 0 for *length* on **GEMDOS** versions lower than 0.15.

SEE ALSO **Fwrite(), Fopen(), Fclose()**

Freadlink()

LONG Freadlink(*bufsiz, buf, name*)
WORD *bufsiz*;
char **buf, *name*;

Freadlink() determines what file the specified symbolic link refers to.

OPCODE 303 (0x12F)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *bufsiz* specifies the length of buffer *buf* into which the original file pointed to by the symbolic link *name* is written.

BINDING

```
pea         name
pea         buf
move.w      bufsiz,-(sp)
move.w      #$12F,-(sp)
trap        #1
lea         12(sp),sp
```

RETURN VALUE **Freadlink()** returns 0 if successful or a negative **GEMDOS** error code otherwise.

SEE ALSO **Fsymlink()**

Frename()

LONG Frename(*reserved, oldname, newname*)
WORD *reserved*;
char **oldname,*newname*;

Frename() renames a standard **GEMDOS** file. It may also be used to move a file in the tree structure of a physical drive.

OPCODE 86 (0x56)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *reserved* is not currently used and should be 0. *oldname* is the **GEMDOS** file specification of the file's current name/location. *newname* is the **GEMDOS** file specification of the new name/location of the file.

BINDING

```
pea         newname
```

```
pea         oldname
move.w      #0,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE **Frename()** returns **E_OK** (0) if the operation was successful or a negative **GEMDOS** error code if not.

CAVEATS Prior to **GEMDOS** version 0.15, this command may not be used to rename folders. Also, do not attempt to rename a file that is currently open under any version of **GEMDOS**.

Fseek()

LONG Fseek(***offset, handle, mode*** **)**
LONG ***offset*****;**
WORD ***handle,mode*****;**

Fseek() moves the file position pointer within a **GEMDOS** file.

OPCODE 66 (0x42)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *handle* specifies the **GEMDOS** file handle of the file pointer to modify. The meaning of *offset* varies with *mode* as follows:

Name	*mode*	Meaning
SEEK_SET	0	*offset* specifies the positive number of bytes from the beginning of the file.
SEEK_CUR	1	*offset* specifies the negative or positive number of bytes from the current file position.
SEEK_END	2	*offset* specifies the positive number of bytes from the end of the file.

BINDING

```
move.w      mode,-(sp)
move.w      handle,-(sp)
move.l      offset,-(sp)
move.w      #$42,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE **Fseek()** returns a positive value representing the new absolute location of the file pointer from the beginning of the file or a negative **GEMDOS** error code.

Fselect()

WORD Fselect(*timeout, rfds, wfds, reserved*)
WORD *timeout*;
LONG **rfds, *wfds*;
LONG *reserved*;

Fselect() enumerates file descriptors which are ready for reading and/or writing.

OPCODE 285 (0x11D)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *timeout* specifies the maximum amount of time (in milliseconds) to wait for at least one of the specified file descriptors to become unblocked. If *timeout* is 0 then the process will wait indefinitely.

rfds and *wfds* each point to a **LONG** bitmap describing the read and write file descriptors to wait for. Setting bit #10 of the **LONG** pointed to by *rfds*, for example, will cause **Fselect()** to return when **GEMDOS** handle 10 is available for reading.

As many read or write file descriptors can be specified per call as desired. Specifying **NULL** for either *rfds* or *wfds* is the same as passing a pointer to a **LONG** with no bits set.

Upon return the **LONG**s pointed to by *rfds* and *wfds* will be filled in with a similar bitmap indicating which handles are ready to be read/written. *reserved* should always be set to 0L.

BINDING

```
move.l      reserved,-(sp)
pea         wfds
pea         rfds
move.w      timeout,-(sp)
move.w      #$11D,-(sp)
trap        #1
lea         16(sp),sp
```

RETURN VALUE **Fselect()** returns the sum of bits set in both *rfds* and *wfds*. A return value of 0 indicates that the function timed out before any of the specified file handles became available. A negative **GEMDOS** error code is returned if the function failed.

CAVEATS **Fselect()** does not currently work on any **BIOS** device except the keyboard.

COMMENTS **Fselect(** 0L, 0L, 0L, 0L**)** will block the calling process forever.

SEE ALSO **Finstat(), Foutstat()**

Fsetdta()

VOID Fsetdta(***ndta*** **)**
DTA ****ndta***;**

Fsetdta() sets the location of a new **DTA** (Disk Transfer Address) in memory.

OPCODE 26 (0x1A)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *ndta* is a pointer to a valid memory area which will be used as the new **DTA**. The **DTA** structure is defined under the entry for **Fgetdta()**.

BINDING

```
pea         ndta
move.w      #$1A,-(sp)
trap        #1
addq.l      #6,sp
```

COMMENTS When an application starts, its **DTA** overlaps the command line string in the processes' basepage. Any use of the **Fsfirst()** or **Fsnext()** call without first reallocating a new **DTA** will cause the processes' command line to be corrupted.

To prevent this, you should use **Fsetdta()** to define a new **DTA** structure for your process prior to using **Fsfirst()** or **Fsnext()**. Be careful to avoid assigning your **DTA** to a local or automatic variable without setting it to its original value before the variable goes out of scope.

SEE ALSO **Fgetdta(), Fsfirst(), Fsnext()**

Fsfirst()

WORD Fsfirst(***fspec*****,** ***attribs*** **)**
char ****fspec***;**
WORD ***attribs*****;**

Fsfirst() searches the file/pathspec given for the first occurrence of a file or subdirectory with named attributes and if found, fill in the current **DTA** with that file's information.

OPCODE 78 (0x4E)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *fspec* is the **GEMDOS** file specification of the file or subdirectory to search for. This specification may use wildcard characters (? or *) within the filename, however they may not be used within the pathname. This function is the only **GEMDOS** function which accepts wildcard characters in the path specification.

attribs is a bit mask which can combine several file characteristics that further narrows the search as follows:

Name	Bit Mask	Meaning
FA_READONLY	0x01	Include files which are read-only.
FA_HIDDEN	0x02	Include hidden files.
FA_SYSTEM	0x04	Include system files.
FA_VOLUME	0x08	Include volume labels.
FA_DIR	0x10	Include subdirectories.
FA_ARCHIVE	0x20	Include files with archive bit set.

BINDING

```
move.w      attribs,-(sp)
pea         fspec
move.w      #$4E,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Fsfirst()** returns **E_OK** (0) if a file was found and the **DTA** was successfully filled in with the file information. Otherwise, it returns a negative **GEMDOS** error code.

The **DTA** structure is defined as:

```
typedef struct
{
      BYTE    d_reserved[21];
      BYTE    d_attrib;
      UWORD   d_time;
      UWORD   d_date;
      LONG    d_length;
      char    d_fname[14];
} DTA;
```

COMMENTS This function uses the application's **DTA** which is initially located in the same memory location as the processes' command line. Using this function without first assigning a new **DTA** will corrupt the command line.

When running in the **MiNT** domain (see **Pdomain()**), **Fsfirst()** and **Fsnext()** will fill in the **DTA** with lowercase filenames rather than the standard **TOS** uppercase.

SEE ALSO **Fsnext(), Fgetdta(), Fsetdta()**

Fsnext()

WORD Fsnext(VOID)

Fsnext() should be called as many times as necessary after a corresponding **Fsfirst()** call to reveal all files which match the search criteria.

OPCODE 79 (0x4F)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$4F,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Fsnext()** returns **E_OK** (0) if another file matching the search criteria given in **Fsfirst()** is found and the **DTA** has been properly filled in with the file's information. Otherwise, a negative **GEMDOS** error code is returned.

COMMENTS This function uses the application's **DTA** which is initially located in the same memory location as the processes' command line. Using this function without first assigning a new **DTA** will corrupt the command line.

This call should only be used after **Fsfirst()** and the contents of the **DTA** should not be modifed between the calls.

SEE ALSO **Fsfirst()**

Fsymlink()

LONG Fsymlink(*oldname, newname*)
char ****oldname, *newname*;**

Fsymlink() creates a symbolic link to a file.

OPCODE 302 (0x12E)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *oldname* points to the file specification of the file to create a link to. *newname*

points to the file specification of the link to create.

BINDING

```
pea         newname
pea         oldname
move.w      #$12E,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE **Fsymlink()** returns 0 if successful or a negative **GEMDOS** error code otherwise.

COMMENTS **Fsymlink()**, unlike **Flink()**, creates symbolic links, which, unlike hard links, can be setup between physical devices and file systems.

An **Fdelete()** call to a symbolic link will delete the link, not the file. A call to **Fdelete()** on the original file will cause future references to the created symbolic link to fail.

SEE ALSO **Flink(), Freadlink()**

Fwrite()

LONG Fwrite(***handle, count, buf*** **)**
WORD ***handle*****;**
LONG ***count*****;**
VOIDP ***buf*****;**

Fwrite() writes the contents of a buffer to the specified **GEMDOS** file.

OPCODE 64 (0x40)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *handle* is the handle of the file to write to. *count* specifies the number of bytes to write. *buf* indicates the starting address of the data to write.

BINDING

```
pea         buf
move.l      count,-(sp)
move.w      handle,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE **Fwrite()** returns the positive number of bytes actually written or a negative **GEMDOS** error code if the operation failed.

CAVEATS Prior to **GEMDOS** version 0.15, calling **Fwrite()** with a *count* parameter of 0 will hang the system.

SEE ALSO **Fread()**

Fxattr()

LONG Fxattr(*flag, name, xattr*)
WORD *flag*;
char **name*;
XATTR **xattr*;

Fxattr() returns extended information about the specified file.

OPCODE 300 (0x12C)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *flag* specifies whether attributes returned by this call on symbolic links should be those of the file to which the link points or the link itself. A value of **FX_FILE** (0) causes the attributes to be those of the actual file whereas a value of **FX_LINK** (1) returns the attributes of the link itself.

name specifies the name of the file from which attributes are to be read and placed in the **XATTR** structure pointed to by *xattr*. **XATTR** is defined as follows:

```
typedef struct
{
      UWORD mode;
      LONG index;
      UWORD dev;
      UWORD reserved1;
      UWORD nlink;
      UWORD uid;
      UWORD gid;
      LONG size;
      LONG blksize;
      LONG nblocks;
      WORD mtime;
      WORD mdate;
      WORD atime;
      WORD adate;
      WORD ctime;
      WORD cdate;
      WORD attr;
      WORD reserved2;
      LONG reserved3;
      LONG reserved4;
} XATTR;
```

XATTR's members have the following meaning:

XATTR Element	Meaning
mode	Masking *mode* with 0xF000 reveals the file type as one of the following: **S_IFCHR** (0x2000) **S_IFDIR** (0x4000) **S_IFREG** (0x8000) **S_IFIFO** (0xA000) **S_IMEM** (0xC000) **S_IFLNK** (0xE000) The lower three nibbles of *mode* is a bit mask which specifies the legal file access mode(s) as defined in **Fchmod()**.
index	This member combined with the *dev* field are designed to provide a unique identifier for a file under file systems which allow multiple files with the same filename.
dev	This value represents either a **BIOS** device number or an identifier created by the file system to represent a remote device.
reserved1	This structure element is currently reserved for future implementations of **MiNT**.
nlink	This value specifies the current number of hard links attached to the file. On a file system that does not support hard links and for most regular files, *nlink* is 1.
uid	*uid* is the user ID of the owner of the file.
gid	*gid* is the group ID of the owner of the file.
size	*size* is the length of the file in bytes.
blksize	*blksize* specifies the size of blocks (in bytes) in this file system.
nblocks	*nblocks* is the actual number of blocks the file is using on the device. This number may include data storage elements other used to keep track of the file (aside from the actual data).
mtime, mdate	Time and date of the last file modification in **GEMDOS** format.
atime, adate	Time and date of the last file access in **GEMDOS** format.
ctime, cdate	Time and date of the file's creation in **GEMDOS** format.
attr	Standard file attributes (same as read by **Fattrib()**).
reserved2	This structure element is currently reserved for future implementations of **MiNT**.
reserved3	This structure element is currently reserved for future implementations of **MiNT**.
reserved4	This structure element is currently reserved for future implementations of **MiNT**.

BINDING

```
pea         xattr
pea         name
move.w      flag,-(sp)
move.w      #$12C,-(sp)
trap        #1
lea         12(sp),sp
```

RETURN VALUE **Fxattr()** returns 0 if successful or a negative **GEMDOS** error code otherwise.

SEE ALSO **Fattrib()**

Maddalt()

LONG Maddalt(***start, size*** **)**
VOIDP ***start*****;**
LONG ***size*****;**

Maddalt() informs **GEMDOS** of the existence of additional 'alternative' RAM that would not normally have been identified by the system.

OPCODE 20 (0x14)

AVAILABILITY Available as of **GEMDOS** version 0.19 only.

PARAMETERS *start* indicates the starting address for the block of memory to be added to the **GEMDOS** free list. *size* indicates the length of this block in bytes.

BINDING

```
move.l      size,-(sp)
pea         start
move.w      #$14,-(sp)
trap        #1
lea         10(sp),sp
```

RETURN VALUE **Maddalt()** returns **E_OK** (0) if the call succeeds or a negative **GEMDOS** error code otherwise.

COMMENTS This call should only be used to identify RAM not normally identified by the **BIOS** at startup (added through a VME-card or hardware modification). Once this RAM has been identified to the system it may not be removed and should only be allocated and used via the standard system calls. In addition, programs wishing to use this RAM must have their alternative RAM load bit set or use **Mxalloc()** to specifically request alternative RAM.

See the discussion earlier in this chapter for more information about the types of available RAM.

SEE ALSO **Mxalloc()**

Malloc()

VOIDP Malloc(***amount*** **)**
LONG ***amount*****;**

Malloc() requests a block of memory for use by an application.

OPCODE 72 (0x48)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *amount* specifies the amount of memory (in bytes) you wish to allocate. You may pass a value of -1L in which case the function will return the size of the largest free block of memory.

BINDING

```
move.l      amount,-(sp)
move.w      #$48,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Malloc()** returns **NULL** if there is no block large enough to fill the request or a pointer to the block if the request was satisfied. The memory allocated will be chosen based on the status of the processes' load flags. To specify the memory requirements in more detail, use **Mxalloc()**.

CAVEATS Prior to **GEMDOS** version 0.15, **Malloc(** 0L **)** will return a pointer to invalid memory as opposed to failing as it should.

COMMENTS Because **GEMDOS** can only allocate a limited amount of blocks per process (as few as 20 depending on the version of **GEMDOS**), applications should limit their usage of this call by allocating a few large blocks instead of many small blocks or use a 'C' memory manager (like **malloc()**) if possible.

SEE ALSO **Mxalloc()**

Mfree()

WORD Mfree(***startadr*** **)**
VOIDP ***startadr*****;**

Mfree() releases a block of memory previously reserved with **Malloc()** or **Mxalloc()** back into the **GEMDOS** free list.

OPCODE 73 (0x49)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *startadr* is the starting address of the block to be freed. This address must be the same as that returned by the corresponding **Malloc()** or **Mxalloc()** call.

BINDING

```
pea         startadr
move.w      #$49,-(sp)
trap        #1
addq.       #6,sp
```

RETURN VALUE **Mfree()** returns **E_OK** (0) if the block was freed successfully or a negative **GEMDOS** error code otherwise.

SEE ALSO **Malloc(), Mxalloc()**

Mshrink()

WORD Mshrink(*startadr, newsize*)
VOIDP *startadr*;
LONG *newsize*;

Mshrink() releases a portion of a block's memory to the **GEMDOS** free list.

OPCODE 74 (0x4A)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *startadr* is the address of the block whose size you wish to decrease. *newsize* is the length you now desire for the block.

BINDING

```
move.l      newsize,-(sp)
pea         startadr
clr.w       -(sp)       // Required/Reserved Value
move.w      #$4A,-(sp)
trap        #1
lea         12(sp),sp
```

RETURN VALUE **Mshrink()** returns **E_OK** (0) if the operation was successful or a negative **GEMDOS** error code otherwise.

CAVEATS This call should be used only to 'shrink' a memory block, not to enlarge it.

SEE ALSO **Malloc(), Mxalloc(), Mfree()**

Mxalloc()

VOIDP Mxalloc(***amount, mode*** **)**
LONG ***amount*****;**
WORD ***mode*****;**

Mxalloc() allocates a block of memory according to specified preferences.

OPCODE 68 (0x44)

AVAILABILITY Available from **GEMDOS** version 0.19.

PARAMETERS *amount* specifies the length (in bytes) of the block requested. As with **Malloc()**, specifying -1L for *amount* will return the size of the largest block of memory available. With modes 0 or 1, the size of the largest block of available RAM from the specified type of RAM is returned. Modes 2 and 3 return the size of the largest available block or whichever type of RAM had the largest block.

mode is a **WORD** bit array which specifies the type of memory requested as follows:

Bit	Meaning
0-1	Bits 0-1 represent a possible value of 0-3 representing the type of RAM to allocate as follows: **Name** / **Value** / **Meaning** **MX_STRAM** 0 Allocate only ST-RAM **MX_TTRAM** 1 Allocate only TT-RAM **MX_PREFSTRAM** 2 Allocate either, preferring ST-RAM **MX_PREFTTRAM** 3 Allocate either, preferring TT-RAM
2	Not used (should be set to 0).
3	If set, refer to bits 4-7 for memory protection advice, otherwise default to protection specified in program header. This bit is only valid in the presence of **MiNT**.
4-7	Bits 4-7 represent a possible value of 0-7 representing the memory protection mode to place on the allocated block of memory. Currently valid values are: **Name** / **Value** / **Meaning** **MX_HEADER** 0 Refer to Program Header **MX_PRIVATE** 1 Private **MX_GLOBAL** 2 Global **MX_SUPERVISOR** 3 Supervisor Mode Only Access **MX_READABLE** 4 Read Only Access These bits are only consulted if bit 3 is set and **MiNT** is present.
8-15	Not used (should be set to 0).

BINDING

```
move.w      mode,-(sp)
move.l      amount,-(sp)
move.w      #$44,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Mxalloc()** returns **NULL** if the request could not be granted or a valid pointer to the start of the block allocated otherwise.

COMMENTS **Mxalloc()** should be used instead of **Malloc()** whenever it is available.

SEE ALSO **Malloc(), Mfree()**

Pause()

VOID Pause(VOID)

Pause() suspends the process until a signal is received.

OPCODE 289 (0x121)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$121,-(sp)
trap        #1
addq.l      #2,sp
```

COMMENTS If the signal handler does a 'C' **longjmp()** to a different point in the process or if the handler's purpose is to exit the process, this call will never return.

SEE ALSO **Psigblock(), Psignal(), Psigsetmask()**

Pdomain()

WORD Pdomain(*domain*)
WORD *domain*;

Pdomain() determines/modifies the calling processes' execution domain.

OPCODE 281 (0x119)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *domain* contains the domain code of the new process domain. Currently the only

valid values are **DOMAIN_TOS** (0) for the **TOS** compatibility domain and **DOMAIN_MINT** (1) for the **MiNT** domain. Passing a negative value for *domain* will not change domains but it will return the current domain.

BINDING

```
move.w      domain,-(sp)
move.w      #$119,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Pdomain()** returns the domain in effect prior to the call.

COMMENTS Process domain affects system calls like **Fread()**, **Fwrite()**, **Fsfirst()**, and **Fsnext()**. Processes behave as expected when under the **TOS** domain.

When processes run under the **MiNT** domain, however, the behavior of **Fread**() and **Fwrite()** calls when dealing with terminals can be modified by **Fcntl()**. Also, **Fsfirst()** and **Fsnext()** may not necessarily return the standard **DOS** 8 + 3 file name format. **MiNT** domain processes must understand filenames formatted for different file systems.

SEE ALSO **Fcntl()**

Pexec()

LONG Pexec(*mode, fname, cmdline, envstr*)
WORD *mode*;
char **fname,*cmdline,*envstr*;

Pexec() has many functions designed to spawn child processes depending on the selected mode.

OPCODE 75 (0x4B)

AVAILABILITY **Pexec()** modes 0, 3, 4, and 5, are available in all **GEMDOS** versions. Mode 6 is available as of **GEMDOS** version 0.15. Mode 6 is available as of **GEMDOS** version 0.19. Modes 100, 104, 106, and 200 are only available in the presence of **MiNT**.

PARAMETERS *mode* defines the function of **Pexec()** and the meaning of its parameters and return value as defined below. For modes which load a program, *fname* specifies the **GEMDOS** file specification of the file to load. *cmdline* is pointer to a string containg the command line which will be passed to the calling program. The first byte of the string should indicate the length of the command line (maximum of 125 bytes). The actual command line starts at byte 2. *envstr* is a pointer to an environment which is copied and assigned to the child process. If *envstr* is **NULL**,

the child inherits a copy of the parent's environment.

Name	*mode*	Meaning
PE_LOADGO	0	**'LOAD AND GO'** - Load and execute named program file and return a **WORD** exit code when the child terminates.
PE_LOAD	3	**'LOAD, DON'T GO'** - Load named program. If successful, the **LONG** return value is the starting address of the child processes' basepage. The parent owns the memory of the child's environment and basepage and must therefore free them when completed with the child.
PE_GO	4	**'JUST GO'** - Execute process with basepage at specified address. With this mode, *fname* and *envstr* are **NULL**. The starting address of the basepage of the process to execute is given in the *cmdline* parameter.
PE_BASEPAGE	5	**'CREATE BASEPAGE'** - This mode allocates the largest block of free memory and creates a basepage in the first 256 bytes of it. *fname* should be set to **NULL**. It is the responsibility of the parent to load or define the child's code, shrink the memory block as necessary, and initialize the basepage pointers to the TEXT, DATA, and BSS segments of the program. With **MiNT**, use of this mode in conjunction with mode **PE_CGO** can be used to emulate the **Pvfork()** call without blocking the parent.
PE_GOTHENFREE	6	**'JUST GO, THEN FREE'** - This mode is identical to mode **PE_GO** except that memory ownership of the child's environment and basepage belong to the child rather than the parent so that when the child **Pterm()**'s, that memory is automatically freed.
PE_CLOADGO	100	**'LOAD, GO, DON'T WAIT'** - This mode is identical to mode **PE_LOADGO** except that the parent process is returned to immediately while the child continues to execute. The positive process ID of the child is returned. Environment and basepage memory blocks are freed automatically when the child **Pterm()**'s
PE_CGO	104	**'JUST GO, DON'T WAIT'** - This mode is similar to mode **PE_GO** except that the parent process is returned to immediately while the child continues to execute concurrently. The positive process ID of the child is returned. Memory ownership of the environment and basepage are shared by the parent and child (this sharing extends to all memory owned by the parent). *fname* may be used to supply a name for the child, otherwise, if **NULL** is used, the name of the parent will be used. *cmdline* should point to the process basepage. *envstr* should be **NULL**.
PE_NOSHARE	106	**'JUST GO, DON'T WAIT, NO SHARING'** - This mode is exactly the same as mode **PE_CGO** except that the child process owns its own environment and basepage sharing no memory with the parent.

PE_REPLACE	200	**'REPLACE PROGRAM AND GO'** - This mode works like mode **PE_CLOADGO** except that the parent process is terminated immediately and the child process completely replaces the parent in memory retaining the same process ID. *fname*, *cmdline*, and *envstr*, are all normally passed and valid.

BINDING

```
pea         envstr
pea         cmdline
pea         fname
move.w      word,-(sp)
move.w      #$4B,-(sp)
trap        #1
lea         16(sp),sp
```

RETURN VALUE The value returned by **Pexec()** is dependent on the *mode* value and is therefore explained above. All **Pexec()** modes return a **LONG** negative **GEMDOS** error code when the call fails. A **WORD** negative value indicates the child was successfully run but it terminated returning a negative error code. In all cases, a process returning after having been interrupted with CTRL-C returns 0x0000FFE0 (-32).

COMMENTS Command lines longer than 126 bytes may be passed to processes aware of the **Atari Extended Command Line Specification** (see discussion earlier in this chapter).

SEE ALSO **shel_write()**

Pfork()

WORD Pfork(VOID)

Pfork() creates a copy of the current process.

OPCODE 283 (0x11B)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$11B,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Pfork()** returns the new process ID in the parent and a 0 in the child.

CAVEATS If the parent is in supervisor mode when this call is made, the child is started in user mode anyway.

COMMENTS After a **Pfork()** call, two instances of one process will exist in memory. Program execution in both processes continue at the same point in the TEXT segment following this call. The parent's DATA and BSS segments are physically copied so that any variables that change in the child will not affect the parent and vice versa.

New processes started with this call should not call **Mshrink()** but are required to do any **GEM** initialization such as **appl_init()** and **v_opnvwk()** again (if **GEM** usage is needed). Both the parent and child use **Pterm()** or **Pterm0()** to terminate themselves.

SEE ALSO **Pexec(), Pvfork()**

Pgetegid()

WORD Pgetegid(VOID)

Pgetegid() returns the effective group ID of the process.

OPCODE 313 (0x139)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.95 exists.

BINDING

```
move.w      #$139,-(sp)
trap        #1
addq.l      #2,sp
```

COMMENTS The effective group ID of a process will be different than its actual group ID if its set gid bit is set. This mechanism allows users to grant file access to other users.

SEE ALSO **Pgetgid(), Pgeteuid()**

Pgeteuid()

WORD Pgeteuid(VOID)

Pgeteuid() returns the effective user ID of the process.

OPCODE 312 (0x138)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.95 exists.

BINDING

```
move.w      #$138,-(sp)
trap        #1
```

```
addq.l      #2,sp
```

COMMENTS The effective group ID of a process will be different than its actual group ID if its set gid bit is set. This mechanism allows users to grant file access to other users.

SEE ALSO **Pgetuid(), Pgetegid()**

Pgetgid()

WORD Pgetgid(VOID)

Pgetgid() returns the group ID (0-255) of the calling process.

OPCODE 271 (0x10F)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$10F,-(sp)
trap        #1
addq.l      #2,sp
```

SEE ALSO **Psetgid()**

Pgetpgrp()

WORD Pgetpgrp(VOID)

Pgetpgrp() returns the process group ID code for the calling process.

OPCODE 269 (0x10D)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$10D,-(sp)
trap        #1
addq.l      #2
```

COMMENTS Process groups are closely related processes which are used for job control and signaling purposes. Process groups usually terminate together rather than one at a time.

SEE ALSO **Psetpgrp(), Pkill()**

Pgetpid()

WORD Pgetpid(VOID)

Pgetpid() returns the positive **WORD** process ID code for the calling process. This identifer uniquely identifies the process within the system.

OPCODE 267 (0x10B)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$10B,-(sp)
trap        #1
addq.l      #2,sp
```

Pgetppid()

WORD Pgetppid(VOID)

Pgetppid() returns the process ID for the calling processes' parent.

OPCODE 268 (0x10C)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$10C,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Pgetppid()** returns the process ID code for the parent of the calling process or 0 if it was started by the kernel (not a child process).

Pgetuid()

WORD Pgetuid(VOID)

Pgetuid() returns the user ID code (0-255) of the calling process which determines access permissions and can be used in a multi-user system to differentiate users.

OPCODE 271 (0x10F)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$10F,-(sp)
trap        #1
addq.l      #2
```

SEE ALSO **Psetuid()**

Pkill()

WORD Pkill(*pid*, *sig*)
WORD *pid*, *sig*;

Pkill() sends a signal to one or more processes.

OPCODE 273 (0x111)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS **Pkill()** sends signal *sig* to certain processes based on the value of *pid*. If *pid* is positive, the signal is sent the the process with process identifier pid. If *pid* is 0, the signal is sent to all processes who belong to the same process group as the caller as well as the caller itself. If *pid* is negative, the signal is sent to all processes with process group number -*pid*.

BINDING

```
move.w      sig,-(sp)
move.w      pid,-(sp)
move.w      #$111,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Pkill()** returns 0 if successful or a negative **GEMDOS** error code otherwise.

COMMENTS If the caller is also a recipient of a signal and that signal causes program termination this call will never return.

SEE ALSO **Psignal()**

Pmsg()

WORD Pmsg(*mode, mboxid, msgptr*)
WORD *mode*;
LONG *mboxid*;
PMSG **msgptr*;

Pmsg() sends/receives a message to/from a 'message box'.

OPCODE 293 (0x125)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS *mode* specifies the action to take as follows:

Name	*mode*	Operation
MSG_READ	0	Block the process and don't return until a message is read from the specified mailbox ID *mboxid* and placed in the structure pointed to by *msgptr*.
MSG_WRITE	1	Block the process and don't return until a process waiting for a message with mailbox ID *mboxid* has received the message contained in the structure pointed to by *msgptr*.
MSG_READWRITE	2	Block the process until a process waiting for a message with mailbox ID *mboxid* has received the message contained in the structure pointed to by *msgptr* and a return message is received with mailbox ID 0xFFFFxxxx where 'xxxx' is the process ID of the current process.

PMSG is defined as:

```
typedef struct
{
       LONG userlong1;
       LONG userlong2;
       WORD pid;
} PMSG;
```

On return from writes, *pmsg.pid* contains the process ID of the process who read your message, on return from reads, its the process ID of the writer. The contents of *userlong1* and *userlong2* is completely up to the sender.

By OR'ing mode with **MSG_NOWAIT** (0x8000), you can prevent the call from blocking the process and simply return -1 if another process wasn't waiting to

read or send your process a message.

BINDING

```
pea         msgptr
move.l      mboxid,-(sp)
move.w      mode,-(sp)
move.w      #$125,-(sp)
trap        #1
lea         12(sp),sp
```

RETURN VALUE **Pmsg()** returns 0 if successful, -1 if bit 0x8000 is set and no process was ready to receive/send the desired message, or a negative **GEMDOS** error code.

Pnice()

WORD Pnice(*delta*)
WORD *delta*;

Pnice() alters the process priority of the calling process.

OPCODE 266 (0x10A)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *delta* is a signed number which is added to the current process priority value. Positive values decrease process priority while negative values increase it.

BINDING

```
move.w      delta,-(sp)
move.w      #$10A,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Pnice()** returns the prior process priority.

COMMENTS The process priority value has no fixed formula so it is hard to be able to predict the results of this call with any accuracy. This call is the same as **Prenice(Pgetpid()**, *delta* **)**.

SEE ALSO **Prenice()**

Prenice()

LONG Prenice(***pid, delta*** **)**
WORD ***pid, delta*****;**

Prenice() adjusts the process priority of the specified process.

OPCODE 295 (0x127)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.90 exists.

PARAMETERS The process priority for the process with process ID *pid* is adjusted by signed value *delta*. Positive values for *delta* decrease process priority while negative values increase it.

BINDING

```
move.w      delta,-(sp)
move.w      pid,-(sp)
move.w      #$127,-(sp)
trap        #1
addq.l      #6
```

RETURN VALUE **Prenice()** returns a 32-bit negative **GEMDOS** error code if unsuccessful. Otherwise, the lower 16-bit signed value can be interpreted as the previous process priority code.

COMMENTS The exact effect adjusting process priorites will have is difficult to determine.

SEE ALSO **Pnice()**

Prusage()

VOID Prusage(***rusg*** **)**
LONG ***rusg*****;**

Prusage() returns resource information about the current process.

OPCODE 286 (0x11E)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *rusg* is a pointer to an array of 8 **LONG**s as follows:

Name	*rusg[x]*	Meaning
PRU_KERNELTIME	0	Time spent by process in **MiNT** kernel.
PRU_PROCESSTIME	1	Time spent by process in its own code.
PRU_CHILDKERNALTIME	2	Total **MiNT** kernel time spent by children of this process.
PRU_CHILDPROCESSTIME	3	Total user code time spent by children of this process.
PRU_MEMORY	4	Total memory allocated by process (in bytes).
—	5-7	Reserved for future use.

BINDING

```
pea         rusg
move.w      #$11E,-(sp)
trap        #1
addq.l      #6,sp
```

COMMENTS All times given are in milliseconds.

SEE ALSO **Psetlimit()**

Psemaphore()

LONG Psemaphore(***mode, id, timeout*** **)**
WORD ***mode*****;**
LONG ***id*****;**
LONG ***timeout*****;**

Psemaphore() creates a semaphore which may only be accessed by one process at a time.

OPCODE 308 (0x134)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.92 exists.

PARAMETERS *mode* specifies the mode of the operation which affects the other two parameters as follows:

Name	*mode*	Meaning
SEM_CREATE	0	Create a semaphore with called *id* and grant ownership to the calling process. *timeout* is ignored.
SEM_DESTROY	1	Destroy the semaphore called *id*. This only succeeds if the semaphore is owned by the caller. *timeout* is ignored.

SEM_LOCK	2	Request ownership of semaphore *id*. The process will wait for the semaphore to become available for *timeout* milliseconds and then return. If *timeout* value of 0 will force the call to return immediately whether or not the semaphore is available. A *timeout* value of -1 will cause the call to wait indefinitely.
SEM_UNLOCK	3	Release ownership of semaphore *id*. The caller must be the current owner of the semaphore to release control. *timeout* is ignore.

BINDING

```
move.l      timeout,-(sp)
move.l      id,-(sp)
move.w      mode,-(sp)
move.w      #$134,-(sp)
trap        #1
lea         12(sp),sp
```

RETURN VALUE **Psemaphore()** returns a 0 if successful, **ERROR** (-1) if the process requested a semaphore it already owned, or a negative **GEMDOS** error code.

COMMENTS If your process is waiting for ownership of a semaphore and it is destroyed by another process, an **ERANGE** (-64) error will result. Any semaphores owned by a process when it terminates are released but not deleted.

Psetgid()

WORD Psetgid(*gid*)
WORD *gid*;

Psetgid() sets the group ID of the calling process.

OPCODE 277 (0x115)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *gid* is the group ID code to assign the calling process (0-255).

BINDING

```
move.w      gid,-(sp)
move.w      #$115,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Psetgid()** returns gid if successful or **EACCDN** (-36) if the process did not have the authority to change the group ID.

COMMENTS The group ID of a process may only be changed when it is currently 0. Therefore, once the group ID has been set, it is fixed and unchangeable. Further attempts to modify it will result in an **EACCDN** error.

SEE ALSO **Pgetgid()**

Psetlimit()

LONG Psetlimit(*limit, value*)
WORD *limit*;
LONG *value*;

Psetlimit() reads/modifies resource allocation limits for the calling process and all of its children.

OPCODE 287 (0x11F)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *limit* defines the resource to read or modify as follows:

Name	*limit*	Meaning
LIM_MAXTIME	1	Maximum CPU time in milliseconds. If *value* is positive, *value* determines the new maximum. If *value* is 0, then the limit is set at 'unlimited'. If *value* is negative, the current value is returned but not modified.
LIM_MAXMEM	2	Maximum total memory allowed for process. If *value* is positive, *value* determines the new maximum. If *value* is 0, then the limit is set at 'unlimited'. If *value* is negative, the current value is returned but not modified.
LIM_MAXMALLOC	3	Maximum total size of each Malloc (Mxalloc). If *value* is positive, *value* determines the new maximum. If *value* is 0, then the limit is set at 'unlimited'. If *value* is negative, the current value is returned but not modified.

BINDING

```
move.l      value,-(sp)
move.w      limit,-(sp)
move.w      #$11F,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Psetlimit()** returns the previous value or **ERANGE** (-64) if the value for *limit* was out of range.

COMMENTS The limits imposed by **Psetlimit()** are inherited from the parent by child processes.

SEE ALSO **Prusage()**

Psetpgrp()

LONG Psetpgrp(*pid, newgrp*)
WORD *pid, newgrp*;

Psetpgrp() sets the process group ID of the specified process.

OPCODE 270 (0x10E)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS The process group ID of the process with process ID *pid* will have its process group ID changed to *newgrp* if the calling process has the same user ID or is the parent of the specified process. If *pid* is 0, the process group ID of the current process is sent. If *newgrp* is 0, the process group ID is set to equal the processes' (not the callers' unless *pid* is also set to 0) process ID.

BINDING

```
move.w      newgrp,-(sp)
move.w      pid,-(sp)
move.w      #$10E,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Psetpgrp()** returns *newgrp* if successful or a negative **GEMDOS** error code otherwise.

SEE ALSO **Pgetpgrp()**

Psetuid()

WORD Psetuid(*uid*)
WORD *uid*;

Psetuid() sets the user ID of the calling process.

OPCODE 272 (0x110)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *uid* is the user ID to assign to the calling process.

BINDING

```
move.w      uid,-(sp)
move.w      #$110,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Psetuid()** returns *uid* if successful or a negative **GEMDOS** error code otherwise.

COMMENTS As with the process group ID, the user ID of a process may only be set if it is currently 0. This means that once the user ID is set, it may not be changed.

SEE ALSO **Pgetuid()**

Psigaction()

LONG Psigaction(*sig*, *act*, *oact*)
WORD *sig*;
SIGACTION **act*, **oact*;

Psigaction() specifies a default action for the specified signal.

OPCODE 311 (0x137)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.95 exists.

PARAMETERS *sig* specifies the signal whose action you wish to change. *act* points to a **SIGACTION** structure (as defined below) which defines the handling of future signals of type *sig*. *oact* points to a **SIGACTION** structure which defines the handling of pending signals of type *sig*.

```
typedef struct
{
       LONG sa_handler;
       WORD sa_mask;
       WORD sa_flags;
} SIGACTION;
```

Setting *sa_hander* to **SIG_DFL** (0) wll cause the default action to take place for the signal. A value of **SIG_IGN** (1) will cause the signal to be ignored. Any other value specifies the address of a signal handler.

The signal handler should expect one **LONG** argument on its stack which contains the signal number being delivered. During execution of the handler, all signals specified in *sa_mask* are blocked.

sa_flags is a signal-specific flag. When *sig* is **SIGCHLD**, setting Bit #0 (**SA_NOCLDSTOP**) will cause the **SIGCHLD** signal to be delivered only when the child process terminated (not when stopped).

BINDING

```
move.w      sig,-(sp)
pea         act
```

```
pea         oact
move.w      #$137,-(sp)
trap        #1
add.l       #12,sp
```

RETURN VALUE **Psigaction()** returns 0 if successful or a negative **GEMDOS** error code otherwise.

COMMENTS Calling **Psigaction()** automatically unmasks the specified signal for delivery.

SEE ALSO **Psignal**

Psigblock()

LONG Psigblock(*mask*)
LONG *mask*;

Psigblock() blocks selected signals from delivery.

OPCODE 278 (0x116)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *mask* is a bit mask of signals block. For each bit *n* set, signal *n* is added to the 'blocked' list.

BINDING

```
move.l      mask,-(sp)
move.w      #$116,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Psigblock()** returns the original set of blocked signals in effect prior to the call.

COMMENTS Blocked signals are preserved with **Pfork()** and **Pvfork()** calls, however, children started with **Pexec()** start with an empty list of blocked signals.

SIGKILL may not be blocked and will be reset by the system.

SEE ALSO **Pkill(), Psignal(), Psigpending()**

Psignal()

LONG Psignal(*sig*, *handler*)
WORD *sig*;
VOID (handler*)(LONG);**

Psignal() determines the action taken when a signal is received by the process.

OPCODE 274 (0x112)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *sig* specifies the signal whose response you wish to modify. If *handler* is cast to **SIG_DFL** (0) then the default action for the signal will occur when received. If *handler* is cast to **SIG_IGN** (1) then the signal will be ignored by the process. Otherwise, *handler* points to a user function which is designed to take action on a signal. This function is called when a signal is received with a **LONG** signal number on the stack.

BINDING

```
pea         handler
move.w      sig,-(sp)
move.w      #$112,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Psignal()** returns the old value of the signal handler if successful or a negative **GEMDOS** error code otherwise.

COMMENTS Signal handler functions may make any **GEMDOS**, **BIOS**, or **XBIOS** calls desired but must not make any **AES** or **VDI** calls. Signal handlers must either return with a 680x0 **RTS** instruction to resume program execution or call **Psigreturn()** to clean the stack if it intends to do a 'C' **longjmp()**.

Signal handling is preserved across **Pfork()** and **Pvfork()** calls. Child processes started with **Pexec()** ignore and follow the default action the same as their parents. Signals which have user functions assigned to them are reset to the default action for child processes.

SEE ALSO **Psigreturn(), Psigblock(), Pkill()**

Psigpause()

LONG Psigpause(*mask*)
LONG *mask*;

Psigpause() sets a new signal mask and then suspends the process until a signal is received.

OPCODE 310 (0x136)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.95 exists.

PARAMETERS *mask* specifies the signal mask to wait for.

BINDING

```
move.l      mask,-(sp)
move.w      #$136,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Psigpause()** returns 0 if successful or non-zero otherwise.

COMMENTS Depending on the state of the signal handler, this call may never return.

SEE ALSO **Psigaction(), Pause()**

Psigpending()

LONG Psigpending(VOID)

Psigpending() indicates which signals have been sent but not yet delivered to the calling process.

OPCODE 291 (0x123)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #123,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Psigpending()** returns a bit mask of which signals have been sent but not yet delivered to the calling process because they are being blocked. For each bit *n* set in the returned **LONG**, signal *n* is waiting for reception.

SEE ALSO **Psigblock(), Psignal(), Psigsetmask()**

Psigreturn()

VOID Psigreturn(VOID)

Psigreturn() prepares exit from a signal handler not planning to return via a 680x0 RTS.

OPCODE 282 (0x11A)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$11A,-(sp)
trap        #1
addq.l      #2,sp
```

CAVEATS Calling this function and then calling the 680x0 RTS opcode to return will produce undesired results.

COMMENTS **Psigreturn()** is only needed by 'C' programs which intend to exit the signal handler by doing a 'C' **longjmp()** rather than simply using the 680x0 RTS.

SEE ALSO **Psignal()**

Psigsetmask()

LONG Psigsetmask(*mask*)
LONG *mask*;

Psigsetmask() defines which signals are to be blocked before being delivered to the calling application.

OPCODE 279 (0x117)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *mask* is a **LONG** bit mask which defines which signals to block and which signals to allow. For each bit *n* set, signal *n* will be blocked. For each bit *n* clear, signal *n* will be delivered.

BINDING

```
move.l      mask,-(sp)
move.w      #$117,-(sp)
trap        #1
```

```
addq.l      #6,sp
```

RETURN VALUE **Psigsetmask()** returns the original mask of blocked/unblocked signals prior to the call or a negative **GEMDOS** error code.

COMMENTS Unlike **Psigblock()**, *mask* completely replaces the old mask rather than simply OR'ing it.

SEE ALSO **Pkill(), Psignal(), Psigpending()**

Pterm()

VOID Pterm(*retcode*)
WORD *retcode*;

Pterm() terminates an application returning the specified error code.

OPCODE 76 (0x4C)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *retcode* indicates the error status upon termination. Some recommended return values are:

Name	*retcode*	Meaning
TERM_OK	0	Program completion without errors
TERM_ERROR	1	Generic Error
TERM_BADPARAMS	2	Bad parameters
TERM_CRASH	-1	Process crashed (returned by **GEMDOS** versions from 0.15.)
TERM_CTRLC	-32	Process terminated by CTRL-C

BINDING

```
move.w      retcode,-(sp)
move.w      #$4C,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Pterm()** never returns.

COMMENTS **GEMDOS** jumps through the *etv_term* (0x102) vector when this call is made prior to process termination to allow the process one last chance to clean up. In addition, all files opened by the process are closed and all memory blocks allocated by the process are freed.

SEE ALSO **Pexec(), Pterm0()**

PtermØ()

VOID PtermØ(VOID)

PtermØ() terminates the application returning an exit code of 0 indicating no errors.

OPCODE 0 (0x00)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
clr.w       -(sp)
trap        #1
```

RETURN VALUE **PtermØ()** never returns.

COMMENTS Same as **Pterm(** 0 **)**.

SEE ALSO **Pterm()**

Ptermres()

VOID Ptermres(*keep*, *retcode*)
LONG *keep*;
WORD *retcode*;

Ptermres() terminates a process leaving a portion of the program's TPA intact and removing the memory left from **GEMDOS**'s memory list.

OPCODE 49 (0x31)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *keep* is the length (in bytes) of the processes' TPA to retain in memory after exit. *retcode* is the code returned on exit.

BINDING

```
move.w      retcode,-(sp)
move.l      keep,-(sp)
move.w      #$31,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE **Ptermres()** never returns.

COMMENTS This function is normally used by TSR's to stay resident in memory. Any files opened by the process are closed. Any memory allocated is, however, retained.

The value for *keep* is usually the sum of the length of the basepage (0x100), the length of the text, data, and bss segments of the application, and the length of the stack. It is important to note that the memory retained by this call may not be freed at a later point as it is removed from the **GEMDOS** memory list altogether.

SEE ALSO **Pterm0(), Pterm()**

Pumask()

WORD Pumask(*mode*)
WORD *mode*;

Pumask() defines an inital file and directory creation mask.

OPCODE 307 (0x133)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.92 exists.

PARAMETERS *mode* specifies the new file access permission mask to apply to all future files created with **Fcreate()** and **Dcreate()**. *mode* is a **WORD** bit mask of various access permission flags as defined in **Fchmod()**.

BINDING

```
move.w      mode,-(sp)
move.w      #$133,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Pumask()** returns the original mask in effect prior to the call.

SEE ALSO **Dcreate(), Fcreate(), Fchmod()**

Pusrval()

LONG Pursval(*val*)
LONG *val*;

Pusrval() reads/modifies a user defined value associated with a process.

OPCODE 280 (0x118)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *val* specifies the new value of the **LONG** associated with this process. If *val* is -1 then this value is not changed but still returned.

BINDING

```
move.w      #$118,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Pusrval()** returns the original value of the user **LONG** prior to the call.

COMMENTS The user-defined longword set by this call is inherited by child processes and may be utilized as desired.

Pvfork()

WORD Pvfork(VOID)

Pvfork() creates a duplicate of the current process which shares address and data space with the parent.

OPCODE 275 (0x113)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$113,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Pvfork()** returns the new process ID to the parent and 0 to the child. If an error occurs the parent receives a negative **GEMDOS** error code.

CAVEATS If the parent is in supervisor mode when this call is made the child is placed in user mode anyway.

COMMENTS The child process spawned by this function shares all address and data space with the parent. In other words, any variables altered by the parent will also be altered by the child and vice versa. The child process should not call **Mshrink()** as its TPA is already correctly sized.

The two processes do not execute concurrently. The parent is blocked until either the child terminates or calls **Pexec()**'s mode 200.

SEE ALSO **Pexec(), Pfork()**

Pwait()

LONG Pwait(VOID)

Pwait() attempts to determine the exit code of a stopped or terminated child process.

OPCODE 265 (0x109)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$109,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Pwait()** returns 0 if no child processes have terminated or a 32-bit return code for a child process which has been terminated or stopped.

The process ID of the child process is placed in the upper 16 bits. A process which returned an exit status (via **Pterm()**, **Ptermres()**, or **Pterm0()**) returns the exit code in the lower 16 bits.

A process which was stopped as the result of a signal returns 0x*nn*7F where *nn* is the signal number which stopped it. A process which was terminated as the result of a signal returns 0x*nn*00 where *nn* is the signal number which killed the process.

COMMENTS **Pwait()** will block the calling process until at least one child has been stopped or terminated. Once the exit code of a process has been returned with this call it will be not be returned again with this call (unless it had been stopped and is restarted and stopped again). This call is identical to **Pwait3(** 2, **NULL**);

SEE ALSO **Pexec(), Pterm(), Ptermres(), Pterm0()**

Pwait3()

LONG Pwait3(*flag*, *rusage*)
WORD *flag*;
LONG **rusage*;

Pwait3() determines the exit code of any children of the calling process which were stopped and/or terminated.

OPCODE 284 (0x11C)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *flag* is a bit mask which specifies the specifics of this call as follows:

Name	Mask	Meaning
PW_NOBLOCK	0x01	If set, the function will not block the calling process if no child has been stopped or terminated, rather it will simply return 0. If clear, the process will be blocked until a child of the process has terminated or is stopped.
PW_STOPPED	0x02	If set, return exit codes for processes which have been terminated as well as stopped. If clear, only return exit codes for processes which have actually terminated.

rusage points to an array of two **LONG**s which are filled in with resource usage information of the stopped or terminated process. The first **LONG** contains the number of milliseconds used by the child in user code. The second **LONG** indicates the number of milliseconds spent by the process in the kernel. *rusage* may be set to **NULL** if this information is undesired.

BINDING

```
pea         rusage
move.w      flag,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Pwait3()** returns 0 if no child processes have been stopped and/or terminated (depending on *flag*) or a 32-bit return code for a child process which has been terminated or stopped.

The process ID of the child process is placed in the upper 16 bits. A process which returned an exit status (via **Pterm()**, **Ptermres()**, or **Pterm0()**) returns the exit code in the lower 16 bits.

A process which was stopped as the result of a signal returns 0x*nn*7F where *nn* is the signal number which stopped it. A process which was terminated as the result of a signal returns 0x*nn*00 where *nn* is the signal number which killed the process.

SEE ALSO **Pwait(), Pexec(), Pterm(), Pterm0(), Ptermres(), Prusage()**

Pwaitpid()

LONG Pwaitpid(***pid, flag, rusage*** **)**
WORD ***pid, flag*****;**
LONG ****rusage***;**

Pwaitpid() returns exit code information about one or more child processes.

OPCODE 314 (0x13A)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.96 exists.

PARAMETERS *pid* specifies the children whose exit codes are of interest as follows.

A *pid* of **PWP_ALL** (-1) indicates that all children are of interest. A *pid* of less than -1 indicates that any child whose process group is -*pid* is of interest. A *pid* of **PWP_GROUP** (0) indicates that any child with the same process group ID of the parent is of interest. A *pid* greater than 0 indicates that the child with the given process ID is of interest.

For the usage of *flag* and *rusage* see **Pwait3()**.

BINDING

```
pea         rusage
move.w      flag,-(sp)
move.w      #$13A,-(sp)
trap        #1
addq.l      #8,sp
```

RETURN VALUE See **Pwait3()**.

SEE ALSO **Pwait(), Pwait3()**

Salert()

VOID Salert(***str*** **)**
char ****str***;**

Salert() sends an alert string to the alert pipe 'U:\PIPE\ALERT\'.

OPCODE 316 (0x13C)

AVAILABILITY Available when a '**MiNT**' cookie with a version of at least 0.98 exists.

PARAMETERS *str* should point to a **NULL** terminated character string containing the alert

message to display. The message should not contain any carriage returns or escape characters. The string should *not* be formatted as in **form_alert()**.

BINDING

```
pea         str
move.w      #$13C,-(sp)
trap        #1
addq.l      #6,sp
```

CAVEATS

Messages sent by **Salert()** are only delivered if a separate application is present which was designed to listen to the alert pipe and post its contents.

SEE ALSO

form_alert()

Super()

VOIDP Super(*stack*)
VOIDP *stack*;

Super() allows you to interrogate or alter the state of the 680x0.

OPCODE

32 (0x20)

AVAILABILITY

All **GEMDOS** versions.

PARAMETERS

stack defines the meaning of the call as follows:

Name	*stack*	Meaning
SUP_SET	(**VOIDP**)0	The processor is placed in supervisor mode and the old supervisor stack is returned.
SUP_INQUIRE	(**VOIDP**)1	This interrogates the current mode of the processor. If the processor is in user mode a **SUP_USER** (0) is returned, otherwise a **SUP_SUPER** (1) is returned.
—	>1	The processor is placed in user mode and the supervisor stack is reset to *stack*.

BINDING

```
pea         stack
move.w      #$20,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE

Super() returns a different value based on the *stack* parameter. The various return values are explained above.

CAVEATS

You should never call the **AES** in supervisor mode. In addition, supervisor mode should be entered and left in the same stack context (same 'C' function) or stack corruption can result.

COMMENTS To execute portion of a program in supervisor mode you normally call **Super()** with a parameter of 0 and save the return value. When ready to return to user mode you call **Super()** again with the saved return value as a parameter.

Supervisor mode should be used sparingly under **MiNT** as no task switching can occur.

SEE ALSO **Supexec()**

Sversion()

UWORD Sversion(VOID)

Sversion() returns the current **GEMDOS** version number.

OPCODE 48 (0x30)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$30,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Sversion()** returns a **UWORD** containing the **GEMDOS** minor version number in the upper word and the major version number in the lower word. Current values returned by Atari **TOS**'s are:

Return Value	TOS versions (normally) found in:
0x1300 (0.13)	**TOS** 1.0, **TOS** 1.02
0x1500 (0.15)	**TOS** 1.04, **TOS** 1.06
0x1700 (0.17)	**TOS** 1.62
0x1900 (0.19)	**TOS** 2.01, **TOS** 2.05, **TOS** 2.06, **TOS** 3.01, **TOS** 3.05, **TOS** 3.06
0x3000 (0.30)	**TOS** 4.00, **TOS** 4.01, **TOS** 4.02, **TOS** 4.03, **TOS** 4.04, **MultiTOS** 1.00, **MultiTOS** 1.08

COMMENTS The **GEMDOS** number is not associated with the **TOS** or **AES** version number. You should check for **GEMDOS** or **MiNT** version numbers when trying to determine the presence or properties of a **GEMDOS** function.

Syield()

VOID Syield(VOID)

Syield() surrenders the remainder of the callers' current process timeslice.

OPCODE 255 (0xFF)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

BINDING

```
move.w      #$FF,-(sp)
trap        #1
addq.l      #2,sp
```

SEE ALSO **Pause(), Fselect()**

Sysconf()

LONG Sysconf(*inq*)
WORD *inq*;

Sysconf() returns information about the limits or capabilities of the currently running version of **MiNT**.

OPCODE 290 (0x122)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *inq* determines the return value as follows:

Name	inq	Return Value
SYS_MAXINQ	-1	Maximum legal value for *inq*.
SYS_MAXREGIONS	0	Maximum memory regions per process.
SYS_MAXCOMMAND	1	Maximum length of **Pexec()** command string.
SYS_MAXFILES	2	Maximum number of open files per process.
SYS_MAXGROUPS	3	Maximum number of supplementary group ID's.
SYS_MAXPROCS	4	Maximum number of processes per user.

BINDING

```
move.w      inq,-(sp)
move.w      #$122,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE See above.

COMMENTS If the requested item returns **UNLIMITED** (0x7FFFFFFF) then that item is unlimited.

SEE ALSO **Dpathconf()**

Talarm()

LONG Talarm(*time*)
LONG *time*;

Talarm() reads/sets a process alarm for the current process.

OPCODE 288 (0x120)

AVAILABILITY This function is available under all **MiNT** versions integrated with **MultiTOS**.

PARAMETERS *time* specifies the length of time (in milliseconds) to wait before a **SIGALRM** signal is delivered. If time is 0 then any previously set alarm is cancelled. If *time* is negative the function does not modify any alarm currently set.

BINDING

```
move.l      time,-(sp)
move.w      #$120,-(sp)
trap        #1
addq.l      #6,sp
```

RETURN VALUE **Talarm()** returns 0 i f no alarm was scheduled prior to this call or the amount of time remaining (in milliseconds) before the alarm is triggered.

CAVEATS An alarm with less than 1000 remaining milliseconds will return a value of 0.

COMMENTS If no **SIGALRM** signal handler has been set up when the alarm is triggered, the process will be killed.

SEE ALSO **Pause(), Psignal()**

Tgetdate()

UWORD Tgetdate(VOID)

Tgetdate() returns the current **GEMDOS** date.

OPCODE 42 (0x2A)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$2A,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Tgetdate()** returns a bit array **UWORD** arranged as follows:

Bits 15-9	Bits 8-5	Bits 4-0
Years since 1980	Month (1-12)	Date (0-31)

SEE ALSO **Tgettime(), Tsetdate(), Gettime()**

Tgettime()

UWORD Tgettime(VOID)

Tgettime() returns the **GEMDOS** system time.

OPCODE 44 (0x2C)

AVAILABILITY All **GEMDOS** versions.

BINDING

```
move.w      #$2C,-(sp)
trap        #1
addq.l      #2,sp
```

RETURN VALUE **Tgettime()** returns a bit array arranged as follows:

Bits 15-11	Bits 10-5	Bits 4-0
Hour (0-23)	Minute (0 to 59)	Secs/2 (0 to 29)

SEE ALSO **Tgetdate(), Tsettime(), Gettime()**

Tsetdate()

WORD Tsetdate(***date*** **)**
UWORD ***date*****;**

Tsetdate() sets the current **GEMDOS** date.

OPCODE 43 (0x2B)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *date* is a bit array arranged as illustrated under **Tgetdate()**.

BINDING

```
move.w      date,-(sp)
move.w      #$2B,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Tsetdate()** returns 0 if the operation was successful or non-zero if a bad date is given.

CAVEATS **GEMDOS** version 0.13 did not inform the **BIOS** of the date change and hence would not change the **IKBD** date or the date of a battery backed-up clock,

SEE ALSO **Tgetdate(), Tsettime(), Settime()**

Tsettime()

WORD Tsettime(*time*)
UWORD *time*;

Tsettime() sets the current **GEMDOS** time.

OPCODE 45 (0x2D)

AVAILABILITY All **GEMDOS** versions.

PARAMETERS *time* is a bit array arranged as illustrated under **Tgettime()**.

BINDING

```
move.w      time,-(sp)
move.w      #$2D,-(sp)
trap        #1
addq.l      #4,sp
```

RETURN VALUE **Tsettime()** returns 0 if the time was set or non-zero if the time given was invalid.

CAVEATS **GEMDOS** version 0.13 did not inform the **BIOS** of the date change and hence would not change the **IKBD** date or the date of a battery backed-up clock.

SEE ALSO **Tgettime(), Tsetdate(), Settime()**

– CHAPTER 3 –

BIOS

Overview

The Basic Input/Output System (**BIOS**) is responsible for the lowest level of communications between the operating system and hardware devices. This chapter will document the operating system functions of the **BIOS** and other system level operations.

System Startup

Upon a cold or warm boot[1], microprocessors in the 680x0 series load the initial supervisor stack pointer from the first longword in memory ($0) and begin execution at the PC found in the second longword ($4). The location this points to is the base initialization point for Atari computers.

Every Atari computer follows a predefined set of steps to accomplish system initialization. The following illustrates these steps leaving out some hardware initialization which is specific to the particular computer line (ST, TT, Falcon, etc.).

- The Interrupt Priority Level (IPL) is set to 7 and the OS switches to supervisor mode.
- A RESET instruction is executed to reset external hardware devices.
- The presence of a diagnostic cartridge is determined. If one is inserted, it is JMP'ed to with a return address in register A6.
- If running on a 68030, the CACR, VBR, TC, TT0, and TT1 registers are initialized.
- If a floating-point coprocessor is present it is initialized.
- If the *memvalid* ($420), *memval2* ($43A), and *memval3* ($51A) system variables are all valid, a warm boot is assumed and the memory controller is initialized with the value from *memcntrl* ($424).
- The initial color palette registers are loaded and the screen base is initialized to $100000.
- Memory is sized if it wasn't from a previous reset.
- Magic numbers are stored in low memory to indicate the successful sizing and initialization of memory.
- System variables and the cookie jar are initialized.
- The **BIOS** initialization point is executed.
- Installed cartridges of type 2 are executed.

[1] A cold boot occurs when the computer system experiences a total loss of power and no memory locations can be considered valid (this can be done artificially by zeroing memory, as is the case with the CTRL-ALT-RSHIFT-DELETE reset). A warm boot is a manual restart of the system which can be accomplished via software (like the CTRL-ALT-DELETE reset) or the external reset button found on some machines.

- The screen resolution is programmed.
- Installed cartridges of type 0 are executed.
- Interrupts are enabled by lowering the IPL to 3.
- Installed cartridges of type 1 are executed.
- The **GEMDOS** initialization point is executed.
- On systems running **TOS** 2.06 or **TOS** 3.06 and above, the Fuji logo is displayed and a memory test and hard disk spin-up sequence is executed.
- If at least one floppy drive is attached to the system, the first sector of the first floppy drive is loaded, and if executable, it is called.
- If at least one hard disk or other media is attached to the system, the first sector of each is loaded in succession until one with an executable sector is found or each has been tried.
- If a hard disk sector was found that was executable, it is executed.
- The text cursor is enabled.
- All "\AUTO*.PRG" files found on the boot disk are executed.
- If *_cmdload* ($482) is 0 then an environment string is created and the **AES** is launched, otherwise "\COMMAND.PRG" is loaded.
- If the **AES** ever terminates, the system is reset and system initialization begins again.

OS Header

The address of the start of operating system is stored in the system variable *_sysbase* ($4F2). The beginning of the operating system contains a table with contents as follows:

Offset (*_sysbase* + $x)	Size	Contents
$0	**WORD**	*os_entry*: BRA to reset hander (shadowed at $0).
$2	**WORD**	*os_version*: **TOS** version number. The high byte is the major revision number, and the low byte is the minor revision number.
$4	**LONG**	*reseth*: Pointer to the system reset handler.
$8	**LONG**	*os_beg*: Base address of the OS (same as *sysbase*).
$C	**LONG**	*os_end*: Address of the first byte of RAM not used by the operating system.
$10	**LONG**	*os_rsv1*: Reserved
$14	**LONG**	*os_magic*: Pointer to the **GEM** Memory Usage Parameter Block (**MUPB**). See below for more information.
$18	**LONG**	*os_date*: Date of system build ($YYYYMMDD).
$1C	**WORD**	*os_conf*: OS Configuration Bits. See below for more information.
$1E	**LONG**	*os_dosdate*: **GEMDOS** format date of system build.

$20	**LONG**	*p_root*: Pointer to a system variable containing the address of the **GEMDOS** memory pool structure. This entry is available as of **TOS** 1.2. The location pointed to by this value should never be modified by an application.
$24	**LONG**	*p_kbshift*: Pointer to a system variable which contains the address of the system keyboard shift state variable. See below for more information. This entry is available as of **TOS** 1.02. This location should never be modified by an application.
$28	**LONG**	*p_run*: Pointer to a system variable which contains the address of the currently executing **GEMDOS** process. See below for more information. This entry is available as of **TOS** 1.02. The information pointed to by this variable should never be modified by an application.
$2C	**LONG**	*p_rsv2*: Reserved

Some versions of AHDI (the Atari Hard Disk Interface) contain a bug which copies the system header to RAM and then corrupts some portions of it. The following 'C' structure definition defines the **OSHEADER** structure. The function GetROMSysbase() can be used to return an **OSHEADER** pointer to the code in ROM. GetROMSysbase() will execute properly in either user or supervisor mode.

```
typedef struct _osheader
{
       UWORD     os_entry;
       UWORD     os_version;
       VOID     *reseth;
       struct _osheader *os_beg;
       char     *os_end;
       char     *os_rsv1;
       char     *os_magic;
       LONG     os_date;
       UWORD    os_conf;
       UWORD    os_dosdate;

       /* Available as of TOS 1.02 */
       char     **p_root;
       char     **p_kbshift;
       char     **p_run;
       char     *p_rsv2;
} OSHEADER;

#define _sysbase        ((OSHEADER **)0x4F2)

OSHEADER *
GetROMSysbase( VOID )
{
       OSHEADER *osret;
       char *savesp = (Super(SUP_INQUIRE) ? NULL : Super(SUP_SET));

       osret = (*_sysbase)->os_beg;

       if( savesp )
           Super( savesp );

       return osret;
}
```

OS Configuration Bits

os_conf contains the country code and video sync mode that the operating system was compiled for. Bit #0 of this variable is 0 to indicate NTSC video mode or 1 to indicate PAL. The remaining bits, when shifted right by one bit, yield the country code as follows:

os_conf >> 1	Country
0	USA
1	Germany
2	France
3	United Kingdom
4	Spain
5	Italy
6	Sweden
7	Switzerland (French)
8	Switzerland (German)
9	Turkey
10	Finland
11	Norway
12	Denmark
13	Saudi Arabia
14	Holland
15	Czechoslovakia
16	Hungary
127	All countries are supported. As of **TOS** 4.0 the OS is compiled with text for all languages and switches between them based on the country code stored in non-volatile RAM. Use the '_AKP' cookie to determine the actual language in use.

GEM Memory Usage Parameter Block

The pointer at offset $14 in the OS header points to the **GEM** Memory Usage Parameter Block which is defined as follows:

```
typedef struct
{
        /* $87654321 if GEM present */
        LONG gem_magic;

        /* End address of OS RAM usage */
        LONG gem_end;

        /* Execution address of GEM */
        LONG gem_entry;
} MUPB;
```

GEM is only launched at system startup if *gem_magic* is $87654321. The **XBIOS** call **Puntaes()** also uses this information to restart the operating system after clearing **GEM** (only if disk-based). It verifies that *gem_magic* was valid and that **GEM** was in RAM, then it modifies *gem_magic* and restarts the operating system.

Keyboard Shift State Variable

The OS header entry *p_kbshift* provides a method of reading the state of the keyboard shift state variables more quickly than with **Kbshift()**. This header entry did not exist in **TOS** 1.0. The following code provides an acceptable method for accessing this variable in all **TOS** versions:

```
#define Kbstate    *p_kbshift

char *p_kbshift;

VOID
init_kbshift( VOID )
{
       /* See above for GetROMSysbase() definition. */
       OSHEADER *os = GetROMSysbase();

       if ( os->os_version == 0x0100)
          p_kbshift = (char *)0xE1BL;
       else
          p_kbshift = *(char **)os->p_kbshift;
}
```

Currently Running Process

The OS header entry *_p_run* is used to locate the address of the basepage of the currently running process. This entry has only existed as of **TOS** 1.02 and should never be modified. The following routine returns the address of the basepage of the currently running process in all versions of **TOS**:

```
#define SPAIN      4
typedef long PID

PID *
get_run()
{
       OSHEADER *os = GetROMSysbase();

       if(os->os_version < 0x0102)
       {
          if(( os->os_conf >> 1 ) == SPAIN)
               return (PID *)0x873C;
          else
               return (PID *)0x602C;
       }
       else
          return (PID *)(os->p_run);
}
```

The Cookie Jar

Overview

The 'Cookie Jar' is a structure in memory containing entries called 'cookies' which are placed in the 'jar' by the operating system or Terminate and Stay Resident (TSR) applications. Applications can test for the presence of a cookie to determine the presence of a hardware device or system feature.

The location of the cookie jar is determined by the address contained in the system variable *_p_cookies* ($5A0). If no cookie jar has been allocated yet, this entry will contain **NULL** (0).

Structure

The variable *_p_cookies* points to multiple **COOKIE** structures as defined below:

```
typedef struct
{
    LONG cookie;
    LONG value;
} COOKIE;
```

The structure member *cookie* contains a value that hopefully uniquely identifies the cookie. *cookie* values are 4-byte packed longword identifiers (often a 4 letter ASCII code word). Entries with the high byte equal to $5F, the underscore character, are reserved for use by Atari.

The structure member *value* may contain any value meaningful to an application or no value at all. In some cases a cookie won't have a meaningful value and its presence simply signals the existence of another process or system feature. TSR's often use *value* to store a pointer to an internal structure. The operating system uses cookies to signal the availability of hardware devices or system features.

The end of the cookie jar is signaled with a final entry with the value for *cookie* equaling **NULL**. The *value* entry for this final cookie contains the number of entries possible without reallocating the jar.

Searching for a Cookie

The following code may be used to find a cookie in the cookie jar. It returns 0 if an error occurred or 1 if successful. If *p_value* is non-**NULL** on entry, the address it points to will be filled in with the value of the cookie.

```
WORD
getcookie( target, p_value )
LONG target;
LONG *p_value;
{
      char *oldssp;
      COOKIE *cookie_ptr;

      oldssp = (Super(SUP_INQUIRE) ? NULL : Super(1L));
```

```
        cookie_ptr = *(COOKIE **)0x5A0;

        if(oldssp)
            Super( oldssp );

        if(cookie_ptr != NULL)
        {
            do
            {
                if(cookie_ptr->cookie == target)
                {
                    if(p_value != NULL)
                        *p_value = cookie_ptr->value;

                    return 1;
                }
            } while((cookie_ptr++)->cookie != 0L);
        }

        return 0;
}
```

Placing a Cookie

Only TSR programs should place cookies in the cookie jar. The cookie these programs place should either signal a function provided by the TSR or the presence of an expansion device. A CPX, desk accessory, or standard application should not place cookies in the jar.

To place a cookie, the TSR must first locate the current location of the cookie jar. It is possible that a cookie jar does not exist (*_p_cookies* == 0). In that case, a new jar should be allocated.

In most instances, the cookie jar should be allocated in increments of 8 slots (though it is not a requirement). In addition, if the process installs a new cookie jar in a **TOS** version lower than 1.06 it is also the processes responsibility to remove it upon a warm reset. Calling the following code after installing the cookie jar for the first time will ensure that the cookie jar pointer is properly reset on a warm boot.

```
RESMAGIC      equ     $31415926
_resvalid     equ     $426
_resvector        equ     $42A
_p_cookies        equ     $5A0

                  .globl  _unjar

_unjar:           move.l  _resvalid,valsave
                  move.l  _resvector,vecsave
                  move.l  #reshand,_resvector
                  move.l  #RESMAGIC,_resvalid
                  rts

reshand:          clr.l   _p_cookies
                  move.l  vecsave,_resvector
                  move.l  valsave,_resvalid
                  jmp     (a6)

                  .bss
```

```
vecsave:          .ds.l       1
valsave           .ds.l       1
```

After determining the location of the cookie jar, the application should search for the first empty slot in the jar by looking for a **NULL** in the *cookie* field of a slot. Next, the application must determine if this is the last slot in the jar by comparing the entry in the *value* field of the current cookie to the number of the actual slot you are comparing. For instance, if you have found **NULL** as the value for *cookie* in slot 16 and *value* is equal to 16, the jar is full and must be reallocated.

If the slot found is not the last one, the application can simply copy the current slot to the next slot and insert its own cookie.

If the jar must be reallocated, you should allocate enough memory to increase the size of the cookie jar, copy the old entries to the new jar, insert your entry as the last cookie in the jar, and finally terminate the jar with a cookie containing a **NULL** and the new number of slots you have allocated.

Though not mentioned previously, it is also advisable to ensure that your cookie isn't already in the jar before placing it to avoid two cookies for multiple executions of the same application to appear.

System Cookies

As of **TOS** 1.06, the operating system will place several cookies in the cookie jar to inform applications of certain operating system and hardware capabilities as follows:

<table>
<tr><th>cookie</th><th>value</th></tr>
<tr><td>_CPU</td><td>The low WORD of the CPU cookie contains a number representing the processor installed in the system as follows:
<table><tr><th>Value</th><th>Processor</th></tr><tr><td>0</td><td>68000</td></tr><tr><td>10</td><td>68010</td></tr><tr><td>20</td><td>68020</td></tr><tr><td>30</td><td>68030</td></tr></table></td></tr>
<tr><td>_VDO</td><td>This cookie represents the revision of the video shifter present. The low WORD represents the minor revision number and the high WORD represents the major revision number. Currently valid values are:
<table><tr><th>Major</th><th>Minor</th><th>Shifter</th></tr><tr><td>0</td><td>0</td><td>ST</td></tr><tr><td>1</td><td>0</td><td>STe</td></tr><tr><td>2</td><td>0</td><td>TT030</td></tr><tr><td>3</td><td>0</td><td>Falcon030</td></tr></table></td></tr>
</table>

_FPU

This cookie identifies the presence of floating-point math capabilities in the system. A non-zero low **WORD** indicates the presence of software floating point support (no specific values have yet been assigned). The high **WORD** indicates the type of coprocessor currently connected to the system as follows:

Value	Meaning
0	No FPU is installed.
1	SFP004
2	68881 or 68882
3	68881 or 68882 and SFP004
4	68881
5	68881 and SFP004
6	68882
7	68882 and SFP004
8	68040 Internal
9	68040 Internal and SFP004

_FDC

This cookie indicates the capability of the currently connected floppy drive. The lowest three bytes is a code indicating the origin of the unit ('ATC' is an Atari unit). The upper byte is a value indicating the highest density floppy present as follows:

Value	Density
0	360 Kb/ 720 Kb
1	1.44 Mb
2	2.88 Mb

_SND

This cookie contains a bitmap of sound features available to the system as follows:

Bit	Feature
0	GI Sound Chip (PSG)
1	Stereo 8-bit Playback
2	DMA Record (w/**XBIOS**)
3	16-bit CODEC
4	DSP

_MCH

This cookie indicates the machine type with the major revision number in the high **WORD** and the minor revision number in the low **WORD** as follows:

Major	Minor	Shifter
0	0	ST
1	0	STe
1	8	ST Book
1	16	Mega STe
2	0	TT030
3	0	Falcon030

_SWI

On machines that contain internal configuration dip switches, this value specifies their positions as a bitmap. Dip switches are generally used to indicate the presence of additional hardware which will be represented by other cookies.

_FRB

This cookie is present when alternative RAM is present. It points to a 64k buffer that may be used by DMA device drivers to transfer memory between alternative RAM and ST RAM for DMA operations.

_FLK

The presence of this cookie indicates that file and record locking extensions to **GEMDOS** exist. The *value* field is a version number currently undefined.

_NET

This cookie indicates the presence of networking software. The cookie value points to a structure which gives manufacturer and version information as follows:

```
struct netinfo
{
       LONG publisher;
       LONG version;
};
```

_IDT

This cookie defines the currently configured date and time format, Bits #0-7 contain the ASCII code of the date separator. Bits #8-11 contain a value indicating the date display format as follows:

Value	Meaning
0	MM-DD-YY
1	DD-MM-YY
2	YY-MM-DD
3	YY-DD-MM

Bits #12-15 contain a value indicating the time format as follows:

Value	Meaning
0	12 hour
1	24 hour

Note: The value of this cookie does not affect any of the internal time functions. It is intended for informational use by applications only.

_AKP

This cookie indicates the presence of an Advanced Keyboard Processor. The high word of this cookie is currently reserved. The low word indicates the language currently used by **TOS** for keyboard interpretation and alerts. See the explanation for the country code in the OS header earlier in this chapter for valid values.

If this cookie is present on TOS 5.0 and higher then the system supports soft-loaded keyboard tables.

FSMC

This cookie indicates the presence of **FSM** or **SpeedoGDOS**. Its *value* field is a pointer to a structure as follows:

```
typedef struct
{
    LONG    gdos_type;
    UWORD   version;
    WORD    quality;
} GDOS_INFO;
```

The *gdos_type* field determines the variety of **GDOS**. '**_FSM**' represents Imagen font-based **FSM** whereas '**_SPD**' represents Bitstream font-based **FSM**. *version* specifies the current GDOS version.

quality determines the output quality of **v_updwk()**. The default setting is **QUAL_DEFAULT** (0xFFFF) which causes the driver to use the setting last set in the driver configuration accessory or CPX. This default setting may be overridden by placing a value of **QUAL_DRAFT** (0x0000) or **QUAL_FINAL** (0x0001) at this location. The quality setting should be restored to **QUAL_DEFAULT** at the end of each print job.

SAM\0	This cookie indicates the presence of System Audio Manager and the **XBIOS** extensions it provides. The *value* field is currently reserved for internal use.
MiNT	This cookie indicates the presence of **MiNT** (**MultiTOS**) and its *value* field is the current version number (ex: **MiNT** 1.02 has a *value* field of 0x00000102).

BIOS Devices

The **BIOS** provides access to six default devices (numbered 0–5). In addition, **TOS** 2.00 provides the ability to add extra devices with the **XBIOS Bconmap()** function (see the **XBIOS** overview for more information). Device assignments higher than device five are dependent upon the machine and any third-party enhancements. The following list indicates the device assignments which remain constant:

Name	Device Number	GEMDOS Filename	Meaning
DEV_PRINTER	0	PRN:	Centronics Parallel Port
DEV_AUX	1	AUX:	Default Serial Device (this device number could actually refer to any serial device connected to the system depending on which was mapped with **Bconmap()**)
DEV_CON	2	CON:	Console (screen device)
DEV_MIDI	3	N/A	MIDI Ports
DEV_IKBD	4	N/A	Intelligent Keyboard Controller
DEV_RAW	5	N/A	Console (no interpretation)

The Console Device

Two methods are provided for outputting characters to the screen. Output via **BIOS** device #2 subjects character codes to interpretation. Codes such as a carriage return (ASCII 13), line feed (ASCII 10), TAB (ASCII 9), CTRL-G (ASCII 7), and ESCAPE (ASCII 27) are interpreted as special cases and handled specially.

Output via **BIOS** device #5 causes all characters to be output literally to the screen without interpretation.

The VT-52 Emulator

The Atari console device contains emulation code compatible with the VT-52 standard. Special escapes may be used to manipulate the cursor and create text effects.

To send an escape sequence, one of the following codes (and possibly additional characters) must be sent following the ESCAPE character (ASCII 27):

Escape	Code	Effect
A	65	Move the cursor up one line. If the cursor is on the top line this does nothing.
B	66	Move the cursor down one line. If the cursor is on the bottom line this does nothing.

C	67	Move the cursor right one line. If the cursor is on the far right of the screen this does nothing.
D	68	Move the cursor left one line. If the cursor is on the far left of the screen this does nothing.
E	69	Clear the screen and place the cursor at the upper-left corner.
H	72	Move the cursor to the upper-left corner of the screen.
I	73	Move the cursor up one line. If the cursor is on the top line, the screen scrolls down one line.
J	74	Erase the screen downwards from the current position of the cursor.
K	75	Clear the current line to the right from the cursor position.
L	76	Insert a line by scrolling all lines at the cursor position down one line.
M	77	Delete the current line and scroll lines below the cursor position up one line.
Y	89	Position the cursor at the coordinates given by the following two codes. The screen starts with coordinates (32, 32) at the upper-left of the screen. Coordinates should be presented in reverse order, Y and then X.
b	98	This code is followed by a character from which the lowest four bits determine a new text foreground color.
c	99	This code is followed by a character from which the lowest four bits determine a new text background color.
d	100	Erase the screen from the upper-left to the current cursor position.
e	101	Enable the cursor.
f	102	Disable the cursor.
j	106	Save the current cursor position. (Only implemented as of **TOS** 1.02)
k	107	Restore the current cursor position. (Only implemented as of **TOS** 1.02)
l	108	Erase the current line and place the cursor at the far left.
o	111	Erase the current line from the far left to the current cursor position.
p	112	Enable inverse video.
q	113	Disable inverse video.
v	118	Enable line wrap.
w	119	Disable line wrap.

Media Change

The **BIOS** function **Mediach()** returns the current media-change status of the drive specified. This state is used to determine if a disk has been changed in removable media drives (floppies, removable hard drives, etc.

The **Getbpb()** incorrectly resets the media change state. Failure to properly reset this state after calling **Getbpb()** can cause data loss. The function **_mediach()**, shown below, forces the **Mediach()** function to return a 'definitely changed' state and should always be called after calling **Getbpb()** on removable media drives.

```
/*
 * _mediach(): force the media 'changed' state on a removable drive.
 *
 * Usage: errcode = _mediach( devno )      - returns 1 if an error occurs
 *
 * Inputs: devno - (0 = 'A:', 1 = 'B:', etc...)
 *
```

```
 */

            .globl   _mediach

_mediach:
            move.w   4(sp),d0
            move.w   d0,mydev
            add.b    #'A',d0
            move.b   d0,fspec     ; Set drive spec for search
loop:
            clr.l    -(sp)        ; Get supervisor mode, leave old SSP
            move.w   #$20,-(sp)   ; and "Super" function code on stack.
            trap     #1
            addq.l   #6,sp
            move.l   d0,-(sp)
            move.w   #$20,-(sp)

            move.l   $472,oldgetbpb
            move.l   $47e,oldmediach
            move.l   $476,oldrwabs

            move.l   #newgetbpb,$472
            move.l   #newmediach,$47e
            move.l   #newrwabs,$476

            ; Fopen a file on that drive
            move.w   #0,-(sp)
            move.l   #fspec,-(sp)
            move.w   #$3d,-(sp)
            trap     #1
            addq.l   #8,sp

            ; Fclose the handle
            tst.l    d0
            bmi.s    noclose

            move.w   d0,-(sp)
            move.w   #$3e,-(sp)
            trap     #1
            addq.l   #4,sp

noclose:
            moveq    #0,d7
            cmp.l    #newgetbpb,$472      ; still installed?
            bne.s    done

            move.l   oldgetbpb,$472       ; Error, restore vectors.
            move.l   oldmediach,$47e
            move.l   oldrwabs,$476

            trap     #1                   ; go back to user mode
            addq.l   #6,sp                ; restore sp

            moveq.l  #1,d0                ; 1 = Error
            rts
done:
            trap     #1                   ; go back to user mode
            addq.l   #6,sp                ; from stack left above

            clr.l    d0                   ; No Error
```

```
            rts

/*
 * New Getbpb()...if it's the target device, uninstall vectors.
 * In any case, call normal Getbpb().
 */

newgetbpb:
            move.w   mydev,d0
            cmp.w    4(sp),d0
            bne.s    dooldg

            move.l   oldgetbpb,$472   ; Got target device so uninstall.
            move.l   oldmediach,$47e
            move.l   oldrwabs,$476
dooldg:     move.l   oldgetbpb,a0     ; Go to real Getbpb()
            jmp      (a0)

/*
 * New Mediach()...if it's the target device, return 2. Else call old.
 */

newmediach:
            move.w   mydev,d0
            cmp.w    4(sp),d0
            bne.s    dooldm
            moveq.l  #2,d0            ; Target device, return 2

            rts

dooldm:
            move.l   oldmediach,a0        ; Call old
            jmp      (a0)

/*
 * New Rwabs()...if it's the target device, return E_CHG (-14)
 */

newrwabs:
            move.w   mydev,d0
            cmp.w    4(sp),d0
            bne.s    dooldr
            moveq.l  #-14,d0
            rts

dooldr:
            move.l   oldrwabs,a0
            jmp      (a0)

            .data

fspec:      dc.b     "X:\\X",0
mydev:      ds.w     1
oldgetbpb:  ds.l     1
oldmediach: ds.l     1
oldrwabs:   ds.l     1

            .end
```

BIOS Vectors

Reset Vector

Shortly after a warm boot the OS will jump to the address contained in the system variable *resvector* ($42A) if the value in the system variable *resvalid* ($426) contains the magic number $31415926. The OS will supply a return address to this code segment in register A6 but the subroutine must not utilize the stack as neither stack pointer will be valid.

If your process needs to do cleanup in the event of a warm reset (see “Placing a Cookie” earlier in this chapter) the following code installs a user routine to accomplish this.

```
_resvalid     equ      $426
_resvector        equ      $42A
RESMAGIC      equ      $31415926

              .text

installres:
              move.l   _resvalid,oldvalid
              move.l   _resvector,oldvector
              move.l   #myresvec,_resvector
              move.l   #RESMAGIC,_resvalid
              rts
myresvec:
              *
              * Insert user code here
              *
              move.l   oldvector,_resvector
              move.l   oldvalid,_resvalid
              jmp      (a6)

              .bss

oldvector:        ds.l     1
oldvalid:     ds.l     1

              .end
```

System Bell Vector

As of **TOS** 1.06, the OS jumps through the address contained in the system variable *bell_hook* ($5AC) to ring the system bell. It is possible for a custom routine to hook into this vector to alter the bell sound. The user routine may modify registers D0-D2/A0-A2 and may chain to the old bell handler if desired. It is also safe to make **BIOS** and **XBIOS** calls following the procedure for calling from an interrupt (when not running under **MultiTOS**). The routine should either jump to the old handler or execute an RTS statement.

System Keyclick Vector

Similar to the system bell vector, another vector is called each time a keyclick sound is generated. This vector is stored in system variable *kcl_hook* ($5B0) and is entered with the keycode (not the ASCII code) of the key struck in the low byte of D0. Registers D1-D2/A0-A2 may be modified, however, all other registers including D0 must be maintained. The replacement handler may either chain to a new handler or RTS.

Deferred Vertical Blank Handlers

Applications may install custom routines which are called during every vertical blank (approx. 50-72 times per second). The OS performs several operations during the vertical blank as follows:

- The system variable *_frclock* is incremented.
- The system variable *vblsem* is tested. If 0, the vertical blank handler exits immediately.
- All registers are saved.
- The system variable *_vbclock* is incremented.
- If the system is currently in a high resolution video mode and a low-resolution monitor is detected, the video resolution is adjusted and the vector found at system variable *swv_vec* is called.
- The text cursor blink routine is called.
- If a new palette has been selected since the last vertical blank, it is loaded.
- If a new screen base address has been selected since the last vertical blank, it is selected.
- Each of the “deferred” vertical blank routine handlers is called.
- If the system variable *prt_cnt* is greater than -1, the vector at system variable *scr_dump* is called.
- Saved registers are restored and processing continues.

To install a routine to be called as a “deferred” vertical blank handler, you must inspect the list of handler vectors at *vblqueue* for a **NULL** slot, replace it with your vector and initialize the next slot to **NULL**. The system variable *nvbls* indicates the number of slots pointed to by

vblqueue. If the vertical blank handler list is filled, you may allocate a new area, copy the old list of handlers with your handler, and update the pointer *vblqueue* and *nvbls*.

The XBRA Protocol

Many applications that add functionality to the system do so by 'hooking' themselves into one or more interrupt or pass-through vectors (usually with **Setexc()**). Most vector handlers work by executing the relevant code when the interrupt is called and then calling the original vector handler. When several applications handle one vector, a vector 'chain' is created. This chain makes it difficult for debuggers or the process itself to 'unhook' itself from the chain.

The XBRA protocol was designed so that processes that wish to be able to unhook themselves may and so that debuggers can trace the 'chain' of vector handlers. Following the protocal is simple. Prior to the first instruction of the vector handler, insert three longwords into the application as follows:

- The longword 'XBRA' 0x58425241.
- Another longword containing the application 'cookie' ID (this is the same as that put into the cookie jar if applicable).
- A longword into which should be placed the address of the original handler.

The following code example shows how to correctly use the XBRA protocol in a routine designed to supplement the 680x0 TRAP #1 vector (**GEMDOS**):

```
instl_trap1:
             move.l       #my_trap1,-(sp)
             move.w       #VEC_GEMDOS,-(sp)
             move.w       #Setexc,-(sp)
             trap         #13
             addq.l       #8,sp
             move.l       d0,old_handler
             rts

             DC.L         'XBRA'
             DC.L         'SDS1'   ; Put your cookie here
old_handler  DC.L         0

my_trap1:
             movem.l      d2-d7/a2-a6,-(sp)

             ;
             ; Your TRAP #1 handler goes here.
             ;

             movem.l      (sp)+,d2-d7/a2-a6
             move.l       old_handler,-(sp)     ; Fake a
       return
             rts                                ; to old code.
```

The following ‘C’ function is an example of how to use the XBRA protocol to unhook a vector handler from the XBRA chain. This function will only work if all installed vector handlers follow the XBRA protocol. It takes a **Setexc()** vector number and an XBRA application id cookie as a parameter. It returns the address of the routine that was unhooked or 0L if unsuccessful.

```
typedef struct xbra
{
       LONG    xbra_id;
       LONG    app_id;
       VOID    (*oldvec)();
} XBRA;

LONG
unhook_xbra( WORD vecnum, LONG app_id )
{
       XBRA *rx;
       LONG vecadr, *stepadr, lret = 0L;
       char *savessp;

       vecadr = Setexc( vecnum, VEC_INQUIRE );
       rx = (XBRA *)(vecadr - sizeof( XBRA ));

       /* Set supervisor mode for search just in case. */
       savessp = Super( SUP_SET );

       /* Special Case: Vector to remove is first in chain. */
       if( rx->xbra_id == ‘XBRA’ && rx->app_id == app_id )
       {
          Setexc( vecnum, rx->oldvec );
          return vecadr;
       }

       stepadr = (LONG *)&rx->oldvec;
       rx = (XBRA *)((LONG)rx->oldvec - sizeof( XBRA ));
       while( rx->xbra_id == ‘XBRA’ )
       {
          if( rx->app_id == app_id )
          {
              *stepadr = lret = (LONG)rx->oldvec;
              break;
          }

          stepadr = (LONG *)&rx->oldvec;
          rx = (XBRA *)((LONG)rx->oldvec - sizeof( XBRA ));
       }

       Super( savessp );
       return lret;
}
```

BIOS Function Calling Procedure

BIOS system functions are called via the TRAP #13 exception. Function arguments are pushed onto the current stack (user or supervisor) in reverse order followed by the function opcode. The calling application is responsible for correctly resetting the stack pointer after the call.

The **BIOS** may utilize registers D0-D2 and A0-A2 as scratch registers and their contents should not be depended upon at the completion of a call. In addition, the function opcode placed on the stack will be modified.

The following example for **Bconout()** illustrates calling the **BIOS** from assembly language:

```
move.w      #char,-(sp)
move.w      #dev,-(sp)
move.w      #$03,-(sp)
trap        #13
addq.l      #6,sp
```

A 'C' binding for a generic **BIOS** handler would be as follows:

```
_bios:
       ; Save the return code from the stack
       move.l  (sp)+,trp13ret
       trap    #13
       move.l  trp13ret,-(sp)
       rts

       .bss
trp13ret:
       .ds.l       1
```

With the above code, you could easily design a 'C' macro to add **BIOS** calls to your compiler as in the following example for **Bconout()**:

```
#define Bconout( a )   bios( 0x02, a )
```

The **BIOS** is re-entrant to three levels, however there is no error checking performed so interrupt handlers should avoid intense **BIOS** usage. In addition, no disk or printer usage should be attempted from the system timer interrupt, critical error, or process-terminate handlers.

Calling the BIOS from an Interrupt

The **BIOS** and **XBIOS** are the *only* two OS sub-systems which can be called from an interrupt handler. Precisely *one* interrupt handler at a time may use the **BIOS** as shown in the following code segment:

```
savptr          equ     $4A2
savamt          equ     $23*2

myhandler:
                sub.l   #savamt,savptr
```

```
; BIOS calls may be performed here
add.l    #savamt,savptr
rte      ; (or rts?)
```

This method is not valid under **MultiTOS**.

BIOS Function Reference

Bconin()

LONG Bconin(***dev*** **)**
WORD ***dev*****;**

Bconin() retrieves a character (if one is waiting) from the specified device.

OPCODE 2 (0x02)

AVAILABILITY All **TOS** versions.

PARAMETERS *dev* specifies the device to read from as follows:

Name	*dev*	Device
DEV_PRINTER	0	Parallel port
DEV_AUX	1	Auxillary device (normally the RS-232 port, however, **TOS** versions with **Bconmap()** can map in other devices to this handle)
DEV_CONSOLE	2	Console device (keyboard)
DEV_MIDI	3	MIDI Port
DEV_IKBD	4	IKBD Controller (not available as an input device)
DEV_RAW	5	Console device (keyboard)
See Overview	6 –	Additional devices (as available)

BINDING

```
move.w      dev,-(sp)
move.w      #$02,-(sp)
trap        #13
addq.l      #4,sp
```

RETURN VALUE **Bconin()** returns a bit array arranged as follows:

Bits 31-24	Bits 23-16	Bits 15-8	Bits 7-0
Shift key status (see **Kbshift()**)	Keyboard Scan Code	Reserved (0)	ASCII value

COMMENTS The shift key status is only returned if the system variable *conterm* (char *(0x484)) has bit 3 set. This is normally disabled.

Non-ASCII keys return 0 in bits 7-0.

SEE ALSO **Bconstat(), Cconin(), Cauxin()**

Bconout()

LONG Bconout(*dev, ch*)
WORD *dev, ch*;

Bconout() outputs a character to a named device.

OPCODE 3 (0x03)

AVAILABILITY All **TOS** versions.

PARAMETERS *dev* specifies the output device as follows:

Name	*dev*	Device
DEV_PRINTER	0	Parallel port
DEV_AUX	1	Auxillary device (see note under **Bconin()**)
DEV_CONSOLE	2	Console device (screen)
DEV_MIDI	3	MIDI port
DEV_IKBD	4	Keyboard (IKBD)
DEV_RAW	5	Raw screen device (control characters and escapes are not processed)
See Overview	6 –	Additional devices (as available)

BINDING

```
move.w      ch,-(sp)
move.w      dev,-(sp)
move.w      #$03,-(sp)
trap        #13
addq.l      #6,sp
```

RETURN VALUE **Bconout()** returns 0 if the character was sent successfully or non-zero otherwise.

SEE ALSO **Bconin(), Cconout(), Cauxout(), Cprnout(), Bcostat()**

Bconstat()

LONG Bconstat(*dev*)
WORD *dev*;

Bconstat() determines whether the specified device is prepared to transmit at least one character.

OPCODE 1 (0x01)

AVAILABILITY All **TOS** versions.

PARAMETERS *dev* specifies the device to check as listed under **Bconin**().

BINDING

```
move.w      dev,-(sp)
move.w      #$01,-(sp)
trap        #13
addq.l      #4,sp
```

RETURN VALUE **Bconstat()** returns 0 if no characters are waiting or -1 if characters are waiting to be received.

SEE ALSO **Bconin(), Cconis(), Cauxis()**

Bcostat()

LONG Bcostat(***dev*** **)**
WORD *dev*;

Bcostat() determines if the specified device is prepared to receive a character.

OPCODE 8 (0x08)

AVAILABILITY All **TOS** versions.

PARAMETERS *dev* specifies the device to poll as listed under **Bconout()**.

BINDING

```
move.w      dev,-(sp)
move.w      #$08,-(sp)
trap        #13
addq.l      #4,sp
```

RETURN VALUE **Bcostat()** returns 0 if the device is not ready to receive characters or -1 otherwise.

CAVEATS A bug in **TOS** 1.0 existed that caused the IKBD and MIDI device numbers to become swapped when being handled by the **Bcostat()** call, subsequently returning data for the wrong device. To allow previously written programs to continue operating correctly, this bug has been maintained on purpose in all current versions of **TOS**. You should therefore specify a value of 3 for the IKBD and 4 for MIDI for this call only.

SEE ALSO **Bconout(), Cauxos(), Cconos(), Cprnos()**

Drvmap()

ULONG Drvmap(VOID)

Drvmap() returns a list of mounted drives.

OPCODE 10 (0x0A)

AVAILABILITY All **TOS** versions.

PARAMETERS None.

BINDING

```
move.w      #$0A,-(sp)
trap        #13
addq.l      #2,sp
```

RETURN VALUE **Drvmap()** returns a **ULONG** bitmap of mounted drives. For each drive present, its bit is enabled. Drive 'A:' is bit 0, drive 'B:' is bit 1, and so on.

COMMENTS Single floppy systems will indicate that two drives are available since both drives can actually be addressed. A request for drive 'B:' will simply cause **TOS** to ask the user to insert 'Disk B' and provide automatic handling routines for all disk swapping.

SEE ALSO **Dsetdrv()**

Getbpb()

BPB *Getbpb(*dev*)
WORD *dev*;

Getbpb() returns the address of the current **BPB** (Bios Parameter Block) for a mounted device.

OPCODE 7 (0x07)

AVAILABILITY All **TOS** versions.

PARAMETERS *dev* specifies the mounted device ('A:' = 0, 'B:' = 1) .

BINDING

```
move.w      dev,-(sp)
move.w      #$07,-(sp)
trap        #13
addq.l      #4,sp
```

RETURN VALUE **Getbpb()** returns a pointer to the device's **BPB**. The **BPB** is defined as follows:

```
typedef struct
{
       WORD recsiz;  /* bytes per sector */
       WORD clsiz;   /* sectors per cluster */
       WORD clsizb;  /* bytes per cluster */
       WORD rdlen;   /* sector length of root directory */
       WORD fsiz;        /* sectors per FAT */
       WORD fatrec;  /* starting sector of second FAT */
       WORD datrec;  /* starting sector of data */
       WORD numcl;   /* clusters per disk */
       WORD bflags;  /* bit 0=1 - 16 bit FAT, else 12 bit */
} BPB;
```

CAVEATS A media change *must* be forced after calling this function prior to making any **GEMDOS** calls. Failure to do so may cause **GEMDOS** to become unaware of a disk change causing data loss. Refer to the discussion of forcing a media change earlier in this chapter.

Getmpb()

VOID Getmpb(*mpb*)

Getmpb() returns information regarding **GEMDOS** free and allocated memory blocks.

OPCODE 0 (0x00)

AVAILABILITY All **TOS** versions.

PARAMETERS *mpb* is a pointer to a **MPB** structure which is filled in by the function. The related structures are defined as follows:

```
typedef struct md
{
       struct md *m_link;     /* pointer to next block */
       VOIDP m_start;         /* pointer to start of block */
       LONG m_length;         /* length of block */
       BASEPAGE *m_own;       /* pointer to basepage of owner */
} MD;

typedef struct mpb
{
       MD *mp_mfl;            /* free list */
       MD *mp_mal;            /* allocated list */
       MD *mp_rover;          /* roving pointer */
} MPB;
```

BINDING

```
pea         mpb
clr.w       -(sp)
trap        #13
addq.l      #6,sp
```

CAVEATS **MultiTOS** uses a very different method of memory management which makes this call useless.

COMMENTS An application should *never* attempt to modify any of the returned information nor make any assumptions about memory allocation because of this function.

SEE ALSO **Malloc(), Mfree()**

Kbshift()

LONG Kbshift(*mode*)
WORD *mode*;

Kbshift() allows the user to interrogate or modify the state of the keyboard 'special' keys.

OPCODE 11 (0x0B)

AVAILABILITY All **TOS** versions.

PARAMETERS *mode* is -1 to read the state of the keys or a mask of the following values to change the current state:

Name	Mask	Meaning
K_RSHIFT	0x01	Right shift key depressed
K_LSHIFT	0x02	Left shift key depressed
K_CTRL	0x04	Control key depressed
K_ALT	0x08	Alternate key depressed
K_CAPSLOCK	0x10	Caps-lock engaged
K_CLRHOME	0x20	Clr/Home key depressed
K_INSERT	0x40	Insert key depressed

BINDING

```
move.w      mode,-(sp)
move.w      #$0B,-(sp)
trap        #13
addq.l      #4,sp
```

RETURN VALUE **Kbshift()** returns the state that the keyboard 'special' keys were in prior to the call.

COMMENTS **Kbshift()** is not a particularly fast call. If you are only interested in reading the state a documented macro follows that replaces **Kbshift()** and is much faster. Call the kb_init() function, as shown below, before using:

```
char *p_kbshift;
#define Kbstate()     *p_kbshift

VOID
kb_init(VOID)
{
       /* GetROMSysbase is defined in the BIOS Overview */
       OSHEADER *osheader = GetROMSysbase();

       if ( osheader->os_version == 0x0100 )
             p_kbshift = (char *)0xe1bL;
       else
             p_kbshift = *(char **)osheader->p_kbshift;
}
```

SEE ALSO **evnt_keybd(), evnt_multi(), Cconin(), Bconin()**

Mediach()

LONG Mediach(***dev*** **)**
WORD ***dev*****;**

Mediach() inquires as to whether the 'media' has been changed since the last disk operation on a removable block device (floppy, removable hard drive, floptical, etc...).

OPCODE 9 (0x09)

AVAILABILITY All **TOS** versions.

PARAMETERS *dev* specifies the mounted device number to inquire ('A:' = 0, 'B:' = 1, etc.).

BINDING

```
move.w       dev,-(sp)
move.w       #$09,-(sp)
trap         #13
addq.l       #4,sp
```

RETURN VALUE **Mediach()** returns one of three values:

Name	Value	Meaning
MED_NOCHANGE	0	Media has not changed
MED_UNKNOWN	1	Media may have changed
MED_CHANGED	2	Media has changed

SEE ALSO **Getbpb()**

Rwabs()

LONG Rwabs(***mode, buf, count, recno, dev, lrecno*** **)**
WORD ***mode*****;**
VOIDP ***buf*****;**
WORD ***count,recno,dev*****;**
LONG ***lrecno*****;**

Rwabs() reads and writes sectors to a mounted device.

OPCODE 4 (0x04)

AVAILABILITY All **TOS** versions. Hard disk access requires the use of a hard disk driver (such as **AHDI**). The long sector offset version is only available as of **AHDI** 3.0. **AHDI** version numbers can be inquired through system variable *pun_ptr* (see discussion earlier in this chapter).

PARAMETERS *mode* is a bit mask which effects the operation to be performed as follows:

Name	Bit	Meaning
RW_READ or **RW_WRITE**	0	0 = Read, 1 = Write
RW_NOMEDIACH	1	Do not read or modify the media change status.
RW_NORETRIES	2	Disable retries
RW_NOTRANSLATE	3	Do not translate logical sectors into physical sectors (*recno* specifies physical instead of logical sectors)

The read or write operation is performed at address *buf*. *buf* must be *count* * bytes per logical sector in logical mode or *count* * 512 bytes in physical mode. *count* specifies how many sectors will be transferred.

dev specifies the index of the mounted device. In logical mode, 'C:' is 2, 'D:' is 3, etc... In physical mode, devices 2-9 are the ACSI devices and 10-17 are SCSI devices.

recno specifies the first sector to read from. If you need to specify a long offset, set *recno* to -1 and pass the long value in *lrecno*. When using a version of the **AHDI** below 3.0, the parameter *lrecno* should not be passed.

BINDING

```
/* If running AHDI <3.0 omit first parameter */
```

```
move.l      lrecno,-(sp)
move.w      dev,-(sp)
move.w      recno,-(sp)
move.w      count,-(sp)
pea         buf,-(sp)
move.w      mode,-(sp)
move.w      #$04,-(sp)
trap        #13
lea         18(sp),sp
```

RETURN VALUE **Rwabs()** returns **E_OK** (0) if successful or a negative **BIOS** error code otherwise.

COMMENTS Some C compilers (Lattice C in particular) have a secondary binding called **Lrwabs()** used to pass the additional parameter.

This function may invoke the critical error handler (*etv_critic*).

Setexc()

(VOIDP)() Setexc(*num*, *newvec*)
WORD *num*;
VOID (newvec*)();**

Setexc() reads or modifies system exception vectors.

OPCODE 5 (0x05)

AVAILABILITY All **TOS** versions.

PARAMETERS *num* indicates the vector number you are interested in. To obtain the vector number divide the address of the vector by 4. Some common vectors are:

Name	*num*	Vector
VEC_BUSERROR **VEC_ADDRESSERROR** **VEC_ILLEGALINSTRUCTION**	0x02 - 0x04	Bomb errors (Bus, Address, Instruction)
VEC_GEMDOS	0x21	Trap #1 (**GEMDOS**)
VEC_GEM	0x22	Trap #2 (**AES/VDI**)
VEC_BIOS	0x2D	Trap #13 (**BIOS**)
VEC_XBIOS	0x2E	Trap #14 (**XBIOS**)
VEC_TIMER	0x100	System timer (*etv_timer*)
VEC_CRITICALERROR	0x101	Critical error handler (*etv_critic*)
VEC_TERMINATE	0x102	Process terminate handle (*etv_term*)

newvec should be the address of your new vector handler. Passing a value of

VEC_INQUIRE ((VOIDP)-1) will not modify the vector.

BINDING

```
pea         newvec
move.w      num,-(sp)
move.w      #$05,-(sp)
trap        #13
addq.l      #8,sp
```

RETURN VALUE The original value of the vector is returned by the call.

COMMENTS You must reinstate old vector handlers you changed prior to your process exiting.

Programs which modify replace system vector code should install themselves following the conventions of the XBRA protocol. For details, consult the overview portion of this chapter.

Tickcal()

LONG Tickcal(VOID)

Tickcal() returns the system timer calibration.

OPCODE 6 (0x06)

AVAILABILITY All **TOS** versions.

PARAMETERS None.

BINDING

```
move.w      #$06,-(sp)
trap        #13
addq.l      #2,sp
```

RETURN VALUE **Tickcal()** returns a **LONG** indicating the number of milliseconds between system clock ticks.

– CHAPTER 4 –

XBIOS

Overview

The e**X**tended **B**asic **I**nput/**O**utput **S**ystem (**XBIOS**) is a software sub-system of **TOS** which contains functions used to interact with and control Atari computer hardware. The availability of many of these functions is dependent on hardware whose presence can be determined by the current **TOS** version or by interrogating the system 'cookie jar' (see *Chapter 3:* ***BIOS*** for more details).

Some functions (notably video hardware and storage device related functions) should only be used by device drivers and system level software as they represent a non-portable method of hardware interaction which may be unsupported in future Atari computers.

As a general rule, **GEMDOS** and **VDI** functions should be used, when possible, rather than **XBIOS** calls. The **GEMDOS** and **VDI** provide a software abstraction layer which will make software applications much more compatible across new computer releases.

Video Control

The video capabilities of Atari computer systems have varied greatly since their introduction. Applications which use the **VDI** for their video displays will require little if any modifications to run on new systems. The **XBIOS** is mostly required for device drivers and other applications which require more direct control over the video hardware. When present, the '_VDO' entry in the system cookie jar will reveal information about the video hardware present.

The Physical/Logical Screen

Two separate video display pointers are maintained by the **XBIOS** at any time. The physical screen address points to the memory location that the video shifter uses to update the display. This memory must *not* be in fast RAM and must be **WORD**-aligned (original ST computers expect screen memory to be aligned to a 256-byte boundary).

A second video memory pointer points to the 'logical' screen. This memory area is used by the **VDI** to output graphics. Normally, the physical screen address is equal to the logical screen address meaning that **VDI** output is shown immediately on screen. Software (most commonly games) can allocate an additional memory block and use these two pointers to page-flip for smooth animations.

Physbase() and **Logbase()** return these two addresses. **Setscreen()** can be used to reset these addresses and change screen modes. As of **TOS** 4.0, **Setscreen()** reinitializes the **VDI** screen driver (you must still call **vq_extnd()** to update your workstations) but will *not* reinitialize the **AES**. This means that if you change resolution using **Setscreen()**, do not use the **AES** until the screen is restored to its original resolution. On **TOS** versions prior to 4.0, you should not use any **GEM** calls while the screen mode is altered.

The Falcon030 function **VgetSize()** is a utility function that will return the number of bytes that must be allocated for the specified video mode. When not running on a Falcon030, you will have to calculate this yourself.

Setting/Determining Screen Resolution

Getrez() was *originally* a safe method for determining the current video hardware configuration. As new video modes became available, though, **Getrez()** became less and less useful. Currently, **Getrez()** should be used for *only* one purpose. The formula **Getrez()** + 2 should be used to select the **VDI** physical device ID for the screen so that the proper screen fonts can be selected. See the description of **v_opnvwk()** for more details.

In order to provide true screen independence, you should use the values returned by the **VDI** call **v_opnvwk()** to determining the screen resolution your application is using. The **XBIOS** provides calls that will determine the current video mode but they are hardware dependent and will probably stop working as expected as new video hardware is released.

The **Getrez()** call can reliably determine the video mode of an ST, STe or Mega ST/e. Three calls have since been added to determine the video mode of the TT030 and Falcon030 computers.

EgetShift() and **EsetShift()** can be used to interrogate and set the TT030 video mode. **VsetMode()** can similarly be used to interrogate and set the Falcon030 video mode. The Falcon030 call **VgetMonitor()** can be used to determine the type of attached monitor and, therefore, the available video modes.

TT030 **TOS** also provides the calls **EsetGray()** and **EsetSmear()**. Together, these calls duplicate some of the functionally contained in **EsetShift()** but can be used individually as desired to configure the special gray-scale and smear modes present in the TT030.

EsetShift() and **VsetMode()** are designed to change the video modes of the TT030 and Falcon030 respectively, however, they do not reinitialize the **AES** or **VDI**. It is also possible to change TT030 and Falcon030 video modes using **Setscreen()**. TT030 modes are set by supplying the appropriate resolution code (see **Getrez()** for a list of resolution codes). Falcon030 modes are set by adding an extra parameter to the call with a special resolution code of 3. See the explanation for **Setscreen()** later in this chapter for details.

Manipulating the Palette

Prior to the introduction of the TT, **Setcolor()** and **Setpalette()** were used to set the 16 available palette entries. **Setpalette()** sets the entire palette at once whereas **Setcolor()** sets colors at an individual level and can also be used to interrogate palette entries.

The ST has 16 palette entries, each supporting any of 512 available colors. The ST specifies color in components of red, green, and blue. Intensity settings of 0–7 are valid for each color component. The following list contains the red, green, and blue values for the ST's default 16 color palette.

Index	Color	Red	Green	Blue
0	White	7	7	7
1	Red	7	0	0
2	Green	0	7	0
3	Yellow	7	7	0
4	Blue	0	0	7
5	Magenta	7	0	7
6	Cyan	0	7	7
7	Light Gray	5	5	5
8	Dark Gray	3	3	3
9	Light Red	7	3	3
10	Light Green	3	7	3
11	Light Yellow	7	7	3
12	Light Blue	3	3	7
13	Light Magenta	7	3	7
14	Light Cyan	3	7	7
15	Black	0	0	0

You might have noticed that these registers are not mapped the same as **VDI** color indexes. The **VDI** re-maps color requests to its own needs. For a list of these re-mappings, see the entry for **vr_trnfm()**. It is also possible to build a remapping table on the fly by plotting one pixel for each **VDI** pen on the screen and using the **VDI v_get_pixel()** call on each to return the **VDI** and hardware register index.

Each of the sixteen color registers is bitmapped into a **WORD** as follows (The first row indicates color, the second is bit significance):

```
xxxx xRRR xGGG xBBB
xxxx x321 x321 x321
```

The STe series expanded the color depth to four bits instead of three which expanded the number of available colors from 512 to 4096. This changed the layout of these color **WORD**s as follows:

```
xxxx RRRR GGGG BBBB
xxxx 1432 1432 1432
```

This odd bit layout allowed for backward compatibility to the ST series.

The TT030 supports an expanded palette of 256 entries in 16 banks containing any of 4096 colors. The first bank of colors is still supported by **Setcolor()** and **Setpalette()**, however to access the additional 240 colors, 4 additional palette support calls were added.

Esetpalette(), **Egetpalette()**, and **Esetcolor()** provide access to these colors in a similar manner to **Setpalette()** and **Setcolor()**. **Esetbank()** switches between the 16 available banks of colors in color modes that support less than 16 colors. You should note that the TT030 color calls returned the color **WORD**s to normal bit ordering as follows:

```
xxxx RRRR GGGG BBBB
xxxx 4321 4321 4321
```

When using the TT's special gray mode, the lower eight bits of each hardware register is used as a gray value from 0–255.

The Falcon030 computer gives up the TT030 calls in favor of a more portable method of setting the hardware palette (ST calls will remain as compatible as possible). **VsetRGB()** and **VgetRGB()** set color palette entries based on 24-bit true color values. The **XBIOS** will scale these values as appropriate for the screen mode.

Advanced Video

Vsync() halts all further processing by the application until a vertical blank interrupt occurs. This interrupt signals that the video display gun has reached the bottom of the display and is returning to the top. At this time, a brief period occurs where updates to the screen will not be immediately apparent to the user. This time is usually used to present flicker-free animation and redraws.

VsetSync() is used to enable external hardware video synchronization for devices such as GENLOCK's. Both the vertical and horizontal syncronizations may be set independent of each other with this call.

VsetMask() provides easy access to the Falcon030's overlay mode. This call allows you to specify bits which will be added or removed to future color definitions created with the **VDI** call **vs_color()**. When a GENLOCK hardware device is connected, pixels with their overlay bit cleared will be replaceable by the device with external video.

The Falcon030 Sound System

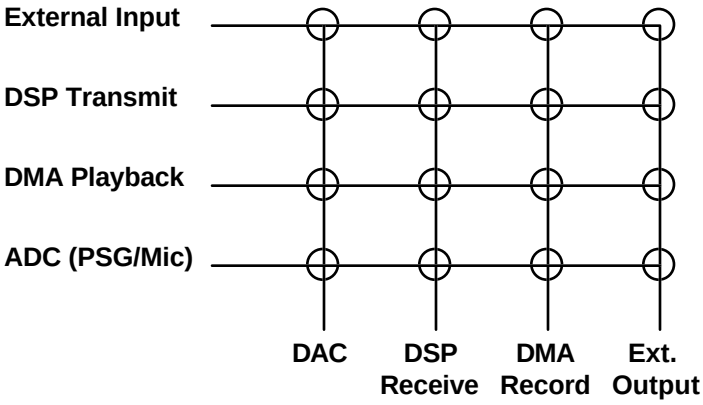
XBIOS sound system calls are only present as of the Falcon030 computer (though their presence should always be verified by the '_SND' cookie). If you want to program digitized audio that plays on an STe, TT, and Falcon030, see *Chapter 5: **Hardware***.

The Falcon030 sound system consists of four stereo 16-bit DMA playback and record channels[1], an onboard ADC (microphone jack), DAC (speaker and headphone jack), connection matrix, and digital signal processor.

When your application uses the sound system you should first lock it with **Locksnd()**. This ensures that other system processes don't try to access the sound system simultaneously. **Unlocksnd()** should be used as soon as the sound system is free.

[1]Only one output track may be monitored at a time, though the DSP may be programmed as a mixer to combine more tracks while sound is being output.

Each of four possible source devices can be connected to any or all of the four possible destination devices using the connection matrix as follows:



The external input and output are accessible with a specially designed hardware device connected to the DSP connector.

The Connection Matrix

The sound system call **Devconnect()** connects sound system components together. You must specify the source device, destination device(s), source clock, prescaler setting, and handshaking protocol.

The source clock can be set to either of two internal clocks (25.175 MHz and 32 MHz) or an external clock. The internal DMA sound routines are only compatible with the 25.175 MHz clock. Other clock sources are used in conjunction with external hardware devices.

The prescaler sets the actual sample playback and recording rate. A value of 0 will cause the sound system to use a STe/ TT030 compatible prescaler for outputting sound recorded at STe/TT030 frequencies. One STe/TT030 frequency, 6.258 kHz, is not supported on the Falcon030. You can set the STe/TT030 prescaler with the **Soundcmd()** call. Using values other than 0 will set the Falcon030 prescaler as documented under the **Devconnect()** call.

The last parameter you must pass to **Devconnect()** specifies whether to enable or disable hardware handshaking. Enabling handshaking will produce data that is 100% error free but will result in a variable transfer rate which may negatively affect digital sound. Handshaking is generally only enabled when the data being transferred must be transferred without errors (usually compressed audio or video data).

Recording/Playing Digital Audio

To record or playback an audio sample, use **Setbuffer()** to identify the location and length of your playback/recording buffer. Also, any **Devconnect()**, **Setmode()**, and **Soundcmd()** calls should be made prior to starting your playback/recording to set the sound hardware to the proper frequency and mode.

The Falcon030 *only* supports the recording of 16-bit stereo audio. To generate 8-bit samples you must scale the values in the buffer from **WORD**s to **BYTE**s after recording.

When processing either recording or playback through the DSP, the command **Dsptristate()** must be used to connect the DSP to the matrix.

You may use the function **Setinterrupt()**, as desired, to cause a MFP or Timer A interrupt at the end of every frame. This is most useful when you are playing or recording in repeat mode and you wish to use multiple buffers.

Buffptr() may be used to determine the current playback or record buffer pointer as sounds are being played/recorded.

Setmontracks() is used to define which track which will be output over the computer speaker/headphones. **Settracks()** controls which tracks will be used to record/playback data.

Configuring Levels

The function **Soundcmd()** has four modes which allow the setting and interrogation of the current levels of attenuation and gain. Gain affects input levels. The higher the value for gain, the louder the microphone input will be. Attenuation affects output levels. The higher the attenuation setting, the softer sounds will be output from the computer speaker/headphone jack.

Other Calls

Sndstatus() can be used to tell if a source clock rate was correctly set or if hardware clipping has occurred on either channel.

Gpio() is used to communicate data over the three general purpose pins of the DSP connector.

The DSP

The Falcon030 comes standard with a Motorola 56001 digital signal processor (DSP). Digital signal processors are useful for many different purposes such as audio/video compression, filtering, encryption, modulation, and math functions.

The DSP is able to support both programs and subroutines. Both must be written in 56001 assembly language (or a language which outputs 56001 object code). A full treatment of 56001 assembly language is beyond the scope of this document. Consult the *DSP56000/56001 Digital Signal Processor's User Manual* published by Motorola, Inc. for more information.

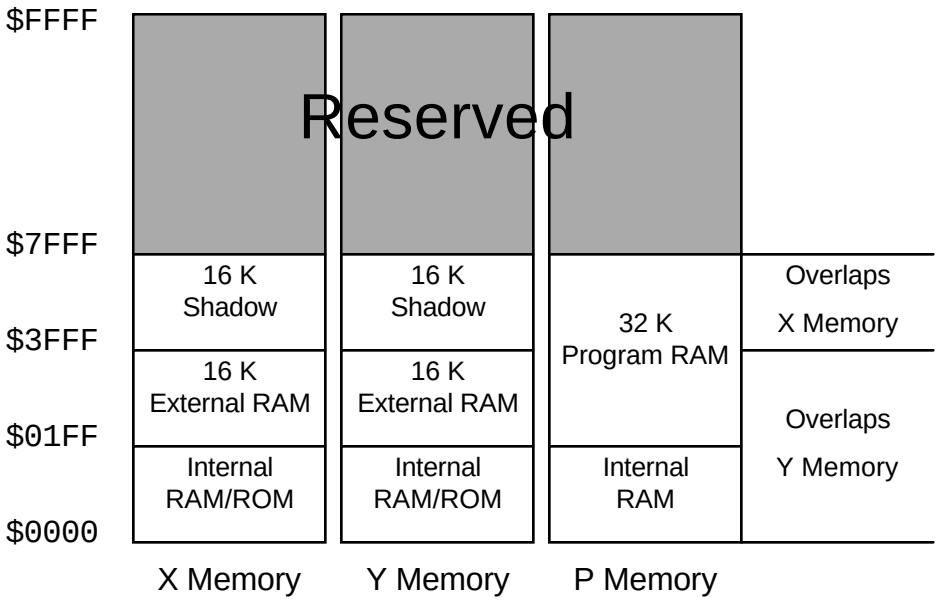
The DSP is capable of having many subroutines resident in memory, however, only one program may be loaded at any time.

When using the DSP you should call **Dsp_Lock()** to prevent other processes from modifying your setup and to ensure that you do not modify the work of other processes. Call **Dsp_Unlock()**

when done (the DSP's MR and IPR registers should have been returned to their original state) to release the DSP semaphore.

DSP Memory

The Falcon030's DSP contains 96K bytes of RAM for system programs, user programs, and subroutines. The DSP uses three distinct address spaces, X, Y, and P. Program memory (P) overlaps both X and Y memory spaces. Because of this, DSP programs should be careful when referencing memory. The following is a memory map of the DSP:



DSP Word Size

The 56001 uses a 24-bit **WORD**. Future Atari computers may use different DSP's with different **WORD** sizes. Use the **Dsp_GetWordSize()** call prior to using the DSP to determine the proper DSP **WORD** size.

DSP Subroutines

Subroutines are usually short programs (no longer than 1024 DSP **WORD**s) which transform incoming data. Each subroutine must be written to be fully relocatable. When writing subroutines, start instructions at location $0. All addresses in the subroutine must be relocatable based on the original PC of $0 in order to function. An alternative to this is to include a stub program at the start of your subroutine that performs a relocation based upon the start address assigned by the **XBIOS** (which is available in X:HRX at subroutine start).

Subroutines should store initialized data within its program space. The memory area from $3f00–$3fff is reserved for use as the BSS of subroutines. Subroutines must not rely on the BSS's data to remain constant between subroutine calls.

Each subroutine must be assigned a unique ability code either by using one predefined by Atari (none have been published yet) or by using the **Dsp_RequestUniqueAbility()** call. Since subroutines are only flushed from the DSP when necessary, an application may be able to use an existing subroutine with the same ability left by another application by using the **Dsp_InqrSubrAbility()** call.

Here is a sample of how to load a DSP subroutine with a non-unique ability code:

```
if(!DSP_Lock())
{
        ability = DSP_RequestUniqueAbility();
        handle = DSP_LoadSubroutine( subptr, length, ability );
        if(!handle)
        {
              DSP_FlushSubroutines();
              handle = DSP_LoadSubroutine( subptr, length, ability );
              if(!handle)
                   error(“Unable to load DSP subroutine”);
        }

        if(handle)
        {
              if(!Dsp_RunSubroutine( handle ))
                   DSP_DoBlock( data_in, size_in, data_out, size_out);
              else
                   error(“Unable to run DSP subroutine!”);
        }
}
```

DSP Programs

Only one DSP program may be resident in memory at once. Prior to loading a DSP program you should ensure enough memory is available for your program by calling **Dsp_Available()**. If not enough memory is available, you may have to flush resident subroutines to free enough memory.

After you have found that enough memory is available, you must reserve it with **Dsp_Reserve()**. This memory will be reserved until the next **Dsp_Reserve()** call so you should ensure that you have called **Dsp_Lock()** to block other processes from writing over your program.

Programs can be stored in either binary or ASCII (‘.LOD’) format. The function **Dsp_LodToBinary()** can be used to convert this data. DSP programs in binary form load much faster than those in the ‘.LOD’ format.

Dsp_LoadProg() is used to execute programs stored on disk in the ‘.LOD’ format. **Dsp_ExecProg()** is used to execute programs stored in memory in binary format.

As with subroutines, programs are assigned a unique ability code that can be determined with **Dsp_GetProgAbility()**.

Sending Data to the DSP

Several functions transfer data to and from DSP programs and subroutines as follows:

- **Dsp_DoBlock()**
- **Dsp_BlkHandshake()**
- **Dsp_BlkUnpacked()**
- **Dsp_BlkWords()**
- **Dsp_BlkBytes()**
- **Dsp_MultBlocks()**
- **Dsp_InStream()**
- **Dsp_OutStream()**

You should read the description of each in the function reference and decide which is best suited for your needs.

Dsp_SetVectors() installs special purpose routines that are called when the DSP sends an interrupt indicating it is ready to send or receive data. **Dsp_RemoveInterrupts()** removes these routines from the vector table in memory.

DSP State

The HFx bits of the HSR register can be read atomically with the four calls **Dsp_Hf0()**, **Dsp_Hf1()**, **Dsp_Hf2()**, and **Dsp_Hf3()**. The current value of the ISR register may be read with **Dsp_Hstat()**.

DSP programs may also define special host commands at DSP vectors $13 and $14 to be triggered by the command **DSP_TriggerHC()**.

DSP Debugging

When full control over the DSP is necessary (such is the case for specialized debuggers), the command **Dsp_ExecBoot()** can be used to download up to 512 DSP **WORD**s of bootstrap code. The DSP will be reset before this happens. This call should only be used by advanced applications as it will cause other DSP functions to stop working unless those functions are properly supported.

User/Supervisor Mode

The **XBIOS** call **Supexec()** provides access to a special mode of the 680x0 processor called supervisor mode. Normal programs always execute in user mode. Programs operating in user mode, however, have less memory access privileges than those operating in supervisor mode.

Some special instructions of the 680x0 may only be executed in supervisor mode. In addition, any memory reads or writes to locations $0–$7FF or memory-mapped I/O must be made in supervisor mode.

To use **Supexec()**, simply pass it the address of a function to be called. When writing the function in 'C', you should be careful to define the function in a way that is safe for your compiler (see your compiler documentation for details).

While in supervisor mode, the **AES** should never be called.

MetaDOS

One special **XBIOS** opcode, **Metainit()** was reserved for a **TOS** extension called **MetaDOS**. **MetaDOS** was designed to supplement the OS to allow for more than 16 drives and to provide the extra support needed for CD-ROM drives. **MetaDOS** is no longer officially supported by Atari because of the increased functionality of **MultiTOS**.

MultiTOS allows the use of all 26 drive letters as well as providing loadable device drivers and file systems. See *Chapter 2: **GEMDOS*** for more information.

Keyboard and Mouse Control

The **XBIOS** has several functions that provide extended control over the keyboard and mouse. These functions should be used with care, however, as the keyboard and mouse are 'global' devices shared by other processes.

Initmous() is used to change the way the keyboard controller reports mouse movements to the system. Changing this mode will cause the **AES** and **VDI** to be unable to recognize mouse input.

Keytbl() allows you to read and manipulate the tables which translate IKBD scan codes into ASCII codes. This is essential when you want your application to run on Atari machines with foreign keyboards. Use **Keytbl()** to return a pointer to the internal table structure and then convert keycodes into ASCII by looking codes up in the appropriate table.

Loadable XBIOS Keyboard Tables

TOS versions 5.0 and greater support the loading of external keyboard tables when the '_AKP' cookie is present. In this case, if a file called 'KEYTBL.TBL' is found in the '\MULTITOS' directory of the boot drive, it will be loaded upon bootup to provide keyboard mapping changes. The format of the file is as follows:

Magic Table Identifier Word This should be a **WORD** value of 0x2771.
Unshifted Keyboard Table This is a 128 byte table of ASCII codes that are generated when no keyboard shift keys are being held down. There is one entry for each possible scan code.
Shifted Keyboard Table This is a 128 byte table of ASCII codes that are generated when the SHIFT key is being held down. There is one entry for each possible scan code.

CAPS-LOCK Keyboard Table
This is a 128 byte table of ASCII codes that are generated when CAPS-LOCK is engaged and no shift keys are being held. There is one entry for each possible scan code.
Alternate-Unshifted Keyboard Table
This is a variable length table consisting of two-byte entries. Each entry consists of a scan code and the ASCII code generated when that scan code occurs while the ALTERNATE key (and no other) keyboard shift keys are being held. The list is terminated by a single **NULL** byte.
Alternate-Shifted Keyboard Table
This is a variable length table consisting of two-byte entries. Each entry consists of a scan code and the ASCII code generated when that scan code occurs while the ALTERNATE key and the SHIFT key is being held. The list is terminated by a single **NULL** byte.
Alternate CAPS-LOCK Keyboard Table
This is a variable length table consisting of two-byte entries. Each entry consists of a scan code and the ASCII code generated when that scan code occurs while the ALTERNATE key is being held with the CAPS-LOCK mode in effect. The list is terminated by a single **NULL** byte.

Bioskeys() returns any mapping changes made by **Keytbl()** to their original state.

The configuration functions **Cursconf()** and **Kbrate()** set the cursor blink rate and keyboard repeat rates respectively. These settings should only be changed by a CPX or other configuration utility at the user's request as they are global and affect all applications.

IKBD Intelligent Keyboard Controller

The IKBD Controller is an intelligent hardware device that handles communications between the computer and the keyboard matrix. The **XBIOS** function **Ikbdws()** can be used to transmit command strings to the IKBD controller. For further information about the IKBD, consult *Chapter 5: **Hardware***.

Disk Functions

Boot Sectors

Both floppy disks and hard disks share a similar format for boot sectors as follows:

Name	Offset	Contents
BRA	0x0000	This **WORD** contains a 680x0 BRA.S instruction to the boot code in this sector if the disk is executable, otherwise it is unused.
OEM	0x0002	These six bytes are reserved for use as any necessary filler information. The disk-based **TOS** loader program places the string 'Loader' here.
SERIAL	0x0008	The low 24-bits of this **LONG** represent a unique disk serial number.

BPS	0x000B	This is an Intel format **WORD** (low byte first) which indicates the number of bytes per sector on the disk.
SPC	0x000D	This is a **BYTE** which indicates the number of sectors per cluster on the disk.
RES	0x000E	This is an Intel format **WORD** which indicates the number of reserved sectors at the beginning of the media (usually one for floppies).
NFATS	0x0010	This is a **BYTE** indicating the number of File Allocation Table's (FAT's) on the disk.
NDIRS	0x0011	This is an Intel format **WORD** indicating the number of ROOT directory entries.
NSECTS	0x0013	This is an Intel format **WORD** indicating the number of sectors on the disk (including those reserved).
MEDIA	0x0015	This **BYTE** is a media descriptor. Hard disks set this value to 0xF8, otherwise it is unused.
SPF	0x0016	This is an Intel format **WORD** indicating the number of sectors per FAT.
SPT	0x0018	This is an Intel format **WORD** indicating the number of sectors per track.
NSIDES	0x001A	This is an Intel format **WORD** indicating the number of sides on the disk.
NHID	0x001C	This is an Intel format **WORD** indicating the number of hidden sectors on a disk (currently ignored).
BOOTCODE	0x001E	This area is used by any executable boot code. The code must be completely relocatable as its loaded position in memory is not guaranteed.
CHECKSUM	0x01FE	The entire boot sector **WORD** summed with this Motorola format **WORD** will equal 0x1234 if the boot sector is executable or some other value if not.

The boot sector may be found on side 0, track 0, sector 1 of each physical disk.

The Floppy Drive

The **XBIOS** provides several functions used for reading, writing, verifying, and formatting sectors on the hard disk.

Floprd() and **Flopwr()** read and write from the floppy drive at the sector level rather than the file level. For example, these functions could be used to create executable boot sectors on a floppy disk. **Flopver()** can be used to verify written sectors against data still in memory.

Formatting a floppy disk is accomplished with **Flopfmt()**. After a floppy is completely formatted use the function **Protobt()** to create a prototype boot sector (as shown above) which can then be written to sector #1 to make the disk usable by **TOS**.

ASCI and SCSI DMA

The functions **DMAread()** and **DMAwrite()** were added as of **TOS** 2.00. These functions provide a method of accessing ACSI and SCSI devices at the sector level.

ASCI accesses must not use alternate RAM as a transfer buffer because they are performing DMA. The TT030 uses handshaking for SCSI so alternate RAM transfers are safe. SCSI transfers on the Falcon030 do, however, use DMA so alternate RAM must be avoided.

If you need to transfer data using these functions to an alternate RAM buffer, use the special standard memory block pointed to by the cookie '_FRB' as an intermediary point between the two types of RAM. You must also use the '*_flock*' system variable (at 0x43E) to lock out other attempted uses of this buffer.

Each physical hard disk drive must contain a boot sector. The boot sector for hard disk drives is the same as floppies except for the following locations:

Name	Offset	Contents
hd_siz	0x01C2	This is a Motorola format **LONG** that indicates the number of physical 512-byte sectors on the device.
Partition Header #0	0x01C6	This section contains a 12 **BYTE** partition information block for the first logical partition.
Partition Header #1	0x01D2	This section contains a 12 **BYTE** partition information block for the second logical partition.
Partition Header #2	0x1DE	This section contains a 12 **BYTE** partition information block for the third logical partition.
Partition Header #3	0x1EA	This section contains a 12 **BYTE** partition information block for the fourth logical partition.
bst_st	0x1F6	This is a Motorola format **LONG** that indicates the sector offset to the bad sector list (from the beginning of the physical disk).
bst_cnt	0x01FA	This is a Motorola format **LONG** that indicates the number of 512-byte sectors reserved for the bad sector list.

The partition information block is defined as follows:

Name	Offset	Contents
p_flg	0x00	This is a **BYTE** size bit field indicating the partition state. If bit 0 is set, the partition exists, otherwise it does not. If bit 7 is set, the partition is bootable, otherwise it is not. Bits 1-6 are unused.
p_id	0x01	This is a three **BYTE** field that indicates the partition type as follows: **Contents** — **Meaning** '**GEM**' — Regular Partition (<16MB) '**BGM**' — Big Partition (>=16MB) '**XGM**' — Extended Partition
p_st	0x04	This is a Motorola format **LONG** that indicates the start of the partition as an offset specified in 512-byte sectors.
p_size	0x08	This is a Motorola format **LONG** that indicates the size of the partition in 512-byte sectors.

A hard disk may have up to four standard (GEM or BGM) partitions or three standard and one extended (XGM) partition. The first partition of a hard disk must be a standard one.

Extended Partitions

The first sector of an extended partition contains a standard boot sector with hard disk information except that the *hd_siz*, *bst_st*, and *bst_cnt* fields are unused. At least one, but no more than two (not necessarily the first two), partition headers are used. The first partition header is the same as described above except that *p_st* describes the offset from the beginning of the extended partition rather than the beginning of the physical disk.

If another partition needs to be linked, the second partition block should contain 'XGM' in its *p_id* field and an offset to the next extended partition in *p_st*.

The Bad Sector List

The bad sector list is a group of three-byte entries describing which physical sectors on the hard disk are unusable. The first three-byte entry contains the number of bad sectors recorded. The second three-byte entry is a checksum and when added to the entire bad sector list bytewise should cause the list to **BYTE** sum to 0xA5. If this is not the case then the bad sector list is considered bad itself.

The Serial Port

Application writers who develop communication programs will need to use some of the special functions the **XBIOS** provides for control of the serial port(s). Older Atari computers support only one serial port connected by the Multi-Function Peripheral (MFP) chip.

The Atari TT030 contains two MFP chips to provide two serial ports and one Serial Communications Chip (SCC) which controls two more serial ports. One of the SCC ports, however, can be switched over to control a Localtalk compatible network port as follows:

Switch to Serial 2 Connector:

```
Ongibit(0x80);
```

Switch to LAN connector:

```
Offgibit(0x7F);
```

The Mega STe is similar to the TT030, however, it has only one MFP chip to provide one less serial device.

The Atari Falcon030 uses a SCC chip to drive its single serial port and networking port. The Falcon030 does contain a MFP chip but it does not control any of the serial device hardware. The MFP's ring indicator has, however, been wired across the SCC to provide compatibility with older applications.

Serial Port Mapping

BIOS input and output calls to device #1 and **XBIOS** calls which configure the serial port always refer to the currently 'mapped' device as set with **Bconmap()**. The Modem CPX allows a user to map any installed device as the default. A program which is aware of the extra ports on newer machines can access them through their own **BIOS** device number as follows:

Device Number	Mega ST	TT030	Falcon030
1	Currently mapped device. **DEV_AUX**	Currently mapped device. **DEV_AUX**	Currently mapped device. **DEV_AUX**
6	Modem 1 (ST MFP) **DEV_MEGAMODEM1**	Modem 1 (ST MFP) **DEV_TTMODEM1**	—
7	Modem 2 (SCC B) **DEV_MEGAMODEM2**	Modem 2 (SCC B) **DEV_TTMODEM2**	Modem (SCC B) **DEV_FALCONMODEM**
8	Serial/LAN (SCC A) **DEV_MEGALAN**	Serial 1 (TT MFP) **DEV_TTSERIAL1**	LAN (SCC A) **DEV_FALCONLAN**
9	—	Serial 2/LAN (SCC A) **DEV_TTLAN**	—

Configuring the Serial Port

Rsconf() and **Iorec()** set the communication mode and input/output buffers of the currently mapped serial port. You should note that while some ports support transfer rates of greater than 19200 baud, this is the limit of the **Rsconf()** call. Other rates must currently be set in hardware (or with the **Fcntl()** when **MiNT** is present).

MFP Interrupts

Each MFP chip supports a number of interrupts used by the serial port and other system needs. The function **Mfpint()** should be used to set define a function in your application that handles one of these interrupts. **Jenabint()** and **Jdisint()** are used to enable/disable these interrupts respectively.

All MFP interrupt calls only work on ST compatible MFP serial ports. The RS-232 ring indicator is the only interrupt that has been wired through the MFP on a Falcon. Because of this, the ring indicator interrupt is the only RS-232 interrupt that may be changed with **Mfpint()** on a Falcon.

SCC Interrupts

The **XBIOS** functions used for setting MFP interrupts do not affect the SCC interrupts regardless of the **Bconmap()** mapping. Refer to the memory map for the location of SCC interrupt registers.

Printer Control

The **XBIOS** contains two functions used for controlling printers. Both functions are very outdated and should not be relied on in any ST.

Scrdmp() triggers the built-in ALT-HELP screen dump code. **Prtblk()** enables the built-in screen dump routine of the ST printing only the desired block to an Atari or Epson dot-matrix printer.

Setprt() configures the built-in screen dump routine as to the basic configuration of the attached printer.

Other XBIOS Functions

NVMaccess() accesses the non-volatile RAM present in the TT, Mega STe, and Falcon030. You should not read or write to this area as all of its locations are currently reserved.

The functions **Settime()** and **Gettime()** set the **BIOS** time and date. As of **TOS** 1.02, they also update the **GEMDOS** time as well.

Besides the sound capabilities of the **XBIOS** when running on a Falcon, the function **Dosound()** generates music on any Atari computer using the FM sound generator. The function works at the interrupt level processing a 'sound command list' you specify. It can be used to reproduce a single tone or a complete song in as many as three parts of harmony.

Random() generates a pseudo-random number using a built-in algorithm whose seed comes from the system 60kHz clock.

Ssbrk() is used by the operating system to reserve system RAM before **GEMDOS** is initialized. It should not be used by application programmers.

Puntaes() is useful only when using a disk-loaded version of **TOS**. It clears the OS from RAM and reboots the computer.

Midiws() is a similar function to **Ikbdws()** in that it writes to the MIDI controller. It is more useful at transferring large amounts of MIDI data than **Bconout()**.

The **Dbmsg() XBIOS** call is added by supporting debuggers as a method of transferring debugging messages between the application and debugger. The Atari Debugger (DB) currently supports this interface.

XBIOS Function Calling Procedure

XBIOS system functions are called via the TRAP #14 exception. Function arguments are pushed onto the current stack (user or supervisor) in reverse order followed by the function opcode. The calling application is responsible for correctly resetting the stack pointer after the call.

The **XBIOS**, like the **BIOS** may utilize registers D0-D2 and A0-A2 as scratch registers and their contents should not be depended upon at the completion of a call. In addition, the function opcode placed on the stack will be modified.

The following example for **Getrez()** illustrates calling the **XBIOS** from assembly language:

```
move.w      #$04,-(sp)
trap        #14
addq.l      #6,sp
```

A 'C' binding for a generic **XBIOS** handler would be as follows:

```
_xbios:
        ; Save the return code from the stack
        move.l  (sp)+,trp14ret
        trap    #14
        move.l  trp14ret,-(sp)
        rts

        .bss
trp14ret:
        .ds.l       1
```

The **XBIOS** is re-entrant to three levels, however there is no depth checking performed so interrupt handlers should avoid intense **XBIOS** usage. In addition, no disk or printer usage should be attempted from the system timer interrupt, critical error, or process-terminate handlers.

Calling the XBIOS from an Interrupt

The **BIOS** and **XBIOS** are the *only* two OS sub-systems which may be called from an interrupt handler. Precisely *one* interrupt handler at a time may use the **XBIOS** as shown in the following code segment:

```
savptr          equ     $4A2
savamt          equ     $23*2

myhandler:
                sub.l   #savamt,savptr

                ; BIOS calls may be performed here

                add.l   #savamt,savptr

                rte     ; (or rts?)
```

Certain **XBIOS** calls are not re-entrant because they call **GEMDOS** routines. The **Setscreen()** function, and any DSP function which loads data from disk should not be attempted during an interrupt.

It is not possible to use this method to call **XBIOS** functions during an interrupt when running under **MultiTOS**.

XBIOS Function Reference

Bconmap()

LONG Bconmap(***devno*** **)**
WORD ***devno*****;**

Bconmap() maps a serial device to **BIOS** device #1. It is also used to add serial device drivers to the system.

OPCODE 44 (0x2C)

AVAILABILITY To reliably check that **Bconmap()** is supported, the **TOS** version must be 1.02 or higher and the following function should return a **TRUE** value.

```
#define BMAP_EXISTS  0

BOOL IsBconmap( VOID )
{
       return (Bconmap(0) == BMAP_EXISTS);
}
```

PARAMETERS The value of *devno* has the following effect:

Name	*devno*	Meaning
BMAP_CHECK	0	Verify the existence of the call (systems without **Bconmap()** will return the function opcode 44).
—	1-5	These are illegal values (will return 0).
*See **XBIOS** Serial Port Mapping for constants.*	6-	Redefine **BIOS** device 1 (the **GEMDOS** 'aux:' device) to map to the named serial device. All **Bcon...(1,...)**, **Rsconf()**, and **Iorec()** calls will return information for the named device. Returns the old value.
BMAP_INQUIRE	-1	Don't change anything, simply return the old value.
BMAP_MAPTAB	-2	Return a pointer to the serial device vector table (see below).

BINDING

```
move.w      devno,-(sp)
move.w      #$2C,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE See above.

CAVEATS You should never install the 38th device (**BIOS** device number 44). It would be indistinguishable from the case where **Bconmap()** was unavailable. In the unlikely event that this case arises, you should install two new devices and assign your new device to the second one.

All current versions of Falcon030 **TOS** (4.00 – 4.04) contain a bug that prevents

the **BIOS** from accessing the extra available devices. A patch program named FPATCH2.PRG is available from Atari Corporation to correct this bug in software.

COMMENTS To add a serial device to the table, use **Bconmap(-2)** to return a pointer to a **BCONMAP** structure. *maptab* points to a list of **MAPTAB** structures (the first entry in **MAPTAB** is the table for device number 6). The list will contain *maptabsize* devices. Allocate a block of memory large enough to store the old table plus your new entry and copy the old table and your new device structure there making sure to increment *maptabsize*. Finally, alter *maptab* to point to your new structure.

```
typedef struct
{
       WORD  (*Bconstat)();
       LONG  (*Bconin)();
       LONG  (*Bcostat)();
       VOID  (*Bconout)();
       ULONG (*Rsconf)();
       IOREC *iorec;          /* See Iorec() */
} MAPTAB;

typedef struct
{
       MAPTAB    *maptab;
       WORD      maptabsize;
} BCONMAP;
```

SEE ALSO **Bconin(), Bconout(), Rsconf(), Iorec()**

Bioskeys()

VOID Bioskeys(VOID)

Bioskeys() is used to reset to the power-up defaults of the keyboard configuration tables.

OPCODE 24 (0x18)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w       #$18,-(sp)
trap         #14
addq.l       #4,sp
```

COMMENTS This call is only necessary to restore changes made by modifying the tables given by **Keytbl()**.

SEE ALSO **Keytbl()**

Blitmode()

WORD Blitmode(*mode*)
WORD *mode*;

Blitmode() detects a hardware BLiTTER chip and can alter its configuration if present.

OPCODE 64 (0x40)

AVAILABILITY This call is available as of **TOS** 1.02.

PARAMETERS *mode* is used to set the BLiTTER configuration. If *mode* is **BLIT_INQUIRE** (-1), the call will return the current state of the BLiTTER without modifying its state. To change the method of OS blit operations, call **Blitmode()** with one of the following values:

Name	*mode*	Meaning
BLIT_SOFT	0	If set, use hardware BLiTTER chip, otherwise use software routines.
BLIT_HARD	1	If set, hardware BLiTTER chip is available.

BINDING

```
move.w      mode,-(sp)
move.w      #$40,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Blitmode()** returns the old *mode* value. Bit #0 of *mode* contains the currently set blitter mode as shown above. Bit #1 is set to indicate the presence of a hardware blitter chip or clear if no blitter chip is installed.

COMMENTS You should use this call once to verify the existence of the BLiTTER prior to attempting to change its configuration.

Buffoper()

LONG Buffoper(*mode*)
WORD *mode*;

Buffoper() sets/reads the state of the hardware sound system.

OPCODE 136 (0x88)

AVAILABILITY Available if '_SND' cookie has third bit set.

PARAMETERS *mode* is a bit array which may be composed of all or none of the following flags indicating the desired sound system state as follows:

Name	Bit Mask	Meaning
PLAY_ENABLE	0x01	Enable DMA Sound Playback. The sound must have been previously identified to the **XBIOS** with the **Buffptr()** function.
PLAY_REPEAT	0x02	Setting this flag will cause any sound currently playing or started as a result of this call to be looped indefinitely (until **Buffoper(**0**)** is used).
RECORD_ENABLE	0x04	Enable DMA Sound Recording. The sound must have been previously identified to the **XBIOS** with the **Buffptr()** function.
RECORD_REPEAT	0x08	Setting this flag during a record will cause the recording to continue indefinitely within the currently set recording buffer (as set by **Buffptr()**)

Alternately, calling this function with a *mode* parameter of **SND_INQUIRE** (-1) will return a bit mask indicating the current sound system state as shown above.

BINDING

```
move.w      mode,-(sp)
move.w      #$88,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Buffoper()** normally returns 0 for no error or non-zero otherwise (except in inquire mode as indicated above.

COMMENTS The sound system uses a 32 bit FIFO. The FIFO is only guaranteed to be clear when the record enable bit is clear. When transferring new data to the record buffers, the record enable bit should be cleared to flush the FIFO.

SEE ALSO **Setbuffer()**

Buffptr()

LONG Buffptr(*sptr*)
**SBUFPTR ***sptr*;

Buffptr() returns the current position of the playback and record pointers.

OPCODE 141 (0x8D)

AVAILABILITY Available if '_SND' cookie has third bit set.

PARAMETER *sptr* is a pointer to a **SBUFPTR** structure which is filled in with the current pointer values. **SBUFPTR** is defined as follows:

```
typedef struct
{
       VOIDP playptr;
       VOIDP recordptr;
       VOIDP reserved1;
       VOIDP reserved2;
} SBUFPTR;
```

BINDING

```
pea          sptr
move.w       #$8d,-(sp)
trap         #14
addq.l       #6,sp
```

RETURN VALUE **Buffptr()** returns 0 if the operation was successful or non-zero otherwise.

SEE ALSO **Setbuffer(), Buffoper()**

Cursconf()

WORD Cursconf(***mode, rate*** **)**
WORD ***mode, rate*****;**

Cursconf() configures the VT-52 cursor.

OPCODE 21 (0x15)

AVAILABILITY All **TOS** versions.

PARAMETERS *mode* defines the operation as follows:

Name	*mode*	Meaning
CURS_HIDE	0	Hide cursor.
CURS_SHOW	1	Show cursor.
CURS_BLINK	2	Enable cursor blink.
CURS_NOBLINK	3	Disable cursor blink.
CURS_SETRATE	4	Set blink rate to *rate.*
CURS_GETRATE	5	Return current blink rate.

BINDING

```
move.w       rate,-(sp)
move.w       mode,-(sp)
move.w       #$15,-(sp)
```

```
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Cursconf()** only returns a meaningful value under *mode* 5 in which it returns the current blink rate.

COMMENTS The blink rate is specified in number of vertical blanks per blink.

Dbmsg()

VOID Dbmsg(***rsrvd, msg_num, msg_arg*** **)**
WORD ***rsrvd, msg_num*****;**
LONG ***msg_arg*****;**

Dbmsg() allows special debugging messages to be sent to a resident debugger application.

OPCODE 11 (0x0B)

AVAILABILITY The only debugger that currently supports this call is the Atari Debugger.

PARAMETERS *rsrvd* is currently reserved and should always be 5. *msg_num* is the message number which you want to send to the debugging host. Values of 0x0000 to 0xEFFF are reserved for applications to define. Values of 0xF000 to 0xFFFF are reserved for special debugging messages.

If *msg_num* is in the application defined range, it and the **LONG** contained in *msg_arg* will be displayed by the debugger and the application will be halted.

If *msg_num* is between 0xF001 and 0xF0FF inclusive then *msg_arg* is interpreted as a character pointer pointing to a string to be output by the debugger and debugging to halt. The string length is determined by the low byte of *msg_num*. If *msg_num* is **DB_NULLSTRING** (0xF000), the string will be output until a **NULL** is reached.

If *msg_num* is **DB_COMMAND** (0xF100), *msg_arg* is interpreted as a character pointer to a string containing a debugger command. The command format is specific to the debugger which you are running.

A useful example of this format when running under the Atari debugger allows a string to be output to the debugger without terminating debugging as shown in the following example:

```
Dbmsg( 5, DB_COMMAND, “echo ‘Debugging Message’;g” );
```

BINDING

```
move.l      msg_arg,-(sp)
move.w      msg_num,-(sp)
move.w      #$5,-(sp)
move.w      #$0B,-(sp)
trap        #14
lea         10(sp),sp
```

COMMENTS

The Atari Debugger only understands the value **DB_COMMAND** (0xF100) for *msg_num* as of version 3.

Though it is normally harmless to run an application with embedded debugging messages when no debugger is present in the system, distribution versions of applications should have these instructions removed.

Devconnect()

LONG Devconnect(***source, dest, clk, prescale, protocol*** **)**
WORD ***source, dest, clk, prescale, protocol*****;**

Devconnect() attaches a source device in the sound system to one or multiple destination devices through the use of the connection matrix.

OPCODE

139 (0x8B)

AVAILABILITY

Available if '_SND' cookie has third bit set.

PARAMETERS

source indicates the source device to connect as follows:

Name	*source*	Meaning
DMAPLAY	0	DMA Playback
DSPXMIT	1	DSP Transmit
EXTINP	2	External Input
ADC	3	Microphone/Yamaha PSG

dest is a bit mask which is used to choose which destination devices to connect as follows:

Name	Mask	Meaning
DMAREC	0x01	DMA Record
DSPRECV	0x02	DSP Receive
EXTOUT	0x04	External Out
DAC	0x08	DAC (Headphone or Internal Speaker)

clk is the clock the source device will use as follows:

Name	*clk*	Meaning
CLK_25M	0	Internal 25.175 MHz clock
CLK_EXT	1	External clock
CLK_32M	2	Internal 32 MHz clock

prescale chooses the source clock prescaler. Sample rate is determined by the formula:

$$rate = \frac{clockrate / 256}{prescale + 1}$$

Valid prescaler values for the internal CODEC using the 25.175 MHz clock are:

Name	*prescale*	Meaning/Sample Rate
CLK_COMPAT	0	TT030/STe compatiblity mode. Use prescale value set with **Soundcmd()**.
CLK_50K	1	49170 Hz
CLK_33K	2	32880 Hz
CLK_25K	3	24585 Hz
CLK_20K	4	19668 Hz
CLK_16K	5	16390 Hz
CLK_12K	7	12292 Hz
CLK_10K	9	9834 Hz
CLK_8K	11	8195 Hz

protocol sets the handshaking mode. A value of **HANDSHAKE** (0) enables handshaking, **NO_SHAKE** (1) disables it. When transferring sound or video data through the CODEC it is usually recommended that handshaking be disabled. When incoming data must be 100% error free, however, handshaking should be enabled.

BINDING

```
move.w      protocol,-(sp)
move.w      prescale,-(sp)
move.w      clk,-(sp)
move.w      dest,-(sp)
move.w      source,-(sp)
move.w      #$8B,-(sp)
trap        #14
lea         12(sp),sp
```

RETURN VALUE

Devconnect() returns 0 if the operation was successful or non-zero otherwise.

CAVEATS

Setting the prescaler to an invalid value will result in a mute condition.

SEE ALSO **Soundcmd()**

DMAread()

LONG DMAread(***sector, count, buf, dev*** **)**
LONG ***sector*****;**
WORD ***count*****;**
VOIDP ***buf*****;**
WORD ***dev*****;**

DMAread() reads raw sectors from a ACSI or SCSI device.

OPCODE 42 (0x2A)

AVAILABILITY This call is available as of **TOS** version 2.00.

PARAMETERS *sector* specifies the sector number to begin reading at. *count* specifies the number of sectors to read. *buf* is a pointer to the address where incoming data will be stored. *dev* specifies the device to read from as follows:

dev	Meaning
0-7	ACSI devices 0-7
8-15	SCSI devices 0-7

BINDING

```
move.w      dev,-(sp)
pea         buf
move.w      count,-(sp)
move.l      sector,-(sp)
move.w      #$2A,-(sp)
trap        #14
lea         14(sp),sp
```

RETURN VALUE **DMAread()** returns 0 if the operation was successful or a negative **BIOS** error code otherwise.

CAVEATS SCSI devices will write data until the device exits its data transfer phase. Since this call is not dependent on sector size, you should ensure that the buffer is large enough to hold sectors from devices with large sectors (CD-ROM = 2K, for example).

COMMENTS ACSI transfers must be done to normal RAM. If you need to read sectors into alternative RAM, use the 64KB pointer found with the '_FRB' cookie as an intermediate transfer point while correctly managing the '*_flock*' system variable.

SCSI transfers on the TT030 do not actually use DMA. Handshaking is used to

transfer bytes individually. This means that alternative RAM may be used. The Falcon030 uses DMA for SCSI transfers making transfers to alternative RAM illegal.

SEE ALSO **DMAwrite(), Rwabs()**

DMAwrite()

LONG DMAwrite(***sector, count, buf, dev*** **)**
LONG ***sector*****;**
WORD ***count*****;**
VOIDP ***buf*****;**
WORD ***dev*****;**

DMAwrite() writes raw sectors to ACSI or SCSI devices.

OPCODE 43 (0x2B)

AVAILABILITY **TOS** versions >= 2.00

PARAMETERS *sector* is the starting sector number to write data to. *count* is the number of sectors to write. *buf* defines the starting address of the data to write. *dev* is the device number as specified in **DMAread()**.

BINDING

```
move.w      dev,-(sp)
pea         buf
move.w      count,-(sp)
move.l      sector,-(sp)
move.w      #$2B,-(sp)
trap        #14
lea         14(sp),sp
```

RETURN VALUE **DMAwrite()** returns 0 if successful or a negative **BIOS** error code otherwise.

COMMENTS ACSI transfers must be done from normal RAM. If you need to read sectors into alternative RAM, use the 64KB pointer found with the '_FRB' cookie as an intermediate transfer point while correctly managing the '*_flock*' system variable.

SCSI transfers do not actually use DMA. Handshaking is used to transfer bytes individually.

SEE ALSO **DMAread(), Rwabs()**

Dosound()

VOID Dosound(*cmdlist*)
char ***cmdlist*;

Dosound() initializes and starts an interrupt driven sound playback routine using the PSG.

OPCODE 32 (0x20)

AVAILABILITY All **TOS** versions.

PARAMETERS If *cmdlist* is positive, it will be interpreted as a pointer to a character array containing a sequential list of commands required for the sound playback. Each command is executed in order and has a meaning as follows:

Command Byte	Meaning
0x00 - 0x0F	Select a PSG register (the register number is the command byte). The next byte in the list will be loaded into this register. See **Appendix I** for a detailed listing of registers, musical frequencies, and sound durations.
0x80	Store the next byte in a temporary register for use by command 0x81.
0x81	Three bytes follow this command. The first is the PSG register to load with the value in the temporary register (set with command 0x80). The second is a signed value to add to the temporary register until the value in the third byte is met.
0x82	If a 0 follows this command, this signals the end of processing, otherwise the value indicates the number of 50Hz ticks to wait until the processing of the next command.

Passing the value **DS_INQUIRE** (-1) for *cmdlist* will cause the pointer to the current sound buffer to be returned or **NULL** if no sound is currently playing.

BINDING

```
pea         cmdlist
move.w      #$20,-(sp)
trap        #14
addq.l      #6,sp
```

CAVEATS This routine is driven by interrupts. Do not use an array created on the stack to store the command list that may go out of scope before the sound is complete.

This function will cause the OS to crash under **MultiTOS** versions prior to 1.08 if every running application is not set to ‘Supervisor’ or ‘Global’ memory protection.

Dosound(DS_INQUIRE) will cause the OS to crash under **MultiTOS** versions 1.08 and below.

Dsp_Available()

VOID Dsp_Available(*xavail, yavail*)
LONG **xavail, *yavail*;

Dsp_Available() returns the amount of free program space in X and Y DSP memory.

OPCODE 106 (0x6A)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS Upon return, the longwords pointed to by *xavail* and *yavail* will contain the length of memory (in bytes) available for DSP programs and subroutines.

BINDING

```
pea         yavail
pea         xavail
move.w      #$6A,-(sp)
trap        #14
lea         10(sp),sp
```

SEE ALSO **Dsp_Reserve()**

Dsp_BlkBytes()

VOID Dsp_BlkBytes(*data_in, size_in, data_out, size_out*)
UBYTE **data_in*;
LONG *size_in*;
UBYTE **data_out*;
LONG *size_out*;

Dsp_BlkBytes() transfers a block of unsigned character data to the DSP and returns the output from the running program or subroutine.

OPCODE 124 (0x7C)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *data_in* is a pointer to an unsigned character array which is transferred to the DSP. *size_in* is the length (in bytes) of data to transfer.

data_out is a pointer to the unsigned character array to be filled in from the low byte of the DSP's transfer register. *size_out* is the length (in bytes) of the output buffer array.

BINDING

```
move.l      size_out,-(sp)
pea         data_out
move.l      size_in,-(sp)
pea         data_in
move.w      #$7C,-(sp)
trap        #14
lea         18(sp),sp
```

CAVEATS No handshaking is performed with this call. Error sensitive data should be transferred with **Dsp_BlkHandShake()**.

COMMENTS Bytes are not sign extended before transfer. Also, due to the length of static memory in the DSP, *size_in* and *size_out* should not exceed 65536.

SEE ALSO **Dsp_BlkWords()**

Dsp_BlkHandShake

VOID Dsp_BlkHandShake(*data_in*, *size_in*, *data_out*, *size_out*)
char ****data_in*;**
LONG *size_in*;
char ****data_out*;**
LONG *size_out*;

Dsp_BlkHandShake() handshakes a block of bytes to the DSP and returns the output generated by the running subroutine or program.

OPCODE 97 (0x61)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *data_in* is a pointer to data being sent to the DSP. *size_in* specifies the number of DSP words of data to be transferred. **Dsp_GetWordSize()** can be used to determine the number of bytes that occur for a DSP word.

data_out is a pointer to the buffer to which processed data will be returned from the DSP. *size_out* indicates the number of DSP words to transfer.

BINDING

```
move.l      size_out,-(sp)
pea         data_out
move.l      size_in,-(sp)
pea         data_in
move.w      #$61,-(sp)
trap        #14
lea         18(sp),sp
```

COMMENTS **Dsp_BlkHandshake()** is identical to **Dsp_DoBlock()**, however, this function handshakes each byte to prevent errors in sensitive data.

SEE ALSO **Dsp_DoBlock()**

Dsp_BlkUnpacked()

VOID Dsp_BlkUnpacked(***data_in*, *size_in*, *data_out*, *size_out*** **)**
LONG *da*ta_in*;
LONG *size_in*;
LONG ***data_out*;
LONG *size_out*;

Dsp_BlkUnpacked() transfers data to the DSP from a longword array. Data processed by the running subroutine or program is returned.

OPCODE 98 (0x62)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *data_in* is a pointer to an array of **LONG**s from which data is transferred to the DSP. As many bytes are transferred from each **LONG** as there are bytes in a DSP **WORD**. For example, if **Dsp_GetWordSize()** returns 3, the lower three bytes of each **LONG** are transferred into each DSP **WORD**.

size_in represents the number of **LONG**s in the array to transfer. *data_out* is a pointer to an array of **LONG**s *size_out* in length in which data sent from the DSP is returned.

BINDING

```
move.l      size_out,-(sp)
pea         data_out
move.l      size_in,-(sp)
pea         data_in
move.w      #$62,-(sp)
trap        #14
lea         18(sp),sp
```

CAVEATS This function only works with DSP's which return 4 or less from **Dsp_GetWordSize()**. In addition, no handshaking is performed with this call. Data which is sensitive to errors should use **Dsp_BlkHandShake()**.

SEE ALSO **Dsp_DoBlock()**

Dsp_BlkWords()

VOID Dsp_BlkWords(***data_in*****,** ***size_in*****,** ***data_out*****,** ***size_out*** **)**
WORD ****data_in***;**
LONG ***size_in*****;**
WORD ****data_out***;**
LONG ***size_out*****;**

Dsp_BlkWords() transfers an array of **WORD**s to the DSP and returns the output generated by the running subroutine or program.

OPCODE 123 (0x7B)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *data_in* is a pointer to the **WORD** array to be transferred to the DSP. *size_in* is the length (in **WORD**s) of data to transfer.

data_out is a pointer to the **WORD** array to be filled in during the data output phase of the DSP from the middle and low bytes of the transfer register. *size_out* is the length (in **WORD**s) of the buffer for the output array.

BINDING

```
move.l      size_out,-(sp)
pea         data_out
move.l      size_in,-(sp)
pea         data_in
move.w      #$7B,-(sp)
trap        #14
lea         18(sp),sp
```

CAVEATS No handshaking is performed with this call. Data which is sensitive to errors should use **Dsp_BlkHandShake()**.

COMMENTS **WORD**s are sign extended before transfer. Also, due to the length of static memory in the DSP, *size_in* and *size_out* should not exceed 32768.

SEE ALSO **Dsp_BlkBytes()**

Dsp_DoBlock()

VOID Dsp_DoBlock(***data_in*****,** ***size_in*****,** ***data_out*****,** ***size_out*** **)**
char ****data_in*;**
LONG ***size_in***;
char ****data_out*;**
LONG ***size_out***;

Dsp_DoBlock() transfers bytewise packed data to the DSP and returns the data processed by the running subroutine or program.

OPCODE 96 (0x60)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *data_in* is a character array containing data to transfer to the DSP. *size_in* specifies the number of DSP words to transfer. For example, if **Dsp_GetWordSize()** returns 3, the first 3 bytes from *data_in* are stored in the first DSP word, the next 3 bytes are stored in the next DSP word and so on.

data_out points to a character array where the output will be stored in a similar manner. *size_out* represents the size of this array.

BINDING

```
move.l      size_out,-(sp)
pea         data_out
move.l      size_in,-(sp)
pea         data_in
move.w      #$60,-(sp)
trap        #14
lea         18(sp),sp
```

CAVEATS No handshaking is performed with this call. Data which is sensitive to errors should use **Dsp_BlkHandShake()**.

SEE ALSO **Dsp_BlkHandShake()**

Dsp_ExecBoot()

VOID Dsp_ExecBoot(***codeptr, codesize, ability*** **)**
char ****codeptr*;**
LONG ***codesize***;
WORD ***ability***;

Dsp_ExecBoot() completely resets the DSP and loads a new bootstrap program into the first 512 DSP words of memory.

OPCODE 110 (0x6E)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *codeptr* points to the beginning of the DSP program data to be transferred. *codesize* indicates the size (in DSP words) of program data to transfer. *ability* indicates the bootstrapper's unique ability code.

BINDING

```
move.w      ability,-(sp)
move.l      codesize,-(sp)
pea         codeptr
move.w      #$6E,-(sp)
trap        #14
lea         12(sp),sp
```

COMMENTS This call is only designed for special development and testing purposes. Use of this call takes over control of the DSP system.

This call is limited to transferring up to 512 DSP words of code.

SEE ALSO **Dsp_LoadProg(), Dsp_ExecProg()**

Dsp_ExecProg()

VOID Dsp_ExecProg(***codeptr, codesize, ability*** **)**
char ****codeptr*;**
LONG ***codesize***;
WORD ***ability***;

Dsp_ExecProg() transfers a DSP program stored in binary format in memory to the DSP and executes it.

OPCODE 109 (0x6D)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *codeptr* points to the start of the binary program in memory. *codesize* indicates the number of DSP words to transfer. *ability* indicates the program's unique ability code.

BINDING

```
move.w      ability,-(sp)
move.l      codesize,-(sp)
pea         codeptr
move.w      #$6D,-(sp)
trap        #14
lea         12(sp),sp
```

COMMENTS *codesize* should not exceed the amount of memory reserved by the **Dsp_Reserve()** call.

SEE ALSO **Dsp_LoadProg(), Dsp_Reserve()**

Dsp_FlushSubroutines()

VOID Dsp_FlushSubroutines(VOID)

Dsp_FlushSubroutines() removes all subroutines from the DSP.

OPCODE 115 (0x73)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$73,-(sp)
trap        #14
addq.l      #2,sp
```

COMMENTS This call should only be used when a program requires more memory than is returned by **Dsp_Available()**.

SEE ALSO **Dsp_Available()**

Dsp_GetProgAbility()

WORD Dsp_GetProgAbility(VOID)

Dsp_GetProgAbility() returns the current ability code for the program currently residing in DSP memory.

OPCODE 114 (0x72)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$72,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Dsp_GetProgAbility()** returns the **WORD** ability code for the current program loaded in the DSP.

COMMENTS If you know the defined ability code of the program you wish to use, you can use this call to see if the program already exists on the DSP and avoid reloading it.

SEE ALSO **Dsp_InqSubrAbility()**

Dsp_GetWordSize()

WORD Dsp_GetWordSize(VOID)

Dsp_GetWordSize() returns the size of a DSP word in the installed Digital Signal Processor.

OPCODE 103 (0x67)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$67,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Dsp_GetWordSize()** returns the number of bytes per DSP word.

COMMENTS This value is useful with many DSP-related **XBIOS** calls to provide upward compatibility as the DSP hardware is not guaranteed to remain the same.

Dsp_Hf0()

WORD Dsp_Hf0(***flag*** **)**
WORD *flag*;

Dsp_Hf0() reads/writes to bit #3 of the HSR.

OPCODE 119 (0x77)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *flag* has three legal values as follows:

Name	*flag*	Meaning
HF_CLEAR	0	Clear bit #3 of the DSP's HSR.
HF_SET	1	Set bit #3 of the DSP's HSR.
HF_INQUIRE	-1	Return the current value of bit #3 of the DSP's HSR.

BINDING

```
move.w      flag,-(sp)
move.w      #$77,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE If *flag* is **HF_INQUIRE** (-1), **Dsp_Hf0()** returns the current state of bit #3 of the HSR register.

SEE ALSO **Dsp_Hf1()**

Dsp_Hf1()

WORD Dsp_Hf1(*flag*)
WORD *flag*;

Dsp_Hf1() reads/writes to bit #4 of the HSR.

OPCODE 120 (0x78)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *flag* has three legal values as follows:

Name	*flag*	Meaning
HF_CLEAR	0	Clear bit #4 of the DSP's HSR.
HF_SET	1	Set bit #4 of the DSP's HSR.
HF_INQUIRE	-1	Return the current value of bit #4 of the DSP's HSR.

BINDING

```
move.w      flag,-(sp)
move.w      #$78,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE If *flag* is **HF_INQUIRE** (-1), **Dsp_Hf1()** returns the current state of bit #4 of the HSR register.

SEE ALSO **Dsp_Hf0()**

Dsp_Hf2()

WORD Dsp_Hf2(VOID)

Dsp_Hf2() returns the current status of bit #3 of the DSP's HCR.

OPCODE 121 (0x79)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$79,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Dsp_Hf2()** returns the current setting of bit #3 of the HCR register (valid values are 0 or 1).

SEE ALSO **Dsp_Hf3()**

Dsp_Hf3()

WORD Dsp_Hf3(VOID)

Dsp_Hf3() returns the current status of bit #4 of the DSP's HCR.

OPCODE 122 (0x7A)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$7A,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Dsp_Hf3()** returns the current setting of bit #4 of the HCR register (valid values are 0 or 1).

SEE ALSO **Dsp_Hf2()**

Dsp_HStat()

BYTE Dsp_Hstat(VOID)

Dsp_HStat() returns the value of the DSP's ICR register.

OPCODE 125 (0x7D)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$7D,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Dsp_Hstat()** returns an 8-bit value representing the current state of the DSP's ICR register as follows:

Name	Bit	Meaning
ICR_RXDF	0	ISR Receive data register full (RXDF)
ICR_TXDE	1	ISR Transmit data register empty (TXDE)
ICR_TRDY	2	ISR Transmitter ready (TRDY)
ICR_HF2	3	ISR Host flag 2 (HF2)
ICR_HF3	4	ISR Host flag 3 (HF3)
—	5	Reserved
ICR_DMA	6	ISR DMA Status (DMA)
ICR_HREQ	7	ISR Host Request (HREQ)

Dsp_InqSubrAbility()

WORD Dsp_InqSubrAbility(*ability*)
WORD *ability*;

Dsp_InqSubrAbility() determines if a subroutine with the specified ability code exists in the DSP.

OPCODE 117 (0x75)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *ability* is the ability code you wish to check.

BINDING

```
move.w      ability,-(sp)
move.w      #$75,-(sp)
```

```
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Dsp_InqSubrAbility()** returns a handle to the subroutine if found or 0 if not.

SEE ALSO **Dsp_RunSubroutine()**

Dsp_InStream()

VOID Dsp_InStream(***data_in, block_size, num_blocks, blocks_done*** **)**
char ****data_in*;**
LONG ***block_size***;
LONG ***num_blocks***;
LONG ****blocks_done*;**

Dsp_InStream() passes data to the DSP via an interrupt handler.

OPCODE 99 (0x63)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *data_in* is a pointer to unsigned character data which should be transferred to the DSP. *block_size* indicates the number of DSP **WORD**s that will be transferred at each interrupt. *num_blocks* indicates the number of blocks to transfer.

The **LONG** pointed to by *blocks_done* will be constantly updated to let the application know the progress of the transfer.

BINDING

```
pea         blocks_done
move.l      num_blocks,-(sp)
move.l      block_size,-(sp)
pea         data_in
move.w      #$63,-(sp)
trap        #14
lea         18(sp),sp
```

CAVEATS No handshaking is performed with this call. If the data you are transmitting is error sensitive, use **Dsp_BlkHandShake()**.

COMMENTS This call is suited for transferring small blocks while other blocks are being prepared for transfer. For larger blocks, **Dsp_DoBlock()** would be more suitable.

SEE ALSO **Dsp_BlkHandShake(), Dsp_DoBlock()**

Dsp_IOStream()

VOID Dsp_IOStream(***data_in, data_out, block_insize, block_outsize, num_blocks, blocks_done*** **)**
char * ***data_in*****, *** ***data_out*****;**
LONG ***block_insize, block_outsize, num_blocks*****;**
LONG * ***blocks_done*****;**

Dsp_IOStream() uses two interrupt handlers to transmit and receive data from the DSP.

OPCODE 101 (0x65)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *data_in* is a pointer to a buffer in which each output block is placed. *data_out* is a pointer to a buffer used to receive each data block from the DSP.

block_insize and *block_outsize* represent the size of the blocks to send and receive, respectively, in DSP **WORD**s. *num_blocks* is the total number of blocks to transfer.

The **LONG** pointed at by *blocks_done* is constantly updated to indicate the number of blocks actually transferred.

BINDING

```
pea         blocks_done
move.l      num_blocks,-(sp)
move.l      block_outsize,-(sp)
move.l      block_insize,-(sp)
pea         data_out
pea         data_in
move.w      #$65,-(sp)
trap        #14
lea         26(sp),sp
```

CAVEATS This call makes the assumption that the DSP will be ready to accept a new block as input every time it finishes sending a block back to the host.

COMMENTS No handshaking is performed with this call. If your data is error-sensitive, you should use **Dsp_BlkHandShake()**.

SEE ALSO **Dsp_InStream(), Dsp_OutStream()**

Dsp_LoadProg()

WORD Dsp_LoadProg(*file*, *ability*, *buf*)
char ****file*;
WORD ***ability*;**
char ****buf*;

Dsp_LoadProg() loads a '.LOD' file from disk, transmits it to the DSP, and executes it.

OPCODE

108 (0x6C)

AVAILABILITY

This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS

file is a pointer to a **NULL**-terminated string containing a valid **GEMDOS** file specification. *ability* is the unique ability code that will be assigned to this program. *buf* should point to a temporary buffer where the DSP will place the binary code it generates. The minimum size of the buffer is determined by the following formula:

```
3 * ( #program/data words + (3 * #blocks in program))
```

BINDING

```
pea         buf
move.w      ability,-(sp)
pea         file
move.w      #$6C,-(sp)
trap        #14
lea         12(sp),sp
```

RETURN VALUE

Dsp_LoadProg() returns a 0 is successful or -1 otherwise.

COMMENTS

Before loading you should determine if a program already exists on the DSP with your chosen ability with **Dsp_GetProgAbility()**.

SEE ALSO

Dsp_LoadSubroutine()

Dsp_LoadSubroutine()

WORD Dsp_LoadSubroutine(*ptr*, *size*, *ability*)
char **ptr*;
LONG *size*;
WORD *ability*;

Dsp_LoadSubroutine() transmits subroutine code to the DSP.

OPCODE 116 (0x74)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *ptr* points to a memory buffer which contains DSP binary subroutine code. *size* is the length of code to transfer (specified in DSP words). *ability* is the **WORD** identifier for the unique ability of this subroutine.

BINDING

```
move.w      ability,-(sp)
move.l      size,-(sp)
pea         ptr
move.w      #$74,-(sp)
trap        #14
lea         12(sp),sp
```

RETURN VALUE **Dsp_LoadSubroutine()** returns the handle assigned to the subroutine or 0 if an error occurred.

COMMENTS DSP subroutines have many restrictions and you should see the previous discussion of the DSP for more information.

SEE ALSO **Dsp_RunSubroutine(), Dsp_InqSubrAbility()**

Dsp_Lock()

WORD Dsp_Lock(VOID)

Dsp_Lock() locks the use of the DSP to the calling application.

OPCODE 104 (0x68)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$68,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Dsp_Lock()** returns a 0 if successful or -1 if the DSP has been locked by another application.

COMMENTS **Dsp_Lock()** should be performed before each use of the DSP to prevent other applications from modifying DSP memory or flushing subroutines. A corresponding **Dsp_Unlock()** should be issued at the end of each usage. You should limit the amount of time the DSP is locked so other applications may utilize it.

SEE ALSO **Dsp_Unlock()**

Dsp_LodToBinary()

LONG Dsp_LodToBinary(*file, codeptr*)
char **file,*codeptr*;

Dsp_LodToBinary() reads a '.LOD' file and converts the ASCII data to binary program code ready to be sent to the DSP via **Dsp_ExecProg()** or **Dsp_ExecBoot()**.

OPCODE 111 (0x6F)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *file* is a character pointer to a null-terminated **GEMDOS** file specification. *codeptr* should point to a large enough buffer to hold the resulting binary program code.

BINDING

```
pea         codeptr
pea         file
move.w      #$6F,-(sp)
trap        #14
lea         10(sp),sp
```

RETURN VALUE **Dsp_LodToBinary()** returns the size of the resulting program code in DSP words or a negative error code.

SEE ALSO **Dsp_ExecProg(), Dsp_LoadProg()**

Dsp_MultBlocks()

VOID Dsp_MultBlocks(***numsend, numreceive, sendblks, receiveblks*** **)**
LONG ***numsend, numreceive*****;**
DSPBLOCK ****sendblks, *receiveblks*****;**

Dsp_MultBlocks() transmit and receive multiple blocks of DSP data of varying size.

OPCODE

127 (0x7F)

AVAILABILITY

This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS

numsend and *numreceive* indicate the number of blocks of DSP data to send and receive respectively. *sendblks* and *receiveblks* are both pointers to arrays of type **DSPBLOCK** which contain information for each block. **DSPBLOCK** is defined as follows:

```
typedef struct
{
#define BLOCK_LONG    0
#define BLOCK_WORD    1
#define BLOCK_UBYTE   2
       /* 0 = LONGs, 1 = WORDs, 2 = UBYTEs */
       WORD blocktype;

       /* Num elements in block */
       LONG blocksize;

       /* Start address of block */
       VOIDP blockaddr;
} DSPBLOCK;
```

BINDING

```
pea          receiveblks
pea          sendblks
move.l       numreceive,-(sp)
move.l       numsend,-(sp)
move.w       #$7F,-(sp)
trap         #14
lea          20(sp),sp
```

CAVEATS

No handshaking is performed with this call. To transfer blocks with handshaking use **Dsp_BlkHandShake()**.

Dsp_OutStream()

VOID Dsp_OutStream(***data_out, block_size, num_blocks, blocks_done*** **)**
char * ***data_out*****;**
LONG ***block_size*****;**
LONG ***num_blocks*****;**
LONG * ***blocks_done*****;**

Dsp_OutStream() transfers data from the DSP to a user-specified buffer using interrupts.

OPCODE 100 (0x64)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS This call transfers data from the DSP to the buffer pointed to by *data_out* via an interrupt handler. *block_size* specifies the number of DSP **WORD**s to be transferred and *num_blocks* specifies the number of blocks to transfer.

The **LONG** pointed to by *blocks_done* will be constantly updated by the interrupt handler to indicate the number of blocks successfully transferred. The process is complete when *blocks_done* is equal to *num_blocks*.

BINDING

```
pea         blocks_done
move.l      num_blocks,-(sp)
move.l      block_size,-(sp)
pea         data_out
move.w      #$64,-(sp)
trap        #1
lea         18(sp),sp
```

SEE ALSO **Dsp_DoBlock(), Dsp_MultBlocks(), Dsp_InStream()**

Dsp_RemoveInterrupts()

VOID Dsp_RemoveInterrupts(***mask*** **)**
WORD ***mask*****;**

Dsp_RemoveInterrupts() turns off the generation of DSP interrupts.

OPCODE 102 (0x66)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *mask* is an **WORD** bit mask indicating which interrupts to turn off composed of one or both of the following values:

Name	Mask	Meaning
RTS_OFF	0x01	Disable DSP Ready to Send Interrupts
RTR_OFF	0x02	Disable DSP Ready to Receive Interrupts

BINDING

```
move.w      mask,-(sp)
move.w      #$66,-(sp)
trap        #14
addq.l      #4,sp
```

COMMENTS This call is used to terminate interrupts when an interrupt driven block transfer function does not terminate as expected (this will occur when less than the expected number of blocks is returned) and to shut off interrupts installed by **Dsp_SetVectors()**.

SEE ALSO **Dsp_SetVectors()**

Dsp_RequestUniqueAbility()

WORD Dsp_RequestUniqueAbility(VOID)

Dsp_RequestUniqueAbility() generates a random ability code that is currently not in use.

OPCODE 113 (0x71)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$71,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Dsp_RequestUniqueAbility()** returns a unique ability code to assign to a subroutine or program.

COMMENTS Using this function allows you to call **Dsp_InqSubrAbility()** and **Dsp_GetProgAbility()** to determine if the DSP code your application has already loaded is still present (i.e. has not been flushed by another application).

SEE ALSO **DspInqSubrAbility(), Dsp_GetProgAbility()**

Dsp_Reserve()

WORD Dsp_Reserve(***xreserve, yreserve*** **)**
LONG ***xreserve, yreserve*****;**

Dsp_Reserve() reserves DSP memory for program usage.

OPCODE 107 (0x6B)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *xreserve* and *yreserve* specify the amount of memory (in DSP words) to reserve for a DSP program in X and Y memory space respectively. *xreserve* and *yreserve* must include all program/data space so that subroutines do not overwrite your reserved area.

BINDING

```
move.l      yreserve,-(sp)
move.l      xreserve,-(sp)
move.w      #$6B,-(sp)
trap        #14
lea         10(sp),sp
```

RETURN VALUE **Dsp_Reserve()** returns a 0 if the memory was reserved successfully or -1 if not enough DSP memory was available.

COMMENTS If this call fails you should call **Dsp_FlushSubroutines()** and then retry it. If it fails a second time, the DSP lacks enough memory space to run your program.

Dsp_RunSubroutine()

WORD Dsp_RunSubroutine(***handle*** **)**
WORD ***handle*****;**

Dsp_RunSubroutine() begins execution of the specified subroutine.

OPCODE 118 (0x76)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *handle* is the **WORD** identifier of the DSP subroutine to engage.

BINDING

```
move.w      handle,-(sp)
move.w      #$76,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Dsp_RunSubroutine()** returns a 0 if successful or a negative code indicating failure.

SEE ALSO **Dsp_LoadSubroutine()**

Dsp_SetVectors()

VOID Dsp_SetVectors(*receiver*, *transmitter*)
VOID (receiver*)();**
LONG (transmitter*)();**

Dsp_SetVectors() sets the location of application interrupt handlers that are called when the DSP is either ready to send or receive data.

OPCODE 126 (0x7E)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *receiver* is the address of an interrupt handler which is called when the DSP is ready to send a DSP word of data or **NULLFUNC** (VOID (*)() 0L) if you do not wish to set this interrupt.

Likewise, *transmitter* is a pointer to an interrupt handler which is called when the DSP is ready to receive a DSP word of data or **NULLFUNC** if you do not wish to install a *transmitter* interrupt.

Any function installed to handle *transmitter* interrupts should return a **LONG** which has one of the following values:

Name	*transmitter* Return Value	Meaning
DSPSEND_NOTHING	0x00000000	Do not send any data to the DSP.
DSPSEND_ZERO	0xFF000000	Transmit a DSP word of 0 to the DSP.
—	Any other	Transmit the low 24 bits to the DSP.

BINDING

```
move.l      #transmitter,-(sp)
move.l      #receiver,-(sp)
move.w      #$7E,-(sp)
trap        #14
lea         10(sp),sp
```

COMMENTS Use **Dsp_RemoveInterrupts()** to turn off interrupts set with this call.

SEE ALSO **Dsp_RemoveInterrupts()**

Dsp_TriggerHC()

VOID Dsp_TriggerHC(***vector*** **);**
WORD ***vector*****;**

Dsp_TriggerHC() causes a host command set aside for DSP programs to execute.

OPCODE 112 (0x70)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

PARAMETERS *vector* specifies the vector to execute.

BINDING

```
move.w      vector,-(sp)
move.w      #$70,-(sp)
trap        #14
addq.l      #4,sp
```

CAVEATS Currently vectors 0x13 and 0x14 are the only vectors available for this purpose. All other vectors are overwritten by the system on program load and are used by the system and subroutines.

Dsp_Unlock()

VOID Dsp_Unlock(VOID)

Dsp_Unlock() unlocks the sound system from use by a process which locked it previously using **Dsp_Lock()**.

OPCODE 105 (0x69)

AVAILABILITY This call is only available if the fifth bit of the '_SND' cookie is set.

BINDING

```
move.w      #$69,-(sp)
trap        #14
addq.l      #2,sp
```

SEE ALSO **Dsp_Lock()**

Dsptristate()

LONG Dsptristate(***dspxmit, dsprec*** **)**
WORD ***dspxmit, dsprec*****;**

Dsptristate() connects or disconnects the DSP from the connection matrix.

OPCODE 137 (0x89)

AVAILABILITY Available if '_SND' cookie has bits 3 and 4 set.

PARAMETERS *dpsxmit* and *dsprec* specify whether data being transmitted and/or recorded into the DSP passes through the connection matrix. A value of **DSP_TRISTATE** (0) indicates a 'tristate' condition where data is not fed through the matrix. A value of **DSP_ENABLE** (1) enables the use of the connection matrix.

BINDING

```
move.w      dsprec,-(sp)
move.w      dspxmit,-(sp)
move.w      #$89,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Dsptristate()** returns 0 if no error occurred or non-zero otherwise.

COMMENTS This call is used in conjunction with **Devconnect()** to link the DSP to the internal sound system.

SEE ALSO **Devconnect()**

EgetPalette()

VOID EgetPalette(***start, count, paldata*** **)**
WORD ***start, count*****;**
WORD ****paldata***;**

EgetPalette() copies the current TT030 color palette data into a specified buffer..

OPCODE 85 (0x55)

AVAILABILITY This call is available when the high word of the '_VDO' cookie has a value of 2.

PARAMETERS *start* gives the index (0-255) of the first color register to copy data into. *count* specifies the total number of registers to copy. *paldata* is a pointer to an array where the TT030 palette data will be stored. Each **WORD** will be formatted as

follows:

Bits 15-12	Bits 11-8	Bits 7-4	Bits 3-0
Reserved	Red	Green	Blue

BINDING

```
pea         palette
move.w      count,-(sp)
move.w      start,-(sp)
move.w      #$55,-(sp)
trap        #14
lea         10(sp),sp
```

CAVEATS This call is machine-dependent to the TT030. It is therefore recommended that **vq_color()** be used in most instances.

COMMENTS Unlike **Setpalette()** this call encodes color nibbles from the most signifigant to least signifigant bit (3-2-1-0) as opposed to the compatibilty method of 0-3-2-1.

SEE ALSO **Esetpalette(), vq_color()**

EgetShift()

WORD EgetShift(VOID)

EgetShift() returns the current mode of the video shifter.

OPCODE 81 (0x51)

AVAILABILITY This call is available when the high word of the '_VDO' cookie has a value of 2.

BINDING

```
move.w      #$51,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **EgetShift()** returns a **WORD** bit array which is divided as follows:

Mask Name	Bit(s)	Meaning
ES_BANK	0–3	These bits determine the current color bank being used by the TT (in all modes with less than 256 colors). The macro **ColorBank()** as defined below will extract the current bank code. `#define ColorBank(x) ((x) & ES_BANK)`
—	4–7	Unused

ES_MODE	8–10	These bits determine the current mode of the TT video shifter as follows: **Name** **Value** **ST_LOW** 0x0000 **ST_MED** 0x0100 **ST_HIGH** 0x0200 **TT_MED** 0x0300 **TT_HIGH** 0x0600 **TT_LOW** 0x0700 The current shifter mode code can be extracted with the following macro: `#define ScreenMode(x) ((x) & ES_MODE)`
—	11	Unused
ES_GRAY	12	This bit determines if the TT video shifter is currently in grayscale mode. The following macro can be used to extract this information: `#define IsGrayMode(x) ((x) & ES_GRAY)`
—	13–14	Unused
ES_SMEAR	15	If this bit is set, the TT video shifter is currently in smear mode. The following macro can be used to extract this information: `#define IsSmearMode(x)  ((x) & ES_SMEAR)`

SEE ALSO **EsetGray(), EsetShift(), EsetSmear(), EsetBank()**

EsetBank()

WORD EsetBank(***bank*** **)**
WORD ***bank*****;**

EsetBank() chooses which of 16 banks of color registers is currently active.

OPCODE 82 (0x52)

AVAILABILITY This call is available when the high word of the '_VDO' cookie has a value of 2.

PARAMETERS *bank* specifies the index of the color bank to activate. A value of **ESB_INQUIRE** (-1) does not change anything but still returns the current bank.

BINDING

```
move.w      bank,-(sp)
move.w      #$52,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **EsetBank()** returns the index of the old blank.

CAVEATS This call is machine-dependent to the TT030.

SEE ALSO **EgetShift()**

EsetColor()

WORD EsetColor(*idx, color*)
WORD *idx, color*;

EsetColor() sets an individual color in the TT030's palette.

OPCODE 83 (0x53)

AVAILABILITY This call is available when the high word of the '_VDO' cookie has a value of 2.

PARAMETERS *idx* specifies the color index to modify (0-255). *color* is a TT030 format color **WORD** bit array divided as follows:

Bits 15-12	Bits 11-8	Bits 7-4	Bits 3-0
Reserved	Red	Green	Blue

If *color* is **EC_INQUIRE** (-1) then the call does not change the register but still returns it value.

BINDING

```
move.w      color,-(sp)
move.w      idx,-(sp)
move.w      #$53,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **EsetColor()** returns the old value of the color register.

CAVEATS This call is machine-dependent to the TT030. It is therefore recommended that **vs_color()** be used instead for compatibility.

COMMENTS Unlike **Setpalette()** this call encodes color nibbles from the most signifigant to least signifigant bit (3-2-1-0) as opposed to the compatibilty method of 0-3-2-1.

SEE ALSO **EsetPalette(), vs_color()**

EsetGray()

WORD EsetGray(*mode*)
WORD *mode*;

EsetGray() reads/modifies the TT030's video shifter gray mode bit.

OPCODE 86 (0x56)

AVAILABILITY This call is available when the high word of the '_VDO' cookie has a value of 2.

PARAMETERS *mode* is defined as follows:

Name	*mode*	Meaning
ESG_INQUIRE	-1	Return the gray bit of the video shifter.
ESG_COLOR	0	Set the video shifter to interpret the lower 16 bits of a palette entry as a TT030 color value (RGB 0-15).
ESG_GRAY	1	Set the video shifter to interpret the lower 8 bits of a palette entry as a TT030 gray value (0-255)

BINDING

```
move.w      mode,-(sp)
move.w      #$56,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **EsetGray()** returns the previous value of the video shifter's gray bit.

CAVEATS This call is machine-dependent to the TT030.

SEE ALSO **EgetShift()**

EsetPalette()

VOID EsetPalette(*start, count, paldata*)
WORD *start,count*;
WORD **paldata*;

EsetPalette() copies TT030 color **WORD**s from the specified buffer into the TT030 Color Lookup Table (CLUT).

OPCODE 84 (0x54)

AVAILABILITY This call is available when the high word of the '_VDO' cookie has a value of 2.

PARAMETERS *start* specifies the index of the starting color register to copy color data to. *count* indicates the number of palette **WORD**s to copy. *paldata* is a pointer to an array of palette **WORD**s to copy.

BINDING

```
pea         palette
move.w      count,-(sp)
move.w      start,-(sp)
move.w      #$54,-(sp)
trap        #14
lea         10(sp),sp
```

CAVEATS This call is machine-dependent to the TT030. It is therefore recommended that **vs_color()** be used instead for compatibility.

COMMENTS For the format of the color **WORD**s, see **EgetPalette()**.

SEE ALSO **EgetPalette(), vq_color()**

EsetShift()

WORD EsetShift(***mode*** **)**
WORD *mode*;

EsetShift() reads/modifies the TT030 video shifter.

OPCODE 80 (0x50)

AVAILABILITY This call is available when the high word of the '_VDO' cookie has a value of 2.

PARAMETERS *mode* is a **WORD** bit array which defines the new setting of the video shifter as follows:

Name	Bit(s)	Meaning
—	0–3	These bits determine the current color bank being used by the TT (in all modes with less than 256 colors).
—	4–7	Unused
—	8–10	These bits determine the current mode of the TT video shifter as follows: **Name** — **Bit Mask** **ST_LOW** 0x0000 **ST_MED** 0x0100 **ST_HIGH** 0x0200 **TT_MED** 0x0300 **TT_HIGH** 0x0600 **TT_LOW** 0x0700

—	11	Unused
ES_GRAY	12	Setting this bit places the TT video shifter in grayscale mode.
—	13–14	Unused
ES_SMEAR	15	Setting this bit places the TT video shifter in smearsmear mode.

BINDING

```
move.w      mode,-(sp)
move.w      #$50,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **EsetShift()** returns the old *mode* setting of the video shifter.

CAVEATS This call is machine-dependent to the TT030.

SEE ALSO **EgetShift(), EsetGray(), EsetSmear(), EsetBank()**

EsetSmear()

WORD EsetSmear(*mode*)
WORD *mode*;

EsetSmear() reads/modifies the current state of the video shifter's smear mode bit.

OPCODE 87 (0x57)

AVAILABILITY This call is available when the high word of the '_VDO' cookie has a value of 2.

PARAMETERS *mode* specifies the action of this call as follows:

Name	*mode*	Meaning
ESM_INQUIRE	-1	Return the smear bit of the video shifter.
ESM_NORMAL	0	Set the video shifter to process video data normally.
ESM_SMEAR	1	Set the video shifter to repeat the color of the last displayed pixel each time a 0x0000 is read from video memory.

BINDING

```
move.w      mode,-(sp)
move.w      #$57,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **EsetSmear()** returns the prior setting of the video shifter's smear mode bit.

SEE ALSO **Egetshift(), EsetShift()**

Flopfmt()

WORD Flopfmt(***buf, skew, dev, spt, track, side, intlv, magic, virgin*** **)**
VOIDP ***buf*****;**
WORD ****skew*****;**
WORD ***dev, spt, track, side, intlv*****;**
LONG ***magic*****;**
WORD ***virgin*****;**

Flopfmt() formats a specified track on a floppy disk.

OPCODE 10 (0x0A)

AVAILABILITY All **TOS** versions.

PARAMETERS *buf* is a pointer to a word-aligned buffer large enough to hold one disk track which is used to build a copy of each sector to write. *skew* should be **NULL** for non-interleaved sectors or point to a **WORD** array containing *spt* entries which specifies the sector interleave order.

dev specifies which floppy drive to format ('A:' = **FLOP_DRIVEA** (0), 'B:' = **FLOP_DRIVEB** (1)). *spt* indicates the number of sectors to format. *track* indicates which track to format.

side indicates the side to format. *intlv* should be **FLOP_NOSKEW** (1) for consecutive sectors or **FLOP_SKEW** (-1) to interleave the sectors based on the array pointed to by *skew*.

magic is a fixed magic number which must be **FLOP_MAGIC** (0x87654321). *virgin* is the value to assign to uninitialized sector data (should be **FLOP_VIRGIN** (0xE5E5)).

BINDING

```
move.w      virgin,-(sp)
move.l      magic,-(sp)
move.w      intlv,-(sp)
move.w      side,-(sp)
move.w      track,-(sp)
move.w      spt,-(sp)
move.w      dev,-(sp)
pea         skew
pea         buf
move.w      #$0A,-(sp)
trap        #14
lea         26(sp),sp
```

RETURN VALUE **Flopfmt()** returns 0 if the track was formatted successfully or non-zero otherwise.

Also, upon exit, *buf* will be filled in with a **WORD** array of sectors that failed formatting terminated by an entry of 0. If no errors occurred then the first **WORD** of *buf* will be 0.

COMMENTS

The steps required to a format a floppy disk are as follows:

1. Call **Flopfmt()** to format the disk as desired.
2. Call **Protobt()** to create a prototype boot sector in memory.
3. Call **Flopwr()** to write the prototype boot sector to track 0, side 0, sector 1.

Interleaved sector formatting is only possible as of **TOS** 1.2. *skew* should be set to **NULL** and *intlv* should be set to **FLOP_NOSKEW** under **TOS** 1.0.

Specifying an *intlv* value of **FLOP_SKEW** and a *skew* array equalling { 1, 2, 3, 4, 5, 6, 7, 8, 9 } is the same as specifying an *intlv* value of **FLOP_NOSKEW**. To accomplish a 9 sector 2:1 interleave you would use a *skew* array which looked like: { 1, 6, 2, 7, 3, 8, 4, 9, 5 }.

The '_FDC' cookie (if present) contains specific information regarding the installed floppy drives. The lower three bytes of the cookie value contain a three-letter code indicating the manufacturer of the drive (Atari is 0x415443 'ATC'). The high byte determines the capabilities of the highest density floppy drive currently installed as follows:

Name	Value	Meaning
FLOPPY_DSDD	0	Standard Density (720K)
FLOPPY_DSHD	1	High Density (1.44MB)
FLOPPY_DSED	2	Extra High Density (2.88MB)

To format a high density diskette, multiple the *spt* parameter by 2. To format a extra-high density diskette, multiply the *spt* parameter by 4.

This call forces a 'media changed' state on the device which will be returned on the next **Mediach()** or **Rwabs()** call.

SEE ALSO **Floprate(), Floprd(), Flopwr()**

Floprate()

WORD Floprate(***dev, rate*** **)**
WORD ***dev, rate*****;**

Floprate() sets the seek rate of the specified floppy drive.

OPCODE 41 (0x29)

AVAILABILITY Available on all **TOS** versions except 1.00.

PARAMETERS *dev* indicates the floppy drive whose seek rate you wish to modify ('A:' = **FLOP_DRIVEA** (0), 'B:' = **FLOP_DRIVEB** (1)). *rate* specifies the seek rate as follows:

Name	*rate*	Meaning
FRATE_6	0	Set seek rate to 6ms
FRATE_12	1	Set seek rate to 12ms
FRATE_2	2	Set seek rate to 2ms
FRATE_3	3	Set seek rate to 3ms

A *rate* value of **FRATE_INQUIRE** (-1) will inquire the current seek rate without modifying it.

BINDING

```
move.w      rate,-(sp)
move.w      dev,-(sp)
move.w      #$29,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Floprate()** returns the prior seek rate for the specified drive.

COMMENTS **TOS** version 1.00 can have its seek rates set by setting the system variable (*_seekrate* (**WORD** *)0x440) to the desired value (as in *rate*). Note that you can only set the seek rate for *both* drives in this manner.

Floprd()

WORD Floprd(*buf, rsrvd, dev, sector, track, side, count*)
VOIDP *buf*;
LONG *rsrvd*;
WORD *dev, sector, track, side, count*;

Floprd() reads sectors from a floppy disk.

OPCODE 8 (0x08)

AVAILABILITY All **TOS** versions.

PARAMETERS *buf* points to a word-aligned buffer where the data to be read will be stored. *rsrvd* is currently unused and should be 0. *dev* specifies the floppy drive to read from

('A:' = **FLOP_DRIVEA** (0), 'B:' = **FLOP_DRIVEB** (1)). The function reads *count* physical sectors starting at sector *sector*, track *track*, side *side*.

BINDING

```
move.w      count,-(sp)
move.w      side,-(sp)
move.w      track,-(sp)
move.w      sector,-(sp)
move.w      dev,-(sp)
move.l      rsrvd,-(sp)
pea         buf
move.w      #$08,-(sp)
trap        #14
lea         20(sp),sp
```

RETURN VALUE **Floprd()** returns 0 if the operation was successful or non-zero otherwise.

CAVEATS This function reads sectors in physical order (not taking interleave into account). Use **Rwabs()** to read logical sectors.

SEE ALSO **Flopwr(), Flopfmt(), Flopver(), Rwabs()**

Flopver()

WORD Flopver(***buf, rsrvd, dev, sector, track, side, count*** **)**
VOIDP ***buf*****;**
LONG ***rsrvd*****;**
WORD ***dev, sector, track, side, count*****;**

Flopver() verifies data on a floppy disk with data in memory.

OPCODE 19 (0x13)

AVAILABILITY All **TOS** versions.

PARAMETERS *buf* is a pointer to a word-aligned buffer to compare the sector against. *rsrvd* is unused and should be 0. *dev* specifies the drive to verify ('A:' = **FLOP_DRIVEA** (0), 'B:' = **FLOP_DRIVEB** (1)). This function verifies *count* sectors starting at sector *sector*, track *track*, side *side*.

BINDING

```
move.w      count,-(sp)
move.w      side,-(sp)
move.w      track,-(sp)
move.w      sector,-(sp)
move.w      dev,-(sp)
move.l      rsrvd,-(sp)
pea         buf
move.w      #$13,-(sp)
trap        #14
lea         20(sp),sp
```

RETURN VALUE **Flopver()** returns 0 if all sectors were successfully verified or a non-zero value otherwise.

CAVEATS This function only verifies sectors in physical order.

COMMENTS As with **Flopfmt()**, upon the return of the function, *buf* is filled in with a **WORD** array containing a list of any sectors which failed. The array is terminated with a **NULL**.

SEE ALSO **Flopwr(), Flopfmt()**

Flopwr()

WORD Flopwr(***buf, rsrvd, dev, sector, track, side, count*** **)**
VOIDP ***buf*****;**
LONG ***rsrvd*****;**
WORD ***dev, sector, track, side, count*****;**

Flopwr() writes sectors to the floppy drive.

OPCODE 9 (0x09)

AVAILABILITY All **TOS** versions.

PARAMETERS *buf* is a pointer containing data to write. *rsrvd* is currently unused and should be set to 0. *dev* specifies the floppy drive to write to ('A:' = 0,'B:' = 1). This function writes *count* sectors starting at sector *sector*, track *track*, side *side*.

BINDING

```
move.w      count,-(sp)
move.w      side,-(sp)
move.w      track,-(sp)
move.w      sector,-(sp)
move.w      dev,-(sp)
move.l      rsrvd,-(sp)
pea         buf
move.w      #$09,-(sp)
trap        #14
lea         20(sp),sp
```

RETURN VALUE **Flopwr()** returns 0 if the sectors were successfully written or non-zero otherwise.

CAVEATS This function writes sectors in physical order only (ignoring interleave). Use **Rwabs()** to write sectors in logical order.

COMMENTS If this call is used to write to track 0, sector 1, side 0, the device will enter a

'media might have changed' state indicated upon the next **Rwabs()** or **Mediach()** call.

SEE ALSO **Floprd(), Flopfmt(), Flopver(),Rwabs()**

Getrez()

WORD Getrez(VOID)

Getrez() returns a machine-dependent code representing the current screen mode/ratio.

OPCODE 4 (0x04)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$04,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Getrez()** returns a value representing the current video display mode. To find the value you will receive back based on current Atari manufactured video hardware, refer to the following chart:

Colors: / Screen Dimension:	2	4	16	256	True Color
320x200	X	X	0	0	X
320x240	X	0	0	0	0
320x480	X	7	7	7	7
640x200	1	X	X	X	X
640x400	2	X	X	X	X
640x480	2	2	2†	2	2
1280x960	6	X	X	X	X

† This value varies. TT030 Medium resolution returns a value of 4, however, the Falcon returns a value of 2.

CAVEATS This call is *extremely* machine-dependent. Dependence on this call will make your program incompatible with third-party video boards and future hardware. Use the values returned by **v_opnvwk()** to determine screen attributes.

COMMENTS Use of this call in preparing to call **v_opnvwk()** is acceptable and must be done to specify the correct fonts to load from **GDOS**.

SEE ALSO **VsetMode(), Egetshift(), Setscreen()**

Gettime()

LONG Gettime(VOID)

Gettime() returns the current IKBD time.

OPCODE 23 (0x17)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$17,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Gettime()** returns a **LONG** bit array packed with the current IKBD time as follows:

Bits	Meaning
0-4	Seconds/2 (0-29)
5-10	Minute (0-59)
11-15	Hour (0-23)
16-20	Day (1-31)
21-24	Month (1-12)
25-31	Year-1980 (0-127)

The return value can be represented in a C structure as follows:

```
typedef struct
{
       unsigned year:7;
       unsigned month:4;
       unsigned day:5;
       unsigned hour:5;
       unsigned minute:6;
       unsigned second:5;
} BIOS_TIME;
```

SEE ALSO **Settime(), Tgettime(), Tgetdate()**

Giaccess()

WORD Giaccess(*data, register*)
WORD *data, register*;

Giaccess() reads/sets the registers of the FM sound chip and Port A/B peripherals.

OPCODE 28 (0x1C)

AVAILABILITY All **TOS** versions.

PARAMETERS The lower eight bits of *data* are written to the register selected by *register* if the value for *register* is OR'ed with 0x80 (high bit set). If this bit is not set, *data* is ignored and the value of the *register* is returned. *register* selects the register to read/write to as follows:

Name	*register*	Meaning
PSG_APITCHLOW **PSG_BPITCHHIGH**	0 1	Set the pitch of the PSG's channel A to the value in registers 0 and 1. Register 0 contains the lower 8 bits of the frequency and the lower 4 bits of register 1 contain the upper 4 bits of the frequency's 12-bit value.
PSG_BPITCHLOW **PSG_BPITCHHIGH**	2 3	Set the pitch of the PSG's channel B to the value in registers 0 and 1. Register 0 contains the lower 8 bits of the frequency and the lower 4 bits of register 1 contain the upper 4 bits of the frequency's 12-bit value.
PSG_CPITCHLOW **PSG_CPITCHHIGH**	2 3	Set the pitch of the PSG's channel C to the value in registers 0 and 1. Register 0 contains the lower 8 bits of the frequency and the lower 4 bits of register 1 contain the upper 4 bits of the frequency's 12-bit value.
PSG_NOISEPITCH	6	The lower five bits of this register set the pitch of white noise. The lower the value, the higher the pitch.
PSG_MODE	7	This register contains an eight bit map which determines various aspects of sound generation. Setting each bit on causes the following actions: **Name** — **Bit Mask** — **Meaning** **PSG_ENABLEA** 0x01 Chnl A tone enable **PSG_ENABLEB** 0x02 Chnl B tone enable **PSG_ENABLEC** 0x04 Chnl C tone enable **PSG_NOISEA** 0x08 Chnl A white noise on **PSG_NOISEB** 0x10 Chnl B white noise on **PSG_NOISEC** 0x20 Chnl C white noise on **PSG_PRTAOUT** 0x40 Port A: 0 = input, 1 = output **PSG_PRTBOUT** 0x80 Port B: 0 - input, 1 = output

PSG_AVOLUME	8	This register controls the volume of channel A. Values from 0-15 are absolute volumes with 0 being the softest and 15 being the loudest. Setting bit 4 causes the PSG to ignore the volume setting and to use the envelope setting in register 13.
PSG_BVOLUME	9	This register controls the volume of channel B. Values from 0-15 are absolute volumes with 0 being the softest and 15 being the loudest. Setting bit 4 causes the PSG to ignore the volume setting and to use the envelope setting in register 13.
PSG_CVOLUME	10	This register controls the volume of channel C. Values from 0-15 are absolute volumes with 0 being the softest and 15 being the loudest. Setting bit 4 causes the PSG to ignore the volume setting and to use the envelope setting in register 13.
PSG_FREQLOW **PSG_FREQHIGH**	11 12	Register 11 contains the low byte and register 12 contains the high byte of the frequency of the waveform specified in register 13. This value may range from 0 to 65535.
PSG_ENVELOPE	13	The lower four bits of the register contain a value which defines the envelope wavefrom of the PSG. The best definition of values is obtained through experimentation.
PSG_PORTA	14	This register accesses Port A of the Yamaha PSG. It is recommended that the functions **Ongibit()** and **Offgibit()** be used to access this register.
PSG_PORTB	15	This register accesses Port B of the Yamaha PSG. This register is currently assigned to the data in/out line of the Centronics Parallel port.

BINDING

```
move.w      register,-(sp)
move.w      data,-(sp)
move.w      #$1C,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Giaccess()** returns the value of the register in the lower eight bits of the word if *data* was OR'ed with 0x80.

Gpio()

LONG Gpio(*mode, data*)
WORD *mode, data*;

Gpio() reads/writes data over the general purpose pins on the DSP connector.

OPCODE 138 (0x8A)

AVAILABILITY Available if '_SND' cookie has bit 3 set.

PARAMETERS *mode* specifies the meaning of *data* and the return value as follows:

Name	*mode*	Meaning
GPIO_INQUIRE	0	Return the old value.
GPIO_READ	1	Read the three general purpose pins and return their state in the lower three bits of the returned value. *data* is ignored.
GPIO_WRITE	2	Write the lower three bits of *data* to the corresponding DSP pins. The return value is 0.

BINDING

```
move.w      data,-(sp)
move.w      mode,-(sp)
move.w      #$8A,-(sp)
trap        #14
addq.l      #6,sp
```

Ikbdws()

VOID Ikbdws(*len*, *buf*)
WORD *len*;
CHAR **buf*;

Ikbdws() writes the contents of a buffer to the intelligent keyboard controller.

OPCODE 25 (0x19)

AVAILABILITY All **TOS** versions.

PARAMETERS This function writes *len* + 1 characters from buffer *buf* to the IKBD.

BINDING

```
pea         buf
move.w      len,-(sp)
move.w      #$19,-(sp)
trap        #14
addq.l      #8,sp
```

Initmous()

VOID Initmous(***mode, param, vec*** **)**
WORD ***mode*****;**
VOIDP ***param*****;**
VOID (***vec*****)();**

Initmous() determines the method of handling IKBD mouse packets from the system.

OPCODE 0 (0x00)

AVAILABILITY All **TOS** versions.

PARAMETERS *mode* indicates a IKBD reporting mode and defines the meaning of the other parameters as listed below. *hand* points to a mouse packet handler which is called when each mouse packet is sent. Register A0 contains the mouse packet address when called.

Name	*mode*	Meaning
IM_DISABLE	0	Disable mouse reporting.

IM_RELATIVE	1	Enable relative mouse reporting mode. Packets report offsets from the previous mouse position. In this mode, *param* is a pointer to a structure as follows:
		
		`struct param`
		`{`
		`  BYTE topmode;`
		`  BYTE buttons;`
		`  BYTE xparam;`
		`  BYTE yparam;`
		`}`
		
		topmode is **IM_YBOT** (0) to indicate that Y=0 means bottom of the screen. A *topmode* value of **IM_YTOP** (1) indicates that Y=0 means the top of the screen.
		
		buttons is a bit array which affect the way mouse clicks are handled. A value of **IM_KEYS** (4) causes mouse buttons to generate keycodes rather than mouse packets. A value of **IM_PACKETS** (3) causes the absolute mouse position to be reported on each button press.
		
		xparam and *yparam* specify the number of mouse X/Y increments between position report packets.
		
		This mode is the default mode of the **AES** and **VDI**.

IM_ABSOLUTE	2	Enable absolute mouse reporting mode. Packets report actual screen positions. In this mode, *param* is a pointer to a structure as follows:
		
		`struct param`
		`{`
		`  BYTE topmode;`
		`  BYTE buttons;`
		`  BYTE xparam;`
		`  BYTE yparam;`
		`  WORD xmax;`
		`  WORD ymax;`
		`  WORD xinitial;`
		`  WORD yinitial;`
		`}`
		
		topmode, *buttons*, *xparam*, and *yparam* are the same as for mode 2.
		
		xmax and *ymax* specify the maximum X and Y positions the mouse should be allowed to move to. *xinital* and *yinitial* specify the mouse's initial location.

—	3	Unused
IM_KEYCODE	4	Enable mouse keycode mode. Keyboard codes for mouse movements are sent rather than actual mouse packets. *param* is handled the same as in mode 1.

BINDING

```
pea         hand
pea         param
move.w      mode,-(sp)
clr.w       -(sp)
trap        #14
lea         12(sp),sp
```

CAVEATS Changing the mouse packet handler to anything but relative mode will cause the **AES** and **VDI** to stop receiving mouse input.

SEE ALSO **Kbdvbase()**

Iorec()

IOREC *Iorec(*dev*)
WORD *dev*;

Iorec() returns the address in memory of system data structures relating to the buffering of input data.

OPCODE 14 (0x0E)

AVAILABILITY All **TOS** versions.

PARAMETERS *dev* specifies the device to return information about as follows:

Name	*dev*	Meaning
IO_SERIAL	0	Currently mapped serial device (see **Bconmap()**)
IO_KEYBOARD	1	Keyboard
IO_MIDI	2	MIDI

BINDING

```
move.w      dev,-(sp)
move.w      #$0E,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Iorec()** returns the address of an **IOREC** array with either one element (Keyboard or MIDI) or two elements (RS-232 - 1st = input, 2nd = output). The **IOREC** structure is defined as follows:

```
typedef struct
{
        /* start of buffer */
        char *ibuf;

        /* size of buffer */
        WORD ibufsize;

        /* head index mark of buffer */
        WORD ibufhd;

        /* tail index mark of buffer */
        WORD ibuftl;

        /* low-water mark of buffer */
        WORD ibuflow;

        /* high-water mark of buffer */
        WORD ibufhi;
} IOREC;
```

SEE ALSO **Bconmap()**

Jdisint()

VOID Jdisint(*intno*)
WORD *intno*;

Jdisint() disables an MFP interrupt.

OPCODE 26 (0x1A)

AVAILABILITY All **TOS** versions.

PARAMETERS *intno* specifies the interrupt to disable (see **Mfpint()** for a list).

BINDING

```
move.w      intno,-(sp)
move.w      #$1A,-(sp)
trap        #14
addq.l      #4,sp
```

SEE ALSO **Jenabint(), Mfpint()**

Jenabint()

VOID Jenabint(*intno*)
WORD *intno*;

Jenabint() enables an MFP interrupt.

OPCODE 27 (0x1B)

AVAILABILITY All **TOS** versions.

PARAMETERS *intno* specifies the interrupt to enable (see **Mfpint()** for a list).

BINDING

```
move.w      intno,-(sp)
move.w      #$1B,-(sp)
trap        #14
addq.l      #4,sp
```

SEE ALSO **Jdsint(), Mfpint()**

Kbdvbase()

KBDVECS *Kbdvbase(VOID)

Kbdvbase() returns a pointer to a system structure containing a 'jump' table to system vector handlers.

OPCODE 34 (0x22)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$22,-(sp)
trap        #14
```

```
addq.l      #2,sp
```

RETURN VALUE **Kbdvbase()** returns a pointer to a system structure **KBDVECS** which is defined as follows:

```
typedef struct
{
       VOID (*midivec)( UBYTE data );  /* MIDI Input */
       VOID (*vkbderr)( UBYTE data );  /* IKBD Error */
       VOID (*vmiderr)( UBYTE data );  /* MIDI Error */
       VOID (*statvec)(char *buf);     /* IKBD Status */
       VOID (*mousevec)(char *buf);        /* IKBD Mouse */
       VOID (*clockvec)(char *buf);        /* IKBD Clock */
       VOID (*joyvec)(char *buf);      /* IKBD Joystick */
       VOID (*midisys)( VOID );        /* Main MIDI Vector */
       VOID (*ikbdsys)( VOID );        /* Main IKBD Vector */
       char ikbdstate;                 /* See below */
} KBDVECS;
```

midivec is called with the received data byte in d0. If an overflow error occurred on either ACIA, *vkbderr* or *vmiderr* will be called, as appropriate by *midisys* or ikbdsys with the contents of the ACIA data register in d0.

statvec, *mousevec*, *clockvec*, and *joyvec* all are called with the address of the packet in register A0.

midisys and *ikbdsys* are called by the MFP ACIA interrupt handler when a character is ready to be read from either the midi or keyboard ports.

ikbdstate is set to the number of bytes remaining to be read by the *ikbdsys* handler from a multiple-byte status packet.

COMMENTS If you intercept any of these routines you should either JMP through the old handler or RTS.

SEE ALSO **Initmous()**

Kbrate()

WORD Kbrate(*delay, rate*)
WORD *delay, rate*;

Kbrate() reads/modifies the keyboard repeat/delay rate.

OPCODE 35 (0x23)

AVAILABILITY All **TOS** versions.

PARAMETERS *delay* specifies the amount of time (in 50Hz ticks) before a key begins repeating. *rate* indicates the amount of time between repeats (in 50Hz ticks). A parameter of **KB_INQUIRE** (-1) for either of these values leaves the value unchanged.

BINDING

```
move.w      rate,-(sp)
move.w      delay,-(sp)
move.w      #$23,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Kbrate()** returns a **WORD** with the low byte being the old value for *rate* and the high byte being the old value for *delay*.

Keytbl()

KEYTAB *Keytbl(*normal, shift, caps*)
char **unshift, *shift, *caps*;

Keytbl() reads/modifies the internal keyboard mapping tables.

OPCODE 16 (0x10)

AVAILABILITY All **TOS** versions.

PARAMETERS *normal* is a pointer to an array of 128 **CHAR**s which can be indexed by a keyboard scancode to return the correct ASCII value for a given unshifted key. *shift* and *caps* point to similar array except their values are only utilized when SHIFT and CAPS-LOCK respectively are used. Passing a value of **KT_NOCHANGE** ((char *)-1) will leave the table unchanged.

BINDING

```
pea         caps
pea         shift
pea         normal
move.w      #$10,-(sp)
trap        #14
lea         14(sp),sp
```

RETURN VALUE **Keytbl()** returns a pointer to a **KEYTAB** structure defined as follows:

```
typedef struct
{
        char *unshift;
        char *shift;
        char *caps;
} KEYTAB;
```

The entries in this table each point to the current keyboard lookup table in their category.

Entries are indexed with a keyboard scancode to obtain the ASCII value of a key. A value of 0 indicates that no ASCII equivalent exists.

SEE ALSO **Bioskeys()**

Locksnd()

LONG Locksnd(VOID)

Locksnd() prevents other applications from simultaneously attempting to use the sound system.

OPCODE 128 (0x80)

AVAILABILITY Available if the '_SND' cookie has bit 2 set.

BINDING

```
move.w      #$80,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Locksnd()** returns 1 if the sound system was successfully locked or **SNDLOCKED** (-129) if the sound system was already locked.

COMMENTS This call should be used prior to any usage of the 16-bit DMA sound system.

SEE ALSO **Unlocksnd()**

Logbase()

VOIDP Logbase(VOID)

Logbase() returns a pointer to the base of the logical screen.

OPCODE 3 (0x03)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$03,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Logbase()** returns a pointer to the base of the logical screen.

COMMENTS The logical screen should not be confused with the physical screen. The logical screen is the memory area where the **VDI** does any drawing. The physical screen is the memory area where the video shifter gets its data from. Normally they are the same; however, keeping the addresses separate facilitates screen flipping.

SEE ALSO **Physbase()**

Metainit()

VOID Metainit(*metainfo*)
METAINFO ****metainfo***;**

Metainit() returns information regarding the current version and installed drives of **MetaDOS**.

OPCODE 48 (0x30)

AVAILABILITY To test for the availability of **MetaDOS** the following steps must be taken:

1. Fill the **METAINFO** structure with all zeros.
2. Call **Metainit()**.
3. If *metainfo.version* is **NULL**, **MetaDOS** is not installed.

PARAMETERS *metainfo* is a pointer to a **METAINFO** structure which is filled in by the call. **METAINFO** is defined as:

```
typedef struct
{
       /* Bitmap of drives (Bit 0 = A, 1 = B, etc... */
       ULONG drivemap;

       /* String containing name and version */
       char *version;

       /* Currently unused */
       LONG reserved[2];
} METAINFO;
```

BINDING

```
pea          metainfo
move.w       #$30,-(sp)
trap         #14
addq.l       #6,sp
```

Mfpint()

VOID Mfpint(***intno, vector*** **)**
WORD ***intno*****;**
VOID (***vector*****)();**

Mfpint() defines an interrupt handler for an MFP interrupt.

OPCODE 13 (0x0D)

AVAILABILITY All **TOS** versions.

PARAMETERS *intno* is an index to a vector to replace with *vector* as follows:

Name	*intno*	Vector
MFP_PARALLEL	0	Parallel port
MFP_DCD	1	RS-232 Data Carrier Detect
MFP_CTS	2	RS-232 Clear To Send
MFP_BITBLT	3	BitBlt Complete
MFP_TIMERD or **MFP_BAUDRATE**	4	Timer D (RS-232 baud rate generator)
MFP_200HZ	5	Timer C (200Hz system clock)
MFP_ACIA	6	Keyboard/MIDI vector
MFP_DISK	7	Floppy/Hard disk vector
MFP_TIMERB or **MFP_HBLANK**	8	Timer B (Horizontal blank)
MFP_TERR	9	RS-232 transmit error
MFP_TBE	10	RS-232 transmit buffer empty
MFP_RERR	11	RS-232 receive error
MFP_RBF	12	RS-232 receive buffer full.
MFP_TIMERA or **MFP_DMASOUND**	13	Timer A (DMA sound)
MFP_RING	14	RS-232 ring indicator
MFP_MONODETECT	15	Mono monitor detect/DMA sound complete

BINDING

```
pea         vector
move.w      intno,-(sp)
move.w      #$0D,-(sp)
trap        #14
addq.l      #8,sp
```

CAVEATS This call does not return the address of the old handler.

The only RS-232 vector that may be set on the Falcon030 with this function is the ring indicator.

COMMENTS Newly installed interrupts must be enabled with **Jenabint()**.

SEE ALSO **Jenabint(), Jdisint()**

Midiws()

VOID Midiws(***count, buf*** **)**
WORD ***count*****;**
char * ***buf*****;**

Midiws() outputs a data buffer to the MIDI port.

OPCODE 12 (0x0C)

AVAILABILITY All **TOS** versions.

PARAMETERS *count* + 1 characters are written from the buffer pointed to by *buf*.

BINDING

```
pea         buf
move.w      count,-(sp)
move.w      #$0C,-(sp)
trap        #14
addq.l      #8,sp
```

NVMaccess()

WORD NVMaccess(***op, start, count, buffer*** **)**
WORD ***op, start, count*****;**
char * ***buffer*****;**

NVMaccess() reads/modifies data in non-volatile (battery backed-up) memory.

OPCODE 46 (0x2E)

AVAILABILITY This function's availability is variable. If it returns 0x2E (its opcode) when called, the function is non-existent and the operation was not carried out.

PARAMETERS *op* indicates the operation to perform as follows:

Name	*op*	Meaning
NVM_READ	0	Read *count* bytes of data starting at offset *start* and place the data in *buffer*.
NVM_WRITE	1	Write *count* bytes of data from *buffer* starting at offset *start*.
NVM_RESET	2	Resets and clears all data in non-volatile memory.

BINDING

```
pea         buffer
move.w      count,-(sp)
move.w      start,-(sp)
move.w      op,-(sp)
move.w      #$2E,-(sp)
trap        #14
lea         12(sp),sp
```

RETURN VALUE **NVMaccess()** returns 0 if the operation succeeded or a negative error code otherwise.

CAVEATS All of the locations are reserved for use by Atari and none are currently documented.

COMMENTS Currently there is a total of 50 bytes in non-volatile RAM.

Offgibit()

VOID Offgibit(***mask*** **)**
WORD *mask*;

Offgibit() clears individual bits of the sound chip's Port A.

OPCODE 29 (0x1D)

AVAILABILITY All **TOS** versions.

PARAMETERS *mask* is a bit mask arranged as shown below. For each of the lower eight bits in *mask* set to 0, that bit will be reset. Other bits (set as 1) will remain unchanged.

Name	Mask	Meaning
GI_FLOPPYSIDE	0x01	Floppy side select
GI_FLOPPYA	0x02	Floppy A select
GI_FLOPPYB	0x04	Floppy B select
GI_RTS	0x08	RS-232 Request To Send
GI_DTR	0x10	RS-232 Data Terminal Ready
GI_STROBE	0x20	Centronics strobe
GI_GPO	0x40	General purpose output (On a Falcon030, this bit controls the state of the internal speaker)
GI_SCCPORT	0x80	On a Mega STe or TT030, calling **Ongibit(** 0x80 **)** will cause SCC channel A to control the Serial 2 port rather than the LAN. To select the LAN, use **Offgibit(** 0x7F **)**.

BINDING

```
move.w      mask,-(sp)
```

```
move.w      #$1D,-(sp)
trap        #14
addq.l      #4,sp
```

SEE ALSO **Giaccess(), Ongibit()**

Ongibit()

VOID Ongibit(*mask*)
WORD *mask*;

Ongibit() sets individual bits of the sound chip's assigned Port A.

OPCODE 30 (0x1E)

AVAILABILITY All **TOS** versions.

PARAMETERS *mask* is a bit mask arranged as defined in **Offgibit()**. For each of the lower eight bits in *mask* set to 1, that bit will be set. Other bits (set as 0) will remain unchanged.

BINDING

```
move.w      mask,-(sp)
move.w      #$1E,-(sp)
trap        #14
addq.l      #4,sp
```

SEE ALSO **Giaccess(), Offgibit()**

Physbase()

VOIDP Physbase(VOID)

Physbase() returns the address of the physical base of screen memory.

OPCODE 2 (0x02)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$02,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Physbase()** returns the physical base address of the screen.

COMMENTS The physical base address is the memory area where the video shifter reads its

data. The logical address is the memory area where the **VDI** draws. These are normally the same but are addressed individually to enable screen flipping.

SEE ALSO **Logbase()**

Protobt()

VOID Protobt(***buf, serial, type, execflag*** **)**
VOIDP ***buf*****;**
LONG ***serial*****;**
WORD ***type, execflag*****;**

Protobt() creates a prototype floppy boot sector in memory for writing to a floppy drive.

OPCODE 18 (0x12)

AVAILABILITY All **TOS** versions.

PARAMETERS *buf* is a 512 byte long buffer where the prototyped buffer will be written. If you are creating an executable boot sector, the memory buffer should contain the code you require. *serial* can be any of the following values:

Name	*serial*	Meaning
SERIAL_NOCHANGE	-1	Don't change the serial number already in memory.
SERIAL_RANDOM	>0x01000000	Use a random number for the serial number
—	any other positive number	Set the serial number to *serial.*

type defines the type of disk to prototype as follows:

Name	*type*	Meaning
DISK_NOCHANGE	-1	Don't change disk type.
DISK_SSSD	0	40 Track, Single-Sided (180K)
DISK_DSSD	1	40 Track, Double-Sided (360K)
DISK_SSDD	2	80 Track, Single-Sided (360K)
DISK_DSDD	3	80 Track, Double-Sided (720K)
DISK_DSHD	4	High Density (1.44MB)
DISK_DSED	5	Extra-High Density (2.88MB)

execflag specifies the executable status of the boot sector as follows:

Name	*execflag*	Meaning
EXEC_NOCHANGE	-1	Don't alter executable status
EXEC_NO	0	Disk is not executable
EXEC_YES	1	Disk is executable

BINDING

```
move.w      execflag,-(sp)
move.w      type,-(sp)
move.l      serial,-(sp)
pea         buf
move.w      #$12,-(sp)
trap        #14
lea         14(sp),sp
```

CAVEATS *type* values of **DISK_DSHD** and **DISK_DSED** are only available when the high byte of the '_FDC' cookie has a value of **FLOPPY_DSHD** (1) and **FLOPPY_DSED** (2) respectively.

COMMENTS To create an MS-DOS compatible disk you must set the first three bytes of the prototyped boot sector to 0xE9, 0x00, and 0x4E.

SEE ALSO **Flopfmt(), Flopwr()**

Prtblk()

WORD Prtblk(*blk*)
PRTBLK ****blk***;**

Prtblk() accesses the built-in bitmap/text printing code.

OPCODE 36 (0x24)

AVAILABILITY All **TOS** versions.

PARAMETERS *blk* is a **PRTBLK** pointer containing information about the bitmap or text to print. **PRTBLK** is defined as follows:

```
typedef struct
{
       VOIDP blkptr;      /* pointer to screen scanline */
       UWORD offset;      /* bit offset of first column */
       UWORD width;       /* width of bitmap in bits */
       UWORD height;      /* height of bitmap in scanlines */
       UWORD left;        /* left print margin (in pixels) */
       UWORD right;       /* right print margin (in pixels) */
       UWORD srcres;      /* same as Getrez() */
       UWORD destres;     /* 0 = draft, 1 = final */
       UWORD *colpal;     /* color palette pointer */
       /*
```

```
         * 0 = B/W Atari
         * 1 = Color Atari
         * 2 = Daisy Wheel
         * 3 = B/W Epson
         */
        UWORD type;
        /* 0 = parallel, 1 = serial */
        UWORD port;
        /* halftone mask pointer or NULL to use default */
        char *masks;
} PRTBLK;
```

BINDING

```
pea         prtblk
move.w      #$24,-(sp)
trap        #14
addq.l      #6,sp
```

CAVEATS This call is extremely device dependent. **v_bit_image()** with **GDOS** installed should be used instead. Only ST compatible screen resolution bitmaps may be printed with this utility function.

COMMENTS When printing text, *blkptr* should point to the text string, *width* should be the length of the text string, *height* should be 0, and *masks* should be **NULL**.

In graphic print mode, *masks* can be **NULL** to use the default halftone masks.

The system variable *_prt_cnt* (**WORD** *)0x4EE should be set to 1 to disable the ALT-HELP key before calling this function. It should be restored to a value of -1 when done.

SEE ALSO **Scrdump(), SetPrt()**

Puntaes()

VOID Puntaes(VOID)

Puntaes() discards the **AES** (if memory-resident) and restarts the system.

OPCODE 39 (0x27)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$27,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE If successful, this function will not return control to the caller.

CAVEATS **Puntaes()** is only valid with disk-loaded AES's.

COMMENTS **Puntaes()** discards the **AES** by freeing any memory it allocated, resetting the system variable *os_magic* (this variable should contain the magic number 0x87654321, however if reset, the **AES** will not initialize), and rebooting the system.

Random()

LONG Random(VOID)

Random() returns a 24 bit random number.

OPCODE 17 (0x11)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$11,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Random()** returns a 24-bit random value in the lower three bytes of the returned **LONG**.

CAVEATS The algorithm used provides an exact 50% occurrence of bit 0.

Rsconf()

ULONG Rsconf(*speed, flow, ucr, rsr, tsr, scr*)
WORD *speed, flow, ucr, rsr, tsr, scr*;

Rsconf() reads/modifies the configuration of the serial device currently mapped to **BIOS** device #1 (**GEMDOS** 'aux:').

OPCODE 15 (0x0F)

AVAILABILITY All **TOS** versions.

PARAMETERS *speed* sets the serial device speed as follows:

Name	*speed*	Baud Rate
BAUD_19200	0	19200
BAUD_9600	1	9600

Name	*speed*	Baud Rate
BAUD_600	8	600
BAUD_300	9	300

BAUD_4800	2	4800
BAUD_3600	3	3600
BAUD_2400	4	2400
BAUD_2000	5	2000
BAUD_1800	6	1800
BAUD_1200	7	1200

BAUD_200	10	200
BAUD_150	11	150
BAUD_134	12	134
BAUD_110	13	110
BAUD_75	14	75
BAUD_50	15	50

If *speed* is set to **BAUD_INQUIRE** (-2), the last baud rate set will be returned.

flow selects the flow control method as follows:

Name	*flow*	Meaning
FLOW_NONE	0	No flow control
FLOW_SOFT	1	XON/XOFF flow control (CTRL-S/CTRL-Q)
FLOW_HARD	2	RTS/CTS flow control (hardware)
FLOW_BOTH	3	Both methods of flow control

ucr, *rsr*, and *tsr* are each status bit arrays governing the serial devices. Each parameter uses only the lower eight bits of the **WORD**. They are defined as follows:

Mask	*ucr*	*rsr* and *tsr*
0x01	Unused	Receiver enable: **RS_RECVENABLE**
0x02	Enable odd parity **RS_ODDPARITY** (0x02) **RS_EVENPARITY** (0x00)	Sync strip **RS_SYNCSTRIP**
0x04	Parity enable **RS_PARITYENABLE**	Match busy **RS_MATCHBUSY**
0x08	Bits 3-4 of the ucr collectively define the start and stop bit configuration as follows: 00 = No Start or Stop bits **RS_NOSTOP** (0x00) 01 = 1 Start bit, 1 Stop bit **RS_1STOP** (0x08) 10 = 1 Start bit, 1½ Stop bits **RS_15STOP** (0x10) 11 = 1 Start bit, 2 Stop bits **RS_2STOP** (0x18)	Break detect **RS_BRKDETECT**
0x10	See above.	Frame error **RS_FRAMEERR**
0x20	Bits 5 and 6 together define the number of bits per word as follows: 00 = 8 bits **RS_8BITS** (0x00) 01 = 7 bits **RS_7BITS** (0x20)	Parity error **RS_PARITYERR**

	10 = 6 bits **RS_6BITS** (0x40) 11 = 5 bits **RS_5BITS** (0x60)	
0x40	See above.	Overrun error **RS_OVERRUNERR**
0x80	CLK/16 **RS_CLK16**	Buffer full **RS_BUFFULL**

scr sets the synchronous character register in which the low byte is used as the character to search for in an underrun error condition.

If a **RS_INQUIRE** (-1) is used for either *ucr*, *rsr*, *tsr*, or *scr*, then that parameter is read and the register is unmodified.

BINDING

```
move.w      scr,-(sp)
move.w      tsr,-(sp)
move.w      rsr,-(sp)
move.w      ucr,-(sp)
move.w      flow,-(sp)
move.w      speed,-(sp)
move.w      #$0F,-(sp)
trap        #14
lea         14(sp),sp
```

RETURN VALUE

Rsconf() returns the last set baud rate if *speed* is set to **RS_LASTBAUD** (-2). Otherwise, it returns the old settings in a packed **LONG** with *ucr* being in the high byte, down to *scr* being in the low byte.

COMMENTS

Bits in the *ucr*, *rsr*, *tsr*, and *scr* should be set atomically. To correctly change a value, read the old value, mask it as appropriate and then write it back.

Baud rates higher than 19,200 bps available with SCC-based serial devices may be set by using the appropriate **Fcntl()** call under **MiNT** or by directly programming the SCC chip.

CAVEATS

The baud rate inquiry mode (speed = **RS_LASTBAUD**) does not work at all on **TOS** versions less than 1.04. **TOS** version 1.04 requires the patch program TOS14FX2.PRG (available from Atari Corp.) to allow this mode to function. All other **TOS** versions support the function normally.

SEE ALSO

Bconmap()

Scrdmp()

VOID Scrdmp(VOID)

Scrdmp() starts the built-in hardware screen dump routine.

OPCODE 20 (0x14)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$14,-(sp)
trap        #14
addq.l      #2,sp
```

CAVEATS **Scrdmp()** only dumps ST compatible screen resolutions.

COMMENTS This routine is extremely device-dependent. You should use the **VDI** instead.

SEE ALSO **Prtblk(), v_hardcopy()**

Setbuffer()

LONG Setbuffer(***mode*****,** ***begaddr*****,** ***endaddr*** **)**
WORD ***mode*****;**
VOIDP ***begaddr*****;**
VOIDP ***endaddr*****;**

Setbuffer() sets the starting and ending addresses of the internal play and record buffers.

OPCODE 131 (0x83)

AVAILABILITY Available when bit #2 of the '_SND' cookie is set.

PARAMETERS *mode* specifies which registers are to be set. A *mode* value of **PLAY** (0) sets the play registers, a value of **RECORD** (1) sets the record registers. *begaddr* specifies the starting location of the buffer. *endaddr* specifies the first invalid location for sound data past *begaddr*.

BINDING

```
pea         endaddr
pea         begaddr
move.w      mode,-(sp)
move.w      #$83,-(sp)
trap        #14
lea         12(sp),sp
```

RETURN VALUE **Setbuffer()** returns a 0 if successful or non-zero otherwise.

SEE ALSO **Buffoper()**

Setcolor()

WORD Setcolor(*idx, new*)
WORD *idx, new*;

Setcolor() sets a ST/TT030 color register.

OPCODE 7 (0x07)

AVAILABILITY All **TOS** versions.

PARAMETERS *idx* specifies the color register to modify (0-16 on an ST, 0-255 on a STe or TT030). *new* is a bit array specifying the new color as follows:

Bits 15-12	Bits 11-8	Bits 7-4	Bits 3-0
Unused	Red	Green	Blue

Each color value has its bits packed in an unusual manner to stay compatible between machines. Bits are ordered 0, 3, 2, 1 with 0 being the least signifigant bit. If *new* is **COL_INQUIRE** (-1) then the old color is returned.

BINDING

```
move.w      new,-(sp)
move.w      idx,-(sp)
move.w      #$06,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Setcolor()** returns the old value of the color register.

CAVEATS This call is extremely device-dependent. **vs_color()** should be used instead.

COMMENTS The top bit of each color nibble is unused on the original ST machines.

SEE ALSO **VsetRGB(), EsetColor(), Setpalette()**

Setinterrupt()

LONG Setinterrupt(*mode, cause*)
WORD *mode, cause*;

Setinterrupt() defines the conditions under which an interrupt is generated by the sound system

OPCODE 135 (0x87)

AVAILABILITY Available when bit #2 of the '_SND' cookie is set.

PARAMETERS *mode* configures interrupts to occur when the end of a buffer is reached. A value of **INT_TIMERA** (0) for *mode* sets Timer A, a value of **INT_I7** (1) sets the MFP i7 interrupt. *cause* defines the conditions for the interrupt as follows:

Name	*cause*	Meaning
INT_DISABLE	0	Disable interrupt
INT_PLAY	1	Interrupt at end of play buffer
INT_RECORD	2	Interrupt at end of record buffer
INT_BOTH	3	Interrupt at end of both buffers

BINDING

```
move.w      cause,-(sp)
move.w      mode,-(sp)
move.w      #$87,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Setinterrupt()** returns 0 if no error occurred or non-zero otherwise.

COMMENTS If either buffer is in repeat mode, these interrupts can be used to double-buffer sounds.

SEE ALSO **Buffoper()**

Setmode()

LONG Setmode(*mode*)
WORD *mode*;

Setmode() sets the mode of operation for the play and record registers.

OPCODE 132 (0x84)

AVAILABILITY Available if bit #2 of the '_SND' cookie is set.

PARAMETERS *mode* defines the playback and record mode as follows:

Name	*mode*	Meaning
MODE_STEREO8	0	8-bit Stereo Mode
MODE_STEREO16	1	16-bit Stereo Mode
MODE_MONO	2	8-bit Mono Mode

BINDING

```
move.w      mode,-(sp)
move.w      #$84,sp
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Setmode()** returns 0 if the operation was successful or non-zero otherwise.

CAVEATS Recording only works in 16-bit stereo mode.

SEE ALSO **Buffoper()**

Setmontracks()

LONG Setmontracks(*track*)
WORD *track*;

Setmontracks() defines which playback track is audible through the internal speaker.

OPCODE 134 (0x86)

AVAILABILITY Available only when bit #2 of the '_SND' cookie is set.

PARAMETERS *track* specifies the playback track to monitor (0-3).

BINDING

```
move.w      track,-(sp)
move.w      #$86,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Setmontracks()** returns a 0 if the operation was successful or non-zero otherwise.

Setpalette()

VOID Setpalette(***palette*** **)**
WORD *****palette**;***

Setpalette() loads the ST color lookup table with a new palette.

OPCODE 6 (0x06)

AVAILABILITY All **TOS** versions.

PARAMETERS *palette* is a pointer to a **WORD** array containing 16 color encoded **WORD**s as defined in **Setcolor()**.

BINDING

```
pea         palette
move.w      #$06,-(sp)
trap        #14
addq.l      #6,sp
```

COMMENTS The actual palette data is not copied from the specified array until the next vertical blank interrupt. For this reason, this call should be followed by **Vsync()** to be sure the array memory is not modified or reallocated prior to the transfer.

SEE ALSO **Setcolor(), EsetPalette(), VsetRGB(), vs_color()**

Setprt()

WORD Setprt(***new*** **)**
WORD ***new*****;**

Setprt() sets the OS's current printer configuration bits.

OPCODE 33 (0x21)

AVAILABILITY All **TOS** versions.

PARAMETERS *new* is a **WORD** bit array defined as follows:

Mask	When clear	When Set
0x01	Dot Matrix **PRT_DOTMATRIX**	Daisy Wheel **PRT_DAISY**
0x02	Monochrome **PRT_MONO**	Color **PRT_COLOR**
0x04	Atari Printer	Epson Printer

	PRT_ATARI	PRT_EPSON
0x08	Draft Mode **PRT_DRAFT**	Final Mode **PRT_FINAL**
0x10	Parallel Port **PRT_PARALLEL**	Serial Port **PRT_SERIAL**
0x20	Continuous Feed **PRT_CONTINUOUS**	Single Sheet Feed **PRT_SINGLE**
–	Unused	Unused

If *new* is set to **PRT_INQUIRE** (-1) **Setprt()** will return the current configuration without modifying the current setup.

BINDING

```
move.w      new,-(sp)
move.w      #$33,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Setprt()** returns the prior configuration.

CAVEATS This call only affects the internal screen dump code which only operates on ST compatible resolutions.

SEE ALSO **Prtblk(), Scrdmp(), v_hardcopy()**

Setscreen()

VOID Setscreen(*log, phys, mode*)
VOIDP *log, phys*;
WORD *mode*;

Setscreen() changes the base addresses and mode of the current screen.

OPCODE 5 (0x05)

AVAILABILITY All **TOS** versions.

PARAMETERS *log* is the address for the new logical screen base. *phys* is the new address for the physical screen base. *mode* defines the screen mode to switch to (same as **Getrez()**). If any of these three parameters is set to **SCR_NOCHANGE** (-1) then that value will be left unchanged.

BINDING

```
move.w      mode,-(sp)
pea         phys
pea         log
move.w      #$5,-(sp)
trap        #14
lea         12(sp),sp
```

CAVEATS Changing screen modes with this call does not reinitialize the **AES**. The **VDI** and **VT52** emulator are, however, correctly reinitialized. The **AES** should not be used after changing screen mode with this call until the old screen mode is restored.

COMMENTS The Atari ST and Mega ST required that its physical screen memory be on a 256 byte boundary. All other Atari computers only require a **WORD** boundary.

To access the unique video modes of the Falcon030 the call **VsetScreen()** (which is actually an alternate binding of this call with the same opcode) should be used in place of this call.

SEE ALSO **VsetMode(), VsetScreen(), EsetShift()**

Settime()

VOID Settime(***time*** **)**
LONG *time*;

Settime() sets a new **IKBD** date and time.

OPCODE 22 (0x16)

AVAILABILITY All **TOS** versions.

PARAMETERS *time* is a **LONG** bit array defined as follows:

Bits	Meaning
0-4	Seconds / 2 (0-29)
5-10	Minute (0-59)
11-15	Hour (0-23)
16-20	Day (1-31)
21-24	Month (1-12)
25-31	Year - 1980 (0-127)

The value can be represented in a C structure as follows:

```
typedef struct
{
       unsigned year:7;
       unsigned month:4;
       unsigned day:5;
       unsigned hour:5;
       unsigned minute:6;
       unsigned second:5;
```

```
} BIOS_TIME;
```

BINDING

```
move.l      time,-(sp)
move.w      #$16,-(sp)
trap        #14
addq.l      #6,sp
```

COMMENTS As of **TOS** 1.02, this function also updates the **GEMDOS** time.

SEE ALSO **Gettime(), Tsettime(), Tsetdate()**

Settracks()

LONG Settracks(***playtracks, rectracks*** **)**
WORD ***playtracks, rectracks*****;**

Setttracks() sets the number of recording and playback tracks.

OPCODE 133 (0x85)

AVAILABILITY Available only when bit #2 of the '_SND' cookie is set.

PARAMETERS *playtracks* specifies the number of playback tracks (0-3) and *rectracks* specifies the number of recording tracks.

BINDING

```
move.w      rectracks,-(sp)
move.w      playtracks,-(sp)
move.w      #$85,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Settracks()** returns 0 if the operation was successful or non-zero otherwise.

COMMENTS The tracks specified are stereo tracks. When in 8-bit Mono mode, two samples are read at a time.

SEE ALSO **Setmode(), Setmontracks()**

Sndstatus()

LONG Sndstatus(***reset*** **)**
WORD ***reset*****;**

Sndstatus() can be used to test the error condition of the sound system and to completely reset it.

OPCODE 140 (0x8C)

AVAILABILITY Available only when bit #2 of the '_SND' cookie is set.

PARAMETERS *reset* is a flag indicating whether the sound system should be reset. A value of **SND_RESET** (1) will reset the sound system.

BINDING

```
move.w      reset,-(sp)
move.w      #$8C,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Sndstatus()** returns a **LONG** bit array indicating the current error status of the sound system defined as follows:

Bit(s)	Meaning
0-3	These bits form a value indicating the error condition of the sound system as follows: **Name** / **Mask** / **Meaning** **SND_ERROR** / 0xF / Use to mask error code **Name** / **Value** / **Meaning** **SND_OK** / 0 / No Error **SND_BADCONTROL** / 1 / Invalid Control Field **SND_BADSYC** / 2 / Invalid Sync Format **SND_BADCLOCK** / 3 / Clock out of range
4	If this bit is set, left channel clipping has occurred. Use the mask **SND_LEFTCLIP** (0x10) to isolate this bit.
5	If this bit is set, right channel clipping has occurred. Use the mask **SND_RIGHTCLIP** (0x20) to isolate this bit.
6-31	Unused.

COMMENTS On reset, the following things happen:

- DSP is tristated
- Gain and attentuation are zeroed
- Old matrix connections are reset
- ADDERIN is disabled

- Mode is set to 8-Bit Stereo
- Play and record tracks are set to 0
- Monitor track is set to 0
- Interrupts are disabled
- Buffer operation is disabled

Soundcmd()

LONG Soundcmd(*mode, data*)
WORD *mode, data*;

Soundcmd() sets various configuration parameters in the sound system.

OPCODE 130 (0x82)

AVAILABILITY Available only when bit #2 of '_SND' cookie is set.

PARAMETERS *mode* specifies how *data* is interpreted as follows:

Name	*mode*	Meaning
LTATTEN	0	Set the left attenuation (increasing attentuation is the same as decreasing volume). *data* is a bit mask as follows: XXXX XXXX LLLL XXXX 'L' specifies a valid value between 0 and 15 used to set the attenuation of the left channel in -1.5db increments. The bits represented by 'X' are reserved and should be 0.
RATTEN	1	Set the right attentuation. *data* is a bit mask as follows: XXXX XXXX RRRR XXXX 'R' specifies a valid value between 0 and 15 used to set the attenuation of the right channel in -1.5db increments. The bits represented by 'X' are reserved and should be 0.
LTGAIN	2	Set the left channel gain (boost the input to the ADC). *data* is a bit mask as follows: XXXX XXXX LLLL XXXX 'L' specifies a valid value between 0 and 15 used to set the gain of the left channel in 1.5db increments. The bits represented by 'X' are reserved and should be 0.

RTGAIN	3	Set the right channel gain (boost the input to the ADC). *data* is a bit mask as follows: XXXX XXXX RRRR XXXX 'R' specifies a valid value between 0 and 15 used to set the gain of the right channel in 1.5Db increments. The bits represented by 'X' are reserved and should be 0.
ADDERIN	4	Set the 16 bit ADDER to receive its input from the source(s) specified in *data*. *data* is a bit mask where each bit indicates a possible souce. Bit 0 represents the ADC (**ADDR_ADC**). Bit 1 represents the connection matrix (**ADDR_MATRIX**). Setting either or both of these bits determines the source of the ADDER.
ADCINPUT	5	Set the inputs of the left and right channels of the ADC. *data* is a bit mask with bit 0 being the right channel: **LEFT_MIC** (0x00) or **LEFT_PSG** (0x02) and bit 1 being the left channel: **RIGHT_MIC** (0x00) or **RIGHT_PSG** (0x01). Setting a bit causes that channel to receive its input from the Yamaha PSG. Clearing a bit causes that channel to receive its input from the microphone.
SETPRESCALE	6	This mode is only valid when **Devconnect()** is used to set the prescaler to TT030 compatibility mode. In that case, *data* represents the TT030 compatible prescale value as follows: **Name** **Value** **Meaning** **CCLK_6K** 0 Divide by 1280 (6.25 MHz) **CCLK_12K** 1 Divide by 640 (12.5 Mhz) **CCLK_25K** 2 Divide by 320 (25 MHz) **CCLK_50K** 3 Divide by 160 (50 MHz)

Setting *data* to **SND_INQUIRE** (-1) with any command will cause that command's current value to be returned and the parameter unchanged.

BINDING

```
move.w      data,-(sp)
move.w      mode,-(sp)
move.w      #$82,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE

Soundcmd() returns the prior value of the specified command if data is **SND_INQUIRE** (-1).

Using the **SETPRESCALE** mode to set a frequency of 6.25 MHz (**CCLK_6K**) will cause the sound system to mute on a Falcon030 as it does not support this sample rate.

CAVEATS

On current systems, a bug exists that causes a *mode* value of **LTGAIN** to set the gain for both channels.

SEE ALSO

Devconnect()

Ssbrk()

VOIDP Ssbrk(*len*)
WORD *len*;

Ssbrk() is designed to reserve memory at the top of RAM prior to the initialization of **GEMDOS**.

OPCODE 1 (0x01)

AVAILABILITY All **TOS** versions.

PARAMETERS *len* is a **WORD** value specifying the number of bytes to reserve at the top of RAM.

BINDING

```
move.w      len,-(sp)
move.w      #$01,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **Ssbrk()** returns a pointer to the allocated block.

CAVEATS **Ssbrk()** was only used on early development systems. Currently the function is unimplemented and does not do anything.

Supexec()

LONG Supexec(*func*)
LONG (func*)(VOID);**

Supexec() executes a user-defined function in supervisor mode.

OPCODE 38 (0x26)

AVAILABILITY All **TOS** versions.

PARAMETERS *func* is the address to a function which will be called in supervisor mode.

BINDING

```
pea         func
move.w      #$26,-(sp)
trap        #14
addq.l      #6,sp
```

RETURN VALUE **Supexec()** returns the **LONG** value returned by the user function.

CAVEATS Care must be taken when calling the operating system in supervisor mode. The **AES** must not be called while in supervisor mode.

SEE ALSO **Super()**

Unlocksnd()

LONG Unlocksnd(VOID)

Unlocksnd() unlocks the sound system so that other applications may utilize it.

OPCODE 129 (0x81)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$81,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **Unlocksnd()** returns a 0 if the sound system was successfully unlocked or **SNDNOTLOCK** (-128) if the sound system wasn't locked prior to the call.

SEE ALSO **Locksnd()**

VgetMonitor()

WORD VgetMonitor(VOID)

VgetMonitor() returns a value which determines the kind of monitor currently being used.

OPCODE 89 (0x59)

AVAILABILITY Available if the '_VDO' cookie has a value of 0x00030000 or greater.

BINDING

```
move.w      #$59,-(sp)
trap        #14
addq.l      #2,sp
```

RETURN VALUE **VgetMonitor()** returns a value describing the monitor currently connected to the system as follows:

Name	Return Value	Monitor Type
MON_MONO	0	ST monochrome monitor
MON_COLOR	1	ST color monitor
MON_VGA	2	VGA monitor
MON_TV	3	Television

VgetRGB()

VOID VgetRGB(***index, count, rgb*** **)**
WORD ***index*****,** ***count*****;**
RGB ****rgb*;**

VgetRGB() returns palette information as 24-bit **RGB** data.

OPCODE 94 (0x5E)

AVAILABILITY Available if the '_VDO' cookie has a value of 0x00030000 or greater.

PARAMETERS *index* specifies the beginning color index in the palette to read data from. *count* specifies the number of palette entries to read. *rgb* is a pointer to an array of **RGB**s which will be filled in by the functions. **RGB** is defined as:

```
typedef struct
{
        BYTE reserved;
        BYTE red;
        BYTE green;
        BYTE blue;
} RGB;
```

BINDING

```
pea         rgb
move.w      count,-(sp)
move.w      index,-(sp)
move.w      #$5E,-(sp)
trap        #14
lea         10(sp),sp
```

COMMENTS **VgetRGB()** is device-dependent in nature and it is therefore recommended that **vq_color()** be used instead.

SEE ALSO **VsetRGB()**

VgetSize()

LONG VgetSize(***mode*** **)**
WORD ***mode*****;**

VgetSize() returns the size of a screen mode in bytes.

OPCODE 91 (0x5B)

AVAILABILITY Available if the '_VDO' cookie has a value of 0x00030000 or greater.

PARAMETERS *mode* is a modecode as defined in **VsetMode()**.

BINDING

```
move.w      mode,-(sp)
move.w      #$5B,-(sp)
trap        #14
addq.l      #4,sp
```

RETURN VALUE **VgetSize()** returns the size in bytes of a screen mode of type *mode*.

VsetMask()

VOID VsetMask(***ormask, andmask, overlay*** **)**
LONG ***ormask, andmask*****;**
WORD ***overlay*****;**

VsetMask() provides access to 'overlay' mode.

OPCODE 146 (0x92)

AVAILABILITY Available if the '_VDO' cookie has a value of 0x00030000 or greater.

PARAMETERS When the **VDI** processes a **vs_color()** call. It converts the desired color into a hardware palette register. In 16-bit true-color mode, this is a **WORD** formatted as follows:

```
RRRR RGGG GGXB BBBB
```

The 'X' is the system overlay bit. In 24-bit true color a **LONG** is formatted as follows:

```
XXXXXXXX RRRRRRRR GGGGGGGG BBBBBBBB
```

VsetMask() sets a logical OR and AND mask which are applied to this register

before being stored. The default system value for *ormask* is 0x00000000 and the default value for *andmask* is 0xFFFFFFFF.

overlay should be **OVERLAY_ON** (1) to enable overlay mode or **OVERLAY_OFF** (0) to disable it.

BINDING

```
move.w   #overlay,-(sp)
move.l   #andmask,-(sp)
move.l   #ormask,-(sp)
move.w   #$92,-(sp)
trap     #14
add.l    #12,sp
```

COMMENTS

To make colors defined by the **VDI** transparent in 16-bit true color with overlay mode enabled, use an *andmask* value of 0xFFFFFFDF and an *ormask* value of 0x00000000. To make colors visible, use an *andmask* of 0x00000000 and an *ormask* of 0x00000020.

VsetMode()

WORD VsetMode(*mode*)
WORD *mode*;

VsetMode() places the video shifter into a specific video mode.

OPCODE

88 (0x58)

AVAILABILITY

Available if the '_VDO' cookie has a value of 0x00030000 or greater.

PARAMETERS

mode is a **WORD** bit array arranged as follows:

Name	Bit(s)	Meaning
BPS1 (0x00) **BPS2** (0x01) **BPS4** (0x02) **BPS8** (0x03) **BPS16** (0x04)	0-2	These bits form a value so that 2 ^ X represents the number of bits per pixel.
COL80 (0x08) **COL40** (0x00)	3	80 Column Flag (if set, 80 columns, otherwise 40)
VGA (0x10) **TV** (0x00)	4	VGA Flag (if set, VGA mode will be used, otherwise television/monitor mode)
PAL (0x20) **NTSC** (0x00)	5	PAL Flag (if set, PAL will be used, otherwise NTSC)
OVERSCAN (0x40)	6	Overscan Flag (not valid with VGA)
STMODES (0x80)	7	ST Compatibility Flag
VERTFLAG (0x100)	8	Vertical Flag (is set, enables interlace mode on a color monitor or double-line mode on a VGA monitor)

–	9-15	Reserved (set to 0)

If *mode* is **VM_INQUIRE** (-1) then the current mode code is returned without changing the current settings.

BINDING

```
move.w      mode,-(sp)
move.w      #$58,sp
trap        #14
addq.l      #4,sp
```

RETURN VALUE **VsetMode()** returns the prior video mode.

CAVEATS **VsetMode()** does not reset the video base address, reserve memory, or reinitialize the **VDI**. To do this, use **VsetScreen()**.

COMMENTS Some video modes are not legal. 40 column monoplane modes and 80 column VGA true color modes are not supported.

SEE ALSO **VsetScreen(), Setscreen()**

VsetRGB()

VOID VsetRGB(*index, count, rgb*)
WORD *index, count*;
RGB **rgb*;

VsetRGB() sets palette registers using 24-bit **RGB** values.

OPCODE 93 (0x5D)

AVAILABILITY Available if the '_VDO' cookie has a value of 0x00030000 or greater.

PARAMETERS *index* specifies the first palette index to modify. *count* specifies the number of palette entries to modify. *rgb* is a pointer to an array of **RGB** elements which will be copied into the palette.

BINDING

```
pea         rgb
move.w      count,-(sp)
move.w      index,-(sp)
move.w      #$5D,-(sp)
trap        #14
lea         10(sp),sp
```

COMMENTS This call is device-dependent by nature. It is therefore recommended that **vs_color()** be used instead.

SEE ALSO **VgetRGB(), EsetPalette(), Setpalette(), vs_color()**

VsetScreen()

VOID VsetScreen(*log*, *phys*, *mode*, *modecode*)
VOIDP *log*, *phys*;
WORD *mode*, *modecode*;

VsetScreen() changes the base addresses and mode of the current screen.

OPCODE 5 (0x05)

AVAILABILITY All **TOS** versions. The ability of this call to utilize the *modecode* parameter and the memory allocation feature is limited to systems having a '_VDO' cookie with a value of 0x00030000 or greater.

PARAMETERS *log* is the address for the new logical screen base. *phys* is the new address for the physical screen base. If either *log* or *phys* is **NULL**, the **XBIOS** will allocate a new block of memory large enough for the current screen and reset the parameter accordingly.

mode defines the screen mode to switch to (same as **Getrez()**). Setting *mode* to **SCR_MODECODE** (3) will cause *modecode* to be used to set the graphic mode (see **VsetMode()** for valid values for this parameter), otherwise *modecode* is ignored. If any of these three parameters is set to **SCR_NOCHANGE** (-1) then that value will be left unchanged.

BINDING

```
move.w      modecode,-(sp)
move.w      mode,-(sp)
pea         phys
pea         log
move.w      #$05,-(sp)
trap        #14
lea         14(sp),sp
```

CAVEATS Changing screen modes with this call does not reinitialize the **AES**. The **VDI** and **VT52** emulator are, however, correctly reinitialized. The **AES** should not be used after changing screen mode with this call until the old screen mode is restored.

COMMENTS TOS 1.00 and 1.02 required that its physical screen memory be on a 256 byte boundary. All other Atari computers only require a **WORD** boundary.

This call is actually a revised binding of **Setscreen()** developed to allow access to the newly available modecode parameter.

SEE ALSO **Setscreen(), VsetMode()**

VsetSync()

VOID VsetSync(***external*** **)**
WORD *external*;

VsetSync() sets the external video sync mode.

OPCODE 90 (0x5A)

AVAILABILITY Available if the '_VDO' cookie has a value of 0x00030000 or greater.

PARAMETERS *external* is a **WORD** bit array defined as follows:

Name	Bit	Meaning
VCLK_EXTERNAL	0	Use external clock.
VCLK_EXTVSYNC	1	Use external vertical sync.
VCLK_EXTHSYNC	2	Use external horizontal sync.
–	3-15	Reserved (set to 0)

BINDING

```
move.w      external,-(sp)
move.w      #$5A,-(sp)
trap        #14
addq.l      #2,sp
```

CAVEATS This call only works in Falcon video modes, not in compatibility or any four color modes.

Vsync()

VOID Vsync(VOID)

Vsync() pauses program execution until the next vertical blank interrupt.

OPCODE 37 (0x25)

AVAILABILITY All **TOS** versions.

BINDING

```
move.w      #$25,-(sp)
trap        #14
addq.l      #2,sp
```

WavePlay()

WORD WavePlay(*flags, rate, sptr, slen*)
WORD *flags*;
LONG *rate*;
VOIDP *sptr*;
LONG *slen*;

WavePlay() provides a easy method for applications to utilize the DMA sound system on the STe, TT030, and Falcon030 and playback user-defined event sound effects.

OPCODE 165 (0xA5)

AVAILABILITY Available only when the 'SAM\0' cookie exists.

PARAMETERS *flags* is a bit mask consisting of the following options:

Name	Mask	Meaning
WP_MONO	0x00	The sound to be played back is monophonic.
WP_STEREO	0x01	The sound to be played back is in stereo.
WP_8BIT	0x00	The sound to be played back was sampled at 8-bit resolution.
WP_16BIT	0x02	The sound to be played back was sampled at 16-bit resolution.
WP_MACRO	0x100	Play back a user-assigned macro or application global sound effect. This flag is exclusive and modifies the meaning of the other parameters to this call as shown below.

rate specifies the sample rate in Hertz (for example 49170L to play back at 49170 Hz). If **WP_MACRO** was specified in *flags*, then this parameter is ignored and should be set to 0L.

sptr is a pointer to the sound sample in memory. If **WP_MACRO** was specified in *flags* then this parameter should be a **LONG** containing either the application cookie specified in the .SAA file or the 'SAM\0' cookie to play an application global.

slen is the length of the sample in bytes. If **WP_MACRO** was specified in *flags* then *slen* is the macro or application global index as specified in the .SAA file. Valid application global values are as follows:

Name	*slen*	Usage

AG_FIND	0	Call **WavePlay()** with this value when the user requests display of the 'Find' dialog box.
AG_REPLACE	1	Call **WavePlay()** with this value when the user requests display of the 'Replace' dialog box.
AG_CUT	2	Call **WavePlay()** with this value when the user requests a 'Cut' operation.
AG_COPY	3	Call **WavePlay()** with this value when the user requests a 'Copy' operation.
AG_PASTE	4	Call **WavePlay()** with this value when the user requests a 'Paste' operation.
AG_DELETE	5	Call **WavePlay()** with this value when the user requests a 'Delete' operation. This should not be called when the user presses the 'Delete' key.
AG_HELP	6	Call **WavePlay()** with this value when the user requests display of application 'Help.' This should not be called when the user presses the 'Help' key.
AG_PRINT	7	Call **WavePlay()** with this value when the user requests display of the 'Print' dialog box.
AG_SAVE	8	Call **WavePlay()** with this value when the user requests that the current document be saved. This should not be used for any operation that calls the file selector.
AG_ERROR	9	Call **WavePlay()** with this value when the application encounters an error not presented to the user in an alert or error dialog (error dialogs may be assigned sounds).
AG_QUIT	10	Call **WavePlay()** with this value when the user requests that the application exit. Use this global after the user has confirmed a quit with any dialog box that may have been necessary.

BINDING

```
move.l      slen,-(sp)
pea         sptr
move.l      rate,-(sp)
move.w      flags,-(sp)
move.w      #$A5,-(sp)
trap        #14
lea         16(sp),sp
```

RETURN VALUE

WavePlay() returns **WP_OK** (0) if the call was successful, **WP_ERROR** (-1) if an error occurred, or **WP_NOSOUND** (1) to indicate that no sound was played (either because the user had not previously assigned a sound to the given macro or SAM was disabled).

CAVEATS

This function is only available when the System Audio Manager TSR (available from Atari Corp. or SDS) is installed. Extended development information is available online the Atari Developer's roundtable on GEnie.

Because of previously misdocumented sample rates, the value for rate must be 33880 to play back a sample at 32880 Hz, 20770 to play back a sample at 19668 Hz, and 16490 to play back a sample at 16390 Hz.

COMMENTS Even if an application does not install any custom events in a .SAA file, an application must still provide a .SAA file if it wishes to use application globals so that the SAM configuration accessory allows the user to assign those sounds.

A macro is commonly used to access the application global sounds available as follows:

```
#define WavePlayMacro(a)  WavePlay( WP_MACRO, 0L, SAM_COOKIE, a
       );
```

Xbtimer()

VOID Xbtimer(***timer, control, data, hand*** **)**
WORD ***timer, control, data*****;**
VOID (***hand*****)(VOID);**

Xbtimer() sets an interrupt on the 68901 chip.

OPCODE 31 (0x1F)

AVAILABILITY All **TOS** versions.

PARAMETERS *timer* is a value defining which timer to set as follows:

Name	Timer	Meaning
XB_TIMERA	0	Timer A (DMA sound counter)
XB_TIMERB	1	Timer B (Hblank counter)
XB_TIMERC	2	Timer C (200Hz system clock)
XB_TIMERD	3	Timer D (RS-232 baud rate generator)

control is placed into the control register of the timer. *data* is placed in the data register of the timer. *hand* is a pointer to the interrupt handler which is called by the interrupt.

BINDING

```
pea         hand
move.w      data,-(sp)
move.w      control,-(sp)
move.w      timer,-(sp)
move.w      #$1F,-(sp)
trap        #14
lea         12(sp),sp
```

SEE ALSO **Mfpint(), Jenabint(), Jdisint()**

– CHAPTER 5 –

HARDWARE

Overview

This chapter will cover those aspects of Atari software programming that can only be accomplished by accessing hardware registers directly. In most cases, Atari has provided OS calls to manipulate the hardware. When an OS call exists to access hardware, it should *always* be used to ensure upward and backward compatibility. Keep in mind that access to hardware registers is limited to those applications operating in supervisor mode only (except where noted otherwise).

Besides those hardware registers discussed here, a complete list of I/O registers, system variables, and interrupt vectors are contained in *Appendix B:* ***Memory Map***.

The 680x0 Processor

Atari computers use the Motorola MC68000 or MC68030. Third party devices have also been created to allow the use of a MC68010, MC68020, or MC68040 processor. The system cookie '_CPU' should be used to determine the currently installed processor. The following table lists the 680x0's interrupt priority assignments:

Level	Assignment
7	NMI
6	MK68901 MFP
5	SCC[1]
4	VBLANK (Sync)
3	VME Interrupter[2]
2	HBLANK (Sync)
1	Unused

Interrupts may be disabled by setting the system interrupt mask (bits 8-10 of the SR register) to a value higher than the interrupts you wish to disable. Setting the mask to a value of 7 will effectively disable all interrupts (except the level 7 non-maskable interrupt).

The Data/Instruction Caches

The Atari TT030 and Falcon030 contain onboard data and instruction caches. These caches may be controlled by writing to the CACR register (in supervisor mode). The following table lists longword values that may be written to the CACR to enable or disable the caches:

Value to Write to CACR	Effect
0xA0A	Flush and disable both caches.
0x101	Enable both caches.
0xA00	Flush and disable the data cache.
0x100	Enable the data cache.

[1] On a computer without an SCC chip, this interrupt is unused.

[2] On a computer without a VME bus, this interrupt is unused.

0xA	Flush and disable the instruction cache.
0x1	Enable the instruction cache.

The 68881/882 Floating Point Coprocessor

A MC6888x math coprocessor may be installed in a Mega ST, Mega STe, or a Falcon030. The TT030 has one installed in its standard configuration. The 6888x is interfaced to the 68000 in peripheral mode and to the 68030 in coprocessor mode. Thus, the TT030 and Falcon030 computers access the 6888x in coprocessor mode while the Mega ST and MegaSTe computers access the 6888x in peripheral mode.

Coprocessor Mode

When the 6888x is interfaced in coprocessor mode, using it is as simple as placing floating-point instructions in the standard instruction stream (use a coprocessor ID of 1). The 68030 will properly dispatch the instruction and respond to exceptions through the following vectors:

Vector Address	Assignment
0x0000001C	FTRAPcc Instruction
0x0000002C	F-Line Emulator
0x00000034	Co-processor Protocol Violation
0x000000C0	Branch or Set on Unordered Condition
0x000000C4	Inexact Result
0x000000C8	Floating-Point Divide by Zero
0x000000CC	Underflow
0x000000D0	Operand Error
0x000000D4	Overflow
0x000000D8	Signaling NAN

Peripheral Mode

Utilizing an installed math coprocessor interfaced using peripheral mode requires the use of several hardware registers mapped to special coprocessor registers. Unlike most hardware registers, these do not have to be accessed in supervisor mode. Atari computers map the 6888x registers to the following locations:

Address	Length	Register	Description
0xFFFFFA40	**WORD**	***FPCIR***	Status register
0xFFFFFA42	**WORD**	***FPCTL***	Control Register
0xFFFFFA44	**WORD**	***FPSAV***	Save Register
0xFFFFFA46	**WORD**	***FPREST***	Restore Register
0xFFFFFA48	**WORD**	***FPOPR***	Operation word register
0xFFFFFA4A	**WORD**	***FPCMD***	Command register
0xFFFFFA4C	**WORD**	***FPRES***	Reserved
0xFFFFFA4E	**WORD**	***FPCCR***	Condition Code Register
0xFFFFFA50	**LONG**	***FPOP***	Operand Register

To execute a floating point instruction, use the following protocol for communicating data with the 6888x:

1. Wait for the chip to be idle.
2. Write a valid 6888x command to ***FPCMD***.
3. If necessary for the command, write an operand to ***FPOP***.
4. Wait for the status port to indicate the command is complete.
5. Read any return data from ***FPOP***.

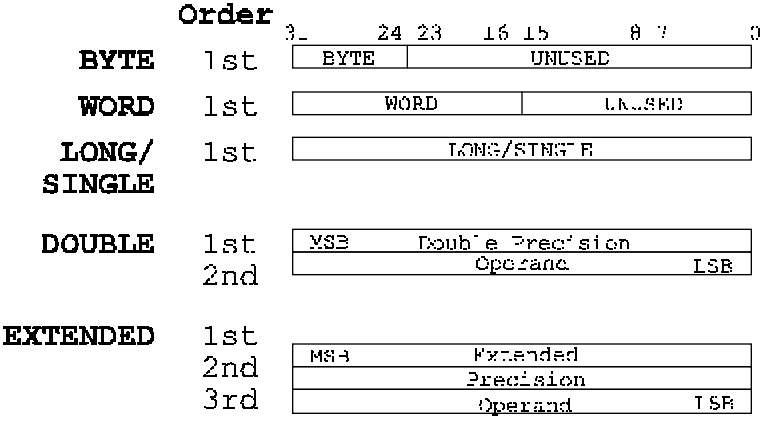
Step one is achieved by waiting for a value of 0x0802 to appear in the status register (after ANDing with 0xBFFF) as follows:

```
while( ( FPCIR & 0xBFFF) != 0x0802 ) ;
```

Steps two and three involve writing the command word to ***FPCMD*** and any necessary operand data to ***FPOP***. A primitive response code will be generated (and should be read) between each write to either ***FPCMD*** or ***FPOP***. For a listing of primitive response codes returned by the 68881, consult the **MC68881/68882 Floating-Point Coprocessor User's Manual (2nd edition), Motorola publication MC68881UM/AD rev. 2, ISBN 0-13-567-009-8**.

After the operation is complete (step 4), data may be read from the 68881 in ***FPOP*** (step 5).

When sending or receiving data in **FPOP**, the following chart details the transfer ordering and alignment:



The following code demonstrates transferring two single precision floating-point numbers to the 68881, multiplying them, and returning the result.

```
/* Number of iterations before an error is triggered */
#define FPCOUNT      0x80

#define FPCIR            ((WORD *)(0xFFFFFA40L))
#define FPCMD            ((WORD *)(0xFFFFFA4AL))
#define FPOP         ((float *)(0xFFFFFA50L))
```

```
WORD fpcount, dum;

/* fperr() is user-defined */

#define FPwait() {    fpcount = FPCOUNT; \
                      while((*FPCIR & 0xBFFF) != 0x0802) \
                          if(!(--fpcount)) fperr();  }

#define FPsglset(r,v) { FPwait(); \
                        *FPCMD = (0x5400 | ((r) << 7)); \
                        while((*FPCIR & 0xFFF0) != 0x8C00) \
                          if(!(--fpcount)) fperr();     \
                        *FPOP = (v); }

#define FPsglmul(r1,r2) {     FPwait();    \
                          *FPCMD = (0x0027 | ((r2) << 10) | ((r1) << 7));     \
                          dum = *FPCIR + 1;}

/* dum = FPCIR +1; forces the status register to be read
   (we assume the data's good) */

#define FPsglget(r,var) { FPwait();    \
                          *FPCMD = (0x6400 | ((r) << 7));        \
                          while(*FPCIR != 0xb104)       \
                              if(!(--fpcount)) fperr();     \
                          var = *FPOP;     }

/*
 * void sglmul( float *f1, float *f2 );
 *
 * Multiplies f1 by f2. Returns result in f1.
 *
 */

void
sglmul( float &f1, float &f2 )
{
       FPsglset( 0, *f1 );
       FPsglset( 1, *f2 );
       FPsglmul( 0, 1 );
       FPsglget( 0, *f1 );
}
```

Cartridges

All Atari computers support an external 128K ROM cartridge port. Cartridges may be created to support applications or diagnostic tools. The 128K of address space allocated to cartridges appears from address 0xFA0000 to 0xFBFFFF. Newer Atari computers support larger cartridges (this is because the address space would no longer overlap the OS). All program code must be compiled to be relative of this base address.

The **LONG** appearing at 0xFA0000 determines the type of cartridge installed as follows:

Cartridge	LONG Value
Application	0xABCDEF42

Diagnostic	0xFA52255F

Diagnostic Cartridges

Diagnostic cartridges are executed almost immediately after a system reset. The OS uses a 680x0 JMP instruction to begin execution at address 0xFA0004 after having set the Interrupt Priority Level (IPL) to 7, entering supervisor mode, and executing a RESET instruction to reset external hardware devices.

Upon execution, register A6 will contain a return address which should be JMP'd to if you wish to continue system initialization at any point. The stack pointers will contain garbage. In addition, keep in mind that no hardware has been initialized, particularly the memory controller. All system memory sizing and initialization must be performed by the diagnostic cartridge.

Application Cartridges

Application cartridges should contain one or more application headers beginning at location 0xFA0004 as follows (one cartridge may contain one or many applications):

Name	Offset	Meaning
CA_NEXT	0x00	Pointer to the next application header (or **NULL** if there are no more).
CA_INIT	0x04	Pointer to the application's initialization code. The high eight bits of this pointer have a special meaning as follows: **Bit Set** — **Meaning** 0 — Execute prior to display memory and interrupt vector initialization. 1 — Execute just before **GEMDOS** is initialized. 2 — (unused) 3 — Execute prior to boot disk. 4 — (unused) 5 — Application is a Desk Accessory. 6 — Application is not a **GEM** application. 7 — Application needs parameters.
CA_RUN	0x08	Pointer to application's main entry point.
CA_TIME	0x0C	Standard **GEMDOS** time stamp.
CA_DATE	0x0E	Standard **GEMDOS** date stamp.
CA_SIZE	0x10	Size of application in bytes.
CA_NAME	0x14	**NULL** terminated ASCII filename in standard **GEMDOS** 8+3 format.

When application cartridges are present, **GEMDOS** will allow a special ‘c’ (lowercase) drive to be accessed. Executable files appear on this drive as they would on any standard disk. This ‘drive’ may also be installed on the desktop.

Game Controllers

The Atari 1040STe and Falcon030 support new enhanced joystick controls as well as older style CX-40 controls. For the usage and polling of the older style controls, refer to the following section which discusses the IKBD controller. This section will focus specifically on the newer style of controllers.

Joysticks

Enhanced joysticks are read by a two-step process. The **WORD** at address 0xFF9202 is written to using a mask which determines which values may subsequently be read from the **WORD**s at address 0xFF9200 and 0xFF9202. Valid mask values and the keys that may be read follow:

Read Controller 0 at 0xFF9200		
Write Mask	**Bit 0 Clear**	**Bit 1 Clear**
0xFFFE	Pause	Fire 0
0xFFFD	-	Fire 1
0xFFFB	-	Fire 2
0xFFF7	-	Option

Read Controller 1 at 0xFF9200		
Write Mask	**Bit 2 Clear**	**Bit 3 Clear**
0xFFEF	Pause	Fire 0
0xFFDF	-	Fire 1
0xFFBF	-	Fire 2
0xFF7F	-	Option

Read Controller 0 at 0xFF9202				
Write Mask	**Bit 8 Clear**	**Bit 9 Clear**	**Bit 10 Clear**	**Bit 11 Clear**
0xFFFE	Up	Down	Left	Right
0xFFFD	Key *	Key 7	Key 4	Key 1
0xFFFB	Key 0	Key 8	Key 5	Key 2
0xFFF7	Key #	Key 9	Key 6	Key 3

Read Controller 1 at 0xFF9202				
Mask	**Bit 12 Clear**	**Bit 13 Clear**	**Bit 14 Clear**	**Bit 15 Clear**
0xFFEF	Up	Down	Left	Right
0xFFDF	Key *	Key 7	Key 4	Key 1
0xFFBF	Key 0	Key 8	Key 5	Key 2
0xFF7F	Key #	Key 9	Key 6	Key 3

To read the joystick, write a mask value corresponding to the row of keys/positions you wish to interrogate to 0xFF9202. Next, read back a **WORD** from either 0xFF9200 or 0xFF9202. As indicated in the table, cleared bits mean that a key is being pressed or a joystick is moved in that direction.

Paddles

Two paddles may be plugged into each joystick port. Each paddle returns an 8-bit value indicating its position (0 = full counter-clockwise, 255 = full clockwise) at the addresses shown below. Unlike joysticks, paddle positions are returned automatically with no need to write to an address prior to a read. Paddle fire buttons, however, are mapped and read in the same manner as the joysticks. See the discussion of joysticks above for an explanation.

Byte Address	Paddle
0xFF9211	X Paddle 0
0xFF9213	Y Paddle 0
0xFF9215	X Paddle 1
0xFF9217	Y Paddle 1

Light Gun/Pen

Joystick port 0 supports a light gun or pen. The position that the gun is pointing to is returned in the **WORD** registers at 0xFF9220 (X position) and 0xFF9222 (Y position). Only the lower 10 bits are significant giving a range of values from 0-1023.

The IKBD Controller

The Atari 16/32 bit computer line uses the Intelligent Keyboard Controller (IKBD) for keyboard, joystick (old-style CX-40), mouse, and clock communication. The 6850 ACIA serial communications chip is used to transfer data packets from the IKBD interface to the host computer.

The **TOS** calls **Bconout(** 4, ??? **)**, **Ikbdws()**, and **Initmous()** handle communication to the controller. Return messages from the controller must be processed by placing a specialized handler in the vector table returned by the **XBIOS** call **Kbdvbase()**. **Kbdvbase()** returns the pointer to a vector table as follows:

```
typedef struct
{
       void (*midivec)( UBYTE data );       /* Passed in d0 */
       void (*vkbderr)( UBYTE data );       /* Passed in d0 */
       void (*vmiderr)( UBYTE data );       /* Passed in d0 */
       void (*statvec)( char *packet );     /* Passed in a0 */
       void (*mousevec)( char *packet );        /* Passed in
       a0 */
       void (*clockvec)( char *packet );        /* Passed in
       a0 */
       void (*joyvec)( char *packet );      /* Passed in a0 */
       void (*midisys)( VOID );
       void (*ikbdsys)( VOID );
       char ikbdstate;
```

```
} KBDVECS;
```

When an IKBD message is pending, the interrupt handler for the ACIAs calls either the midisys handler or the ikbdsys handler to retrieve the data and handle any errors. The default action for the *ikbdsys* handler is to decide whether the packet contains error, status, joystick, clock, or mouse information and to route it appropriately to *vkbderr*, *statvec*, *joyvec*, *clockvec*, or *mousevec*. Keyboard packets are handled internally by *ikbdsys*.

Your handler should be patched into the appropriate vector and, if appropriate, expect the packet buffer to be pointed to by register A0. Unless your handler is designed to completely replace the functions of the default handler you should jump through the original vector pointer upon exit, otherwise simply use the 680x0 RTS instruction.

Each byte received through the keyboard ACIA falls into one of the following categories as follows:

Category	Value(s)	Meaning
Keyboard Make Code	0x00–0x7F	One of these values is generated each time a key is depressed.This value may be used with **Keytbl()** to generate an ASCII code for the scan code.
Keyboard Break Code	0x80–0xFF	This code is generated when a key previously depressed has been released. It represents the make code logically OR'ed with 0x80.
Status Packet Header	0xF6	This codes indicate the beginning of a multiple byte status packet.
Absolute Mouse Position	0xF7	See Below
Relative Mouse Position	0xF8-0xFB	See Below
Time-of-Day	0xFC	See Below
Joystick Report	0xFD	See Below
Joystick 0 Event	0xFE	See Below
Joystick 1 Event	0xFF	See Below
Status Packet Data	Any	When the *ikbdstate* variable (found in the **KBDVECS** structure) is non-zero, it represents the number of remaining bytes to retrieve that are part of a status packet and should thus not be treated as any of the above codes.

The Keyboard

Keyboard keys generate both a 'make' and 'break' code for each complete press and release respectively. The 'make' code is equivalent to the high byte of the IKBD scan code. 'make' codes are not related in any way to ASCII codes. They represent the physical position of the key in the keyboard matrix and may vary in keyboards designed for other countries. The **XBIOS** function **Keytbl()** provides lookup values which make internationalization possible. The key 'break' code is the 'make' code logically ORed with 0x80.

It should be noted that 'key repeats' are not generated by the ACIA but by a coordination of the *ikbdsys* and system timer handlers.

The Mouse

The mouse may be programmed to return position reports in either absolute, relative, or keycode mode (it is by default programmed to return relative position reports).

In relative reporting mode, the IKBD generates a mouse packet each time a mouse button is pressed or released, and every time the mouse is moved over a preset threshold distance (which is configurable). A relative mouse report packet is headed by a byte value between 0xF8 and 0xFB followed by the X and Y movement of the mouse as signed bytes. If the movement is greater than can be represented as signed bytes (-128 to 127), multiple packets are sent.

The header byte determines the state of the mouse buttons as follows:

Header	Mouse Button State
0xF8	No buttons depressed.
0xF9	Left button depressed.
0xFA	Right button depressed.
0xFB	Both buttons depressed.

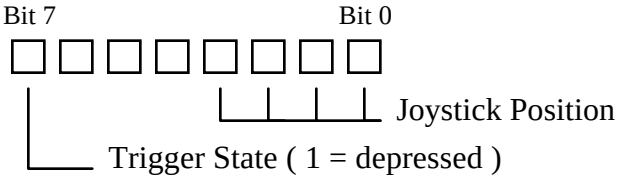
In absolute reporting mode, the IKBD only generates a mouse packet when interrogated. Mouse packets in absolute mode are headed by a 0xF7 byte followed by the MSB and LSB of the X value and the MSB and LSB of the Y value respectively. The minimum and maximum X and Y values are user-definable.

Keycode reporting mode generates keyboard 'make' and 'break' codes for mouse movements rather than sending standard mouse packets. Mouse movement is translated into the arrow keys and the codes 0x74 and 0x75 represent the left and right mouse button respectively. 'break' codes are sent immediately after the corresponding 'make' code is delivered.

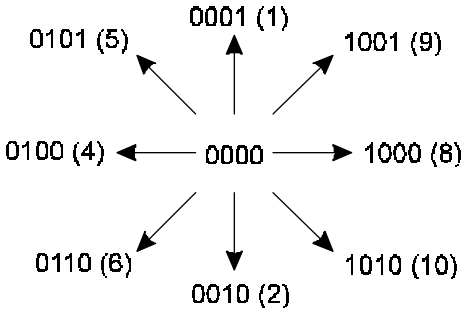
The Joystick

The basic CX-40 style joystick controls are still present on every Atari computer. Atari recommends that these ports should not be supported when STe/Falcon030 enhanced joysticks are present unless the option for four-player play is desired. While no direct **TOS** support is available for reading these ports, it is possible using the IKBD controller in one of several joystick reporting modes.

Joystick event reporting mode (the default) sends a joystick packet each time the status of one of the joysticks changes. The joystick packet header is 0xFE if the state of joystick 0 has changed or 0xFF if the status of joystick 1 has changed. This header byte is followed by a **BYTE** containing the new state of the joystick as follows:



The four bits corresponding to joystick position can be interpreted as follows:



Joysticks may be interrogated at any time by sending an interrogate command (as described later in this chapter). The packet response to this command is 0xFD followed by the **BYTE** report of joystick 0 and 1 (as shown above).

The joysticks may be placed into joystick monitoring or fire button monitoring mode. In these modes, all other IKBD communication is stopped and all processor time is devoted to the processing of packets. Joystick monitoring mode cause the IKBD to send a continuous stream of two-byte packets as follows: The first byte contains the status of joystick buttons 0 and 1 in bits 1 and 0 respectively. The second byte contains the position state of joystick 0 in the high nibble and joystick 1 in the lower nibble (the position state can be interpreted as shown in the diagram above).

Fire button monitoring mode constantly scans joystick button 1 and returns the results in **BYTE**s packed with 8 reports each (one per bit). These modes may be paused or halted using the appropriate commands.

Joystick keycode mode is similar to mouse keycode mode. This mode translates all joystick position information into arrow keys. A 'make' code of 0x74 is generated when joystick button 0 is depressed and a 'make' code of 0x75 is generated when joystick button 1 is depressed. The rate at which the IKBD controller generates these joystick events can be controlled using commands discussed in the following section.

Time-of-Day

The IKBD controller maintains a separate time-of day clock that is kept synchronized with **GEMDOS** time by OS calls. A time-of-day packet may be requested using the method shown below under IKBD commands.

The response packet from the IKBD is seven bytes in length identified by its header byte of 0xFC and followed by six UBYTES containing the year (last two digits), month, day, hours (0-24), minutes, and seconds in BCD format (ex: a month byte in December would be 0x12).

IKBD Commands

Commands may be sent to the IKBD using any of the **TOS** function calls described above. Some commands may generate packets while other commands change the operating state of the IKBD controller. Unrecognized command codes are treated as NOPs. The following lists valid IKBD command codes:

Command BYTE	Result
0x07	Set mouse button action. This command **BYTE** should be followed by a **BYTE** which describes how the mouse buttons should be treated as follows: **BYTE** **Meaning** 0x00 Default mode. 0x01 Mouse button press triggers an absolute position report. 0x02 Mouse button release triggers an absolute position report. 0x03 Mouse button press and release triggers absolute position reports. 0x04 Mouse buttons report key presses.
0x08	Enable relative mouse position reporting (default).
0x09	Enable absolute mouse position reporting. This command is followed by the MSB and LSB of the X and Y coordinate maximum values for the mouse.
0x0A	Enable mouse keycode mode. This command is followed by two **BYTE**s indicating the maximum number of mouse 'ticks' required to generate a keycode for the X and Y axis respectively.

0x0B	Set mouse threshold. This command is followed by two **BYTE**s which determine the number of mouse 'ticks' required to generate a mouse position report in relative positioning mode.
0x0C	Set mouse scale. This command is followed by two **BYTE**s which determine the number of mouse 'ticks' for each single coordinate on the X and Y axis respectively.
0x0D	Interrogate mouse position. This command generates an absolute mouse position report.
0x0E	Load mouse position. This command sets the mouse position based on the current coordinate system in absolute reporting mode. The command is followed by a filler **BYTE** of 0x00 and the MSB and LSB of the new X and Y axis for the mouse.
0x0F	Set Y=0 to the bottom. This command changes the origin of the mouse coordinate system to the upper left of the screen.
0x10	Set Y=0 to the top. This command changes the origin of the mouse coordinate system to the lower left of the screen.
0x11	Resume sending data. This command (or for that matter any command) will cause the IKBD to resume sending packet data to the host.
0x12	Disable all mouse packet reporting. Any valid mouse command resets this state. If the mouse buttons have been programmed to act like keyboard keys, this command will have no effect on them.
0x13	Pause output. All output from the IKBD controller is halted until a 'Resume' or other command is received.
0x14	Set joystick event reporting mode. This command causes a joystick report to be generated whenever the state of either joystick changes.
0x15	Set joystick interrogation mode. This command causes the IKBD to generate joystick packets only when requested by the host.
0x16	Joystick interrogation. This command causes a joystick packet indicating the status of both joysticks to be generated.
0x17	Enables joystick monitoring mode. Besides serial communication and the maintenance of the time-of-day clock, this command causes only special joystick reports to be generated. The command **BYTE** should be followed by a **BYTE** indicating how often the joystick should be polled in increments of 1/100ths of a second.
0x18	Enables fire button monitoring mode. As above, this mode limits the IKBD to serial communication, updating the time-of-day clock, and the reporting of the state of joystick button 1.

<table>
<tr><td>0x19</td><td>Set joystick keycode mode. This command is followed by six BYTEs as follows:

<u>BYTE</u> <u>Meaning</u>
1 The length of time (in tenths of a second) before the horizontal breakpoint is reached.
2 Same as above for the vertical plane.
3 The length of time (in tenths of a second) between key repeats before the velocity breakpoint is reached.
4 Same as above for the vertical plane.
5 The length of time (in tenths of a second) between key repeats after the velocity breakpoint is reached.
6 Same as above for the vertical plane.</td></tr>
<tr><td>0x1A</td><td>Disable joystick event reporting.</td></tr>
<tr><td>0x1B</td><td>Set the time of day clock. This command is followed by six BYTEs used to set the IKBD clock. These BYTEs are in binary-coded decimal (BCD) format. Each BYTE contains two digits (0-9), one in each nibble. The format for these BYTEs is as follows:

<u>BYTE</u> <u>Meaning</u>
1 Year (last two digits)
2 Month
3 Date
4 Hours (0-23)
5 Minutes (0-59)
6 Seconds (0-59)</td></tr>
<tr><td>0x1C</td><td>Interrogate the time-of-day clock. This command returns a packet headed by the value 0xFC followed by six BYTEs as indicated above.</td></tr>
<tr><td>0x20</td><td>Load BYTEs into the IKBD memory. This command is followed by at least three BYTEs containing the MSB and LSB of the address into which to load the data, the number of BYTEs to load (0-127), and the data itself.</td></tr>
<tr><td>0x21</td><td>Read BYTEs from the IKBD controller. This command is followed by two BYTEs containing the MSB and LSB of the address to read from. This returns a packet headed by the BYTE values 0xF6 and 0x20 followed by the memory data.</td></tr>
<tr><td>0x22</td><td>Execute a subroutine on the IKBD controller. This command BYTE is followed by two BYTEs containing the MSB and LSB of the memory location of the subroutine to execute.</td></tr>
<tr><td>0x80</td><td>Reset the IKBD controller. This command is actually a two-BYTE command. The BYTE 0x80 must be followed by a BYTE of 0x01 or the command will be ignored.</td></tr>
</table>

<table>
<tr><td>0x87</td><td>Return a status message containing the current mouse action state. After receiving this command the IKBD will respond by sending a status packet (which may be intercepted at statvec) as follows:

<u>BYTE</u> <u>Meaning</u>
1 0xF6
2 0x07
3 Current mouse action state
(see command 0x07)
4-8 0</td></tr>
<tr><td>0x88</td><td>Return a status message containing the current mouse mode. After receiving this command the IKBD will respond by sending a status packet (which may be intercepted at statvec) as follows:

<u>BYTE</u> <u>Meaning</u>
1 0xF6
2 Current mode as follows:
0x08 = Relative mode
0x09 = Absolute mode
0x0A = Keycode mode
3 Absolute mode: MSB of maximum X position (units to current scale).
Keycode mode: Horizontal distance threshold that must be passed prior to sending a keycode.
Relative mode: 0
4 Absolute mode: LSB of maximum X position.
Keycode mode: Vertical distance threshold that must be passed prior to sending a keycode.
Relative mode: 0
5 Absolute mode: MSB of maximum Y position (units to current scale).
Keycode mode: 0
Relative mode: 0
6 Absolute mode: LSB of maximum Y position.
Keycode mode: 0
Relative mode: 0
7-8 0</td></tr>
<tr><td>0X89</td><td>Same as 0x88.</td></tr>
<tr><td>0X8A</td><td>Same as 0x88.</td></tr>
</table>

<table>
<tr><td>0x8B</td><td>Return a status message containing the current mouse threshold state. After receiving this command the IKBD will respond by sending a status packet (which may be intercepted at statvec) as follows:

<u>BYTE</u> <u>Meaning</u>
1 0xF6
2 0x0B
3 Number of horizontal mouse ‘ticks’ that must be traveled prior to sending a mouse packet.
4 Number of vertical mouse ‘ticks’ that must be traveled prior to sending a mouse packet.
5-8 0</td></tr>
<tr><td>0x8C</td><td>Return a status message containing the current mouse scaling factor. After receiving this command the IKBD will respond by sending a status packet (which may be intercepted at statvec) as follows:

<u>BYTE</u> <u>Meaning</u>
1 0xF6
2 0x0C
3 Horizontal mouse ‘ticks’ between a change in mouse position on the X axis.
4 Vertical mouse ‘ticks’ between a change in mouse position on the Y axis.
5-8 0</td></tr>
<tr><td>0x8F</td><td>Return a status message containing the current origin point of the Y axis used for mouse position reporting. After receiving this command the IKBD will respond by sending a status packet (which may be intercepted at statvec) as follows:

<u>BYTE</u> <u>Meaning</u>
1 0xF6
2 0x0F = Bottom is (Y=0)
0x10 = Top is (Y=0)
3-8 0</td></tr>
<tr><td>0x90</td><td>Same as 0x8F.</td></tr>
<tr><td>0x92</td><td>Return a status message containing the current state of mouse reporting. After receiving this command the IKBD will respond by sending a status packet (which may be intercepted at statvec) as follows:

<u>BYTE</u> <u>Meaning</u>
1 0xF6
2 0x00 = Mouse reporting enabled.
0x12 = Mouse reporting disabled.
3-8 0</td></tr>
</table>

<table>
<tr><td>0x94</td><td>Return a status message containing the current joystick mode. After receiving this command the IKBD will respond by sending a status packet (which may be intercepted at statvec) as follows:

<u>BYTE</u> <u>Meaning</u>
1 0xF6

2 Current mode as follows:
0x14 = Event reporting mode
0x15 = Interrogation mode
0x19 = Keycode mode

3 Keycode mode: This value represents the amount of time (in tenths of a second) that keycodes are returned to the host for horizontal position events at the initial velocity level (after this time expires, the secondary velocity level is used).
Event recording mode: 0
Interrogation mode: 0

4 Keycode mode: Same as BYTE 3 for vertical events.
Event recording mode: 0
Interrogation mode: 0

5 Keycode mode: This value represents the initial horizontal velocity level (in tenths of a second). This is the initial rate at which keycodes are generated.
Event recording mode: 0
Interrogation mode: 0

6 Keycode mode: Same as byte 5 for vertical events.
Event recording mode: 0
Interrogation mode: 0

7 Keycode mode: This value represents the secondary horizontal velocity level (in tenths of a second). This is the rate used after the amount of time specified in bytes 3-4 expires.
Event recording mode: 0
Interrogation mode: 0

8 Keycode mode: Same as byte 7 for vertical events.
Event recording mode: 0
Interrogation mode: 0</td></tr>
<tr><td>0x95</td><td>Same as 0x94.</td></tr>
<tr><td>0x99</td><td>Same as 0x94.</td></tr>
</table>

0x9A	Return a status message containing the current status of the joystick. After receiving this command the IKBD will respond by sending a status packet (which may be intercepted at *statvec*) as follows: **BYTE** **Meaning** 1 0xF6 2 0x00 = Joystick enabled 0x1A = Joystick disabled 3-8 0

STe/TT030 DMA Sound

The Atari STe, Mega STe, TT030, and Falcon030 are all equipped with the ability to playback stereo digital audio. Only the Falcon030, however, has supporting **XBIOS** calls which eliminate the need for the programmer to directly access the sound system hardware. Although the Falcon030 has a more sophisticated sound system than the earlier Atari machines, the hardware registers have been kept compatible so older applications should function as expected. Programmers designing Falcon030 applications which use digital audio should use the appropriate **XBIOS** calls.

The STe, MegaSTe, and TT030 support 8-bit monophonic or stereophonic sound samples. Samples should be signed (-128 to 127) with alternating left and right channels (for stereo) beginning with the left channel. Samples may be played at 50 kHz, 25 kHz, 12.5 kHz, or 6.25 kHz (6.25 kHz is not supported on the Falcon030).

DMA Sound Registers

Several hardware registers control DMA sound output as follows:

Address	Bit Layout	Meaning
0xFF8900	`---- ---- ---- --cc`	Sound DMA Control
0xFF8902	`---- ---- 00xx xxxx`	Frame Base Address High (bits 21-16)
0xFF8904	`---- ---- xxxx xxxx`	Frame Base Address Middle (bits 15-8)
0xFF8906	`---- ---- xxxx xxx0`	Frame Base Address Low (bits 7-1)
0xFF8908	`---- ---- 00xx xxxx`	Frame Address Counter (bits 21-16)
0xFF890A	`---- ---- xxxx xxxx`	Frame Address Counter (bits 15-8)
0xFF890C	`---- ---- xxxx xxx0`	Frame Address Counter (bits 7-1)
0xFF890E	`---- ---- 00xx xxxx`	Frame End Address High (bits 21-16)
0xFF8910	`---- ---- xxxx xxxx`	Frame End Address Middle (bits 15-8)
0xFF8912	`---- ---- xxxx xxx0`	Frame End Address Low (bits 7-1)
0xFF8920	`0000 0000 m000 00rr`	Sound Mode Control

Addresses placed in the three groups of address pointer registers must begin on an even address. In addition, only sounds within the first 4 megabytes of memory may be accessed (this limitation has been lifted on the Falcon030). Sounds may not be played from alternate RAM.

Playing a Sound

To begin sound playback, place the start address of the sound in the Frame Base Address registers. Place the address of the end of the sound in the Frame End Address registers. The address of the end of the sound should actually be the first byte in memory past the last byte of the sample.

Set the Sound Mode Control register to the proper value. Bit 7, notated as 'm' should be set to 1 for a monophonic sample or 0 for a stereophonic sample. Bits 0 and 1, notated as 'r', control the sample playback rate as follows:

'r'	Playback Rate
00	6258 Hz
01	12517 Hz
10	25033 Hz
11	50066 Hz

To begin the sample playback, set bits 0 and 1 of the Sound DMA Control register, notated as 'c', as follows:

'c'	Sound Control
00	Sound Disabled (this will stop any sound currently being played)
01	Sound Enabled (play once)
11	Sound Enabled (repeat until stopped)

Sound playback may be prematurely halted by writing a 0 to address 0x00FF8900.

Sound Interrupts using MFP Timer A

Discontinuous sample frames may be linked together using the MFP Timer A interrupt. When a sound is played using repeat mode an interrupt is generated at the end of every frame. By configuring Timer A to 'event count' mode you can ensure the seamless linkage and variable repeating of frames.

For example, suppose you have three sample frames, A, B, and C, in memory and you want to play A five times, B five times, and C only once. Use the following steps to properly configure Timer A and achieve the desired result:

- Use **Xbtimer()** to set Timer A to event count mode with a data value of 4 (the first data value should be one less than actually desired since the sound will play once before the interrupt occurs).
- Configure the sound registers as desired and start sound playback in repeat mode.
- When the interrupt fires, place the address of frame B in the sound playback registers (these values aren't actually used until the current frame finishes).
- Reset Timer A's data register to 5 and exit your interrupt handler.

- When the second interrupt fires, place the address of frame C in the sound playback registers.
- Reset Timer A's data register to 1 and exit your interrupt handler.
- When the final interrupt is triggered, write a 0x01 to the sound control register to cause sound playback to end at the end of the current frame.

Sound Interrupts using GPIP 7

Another method of generating interrupts at the end of sound frames is by using the MFP's General Purpose Interrupt Port (GPIP) 7. This interrupt does not support an event count mode so it will generate an interrupt at the end of every frame. In addition, the interrupt must be configured differently depending on the type on monitor connected to the system (this is because GPIP 7 serves double-duty as the monochrome detect signal).

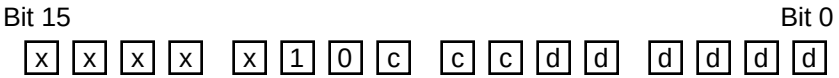
To program GPIP 7 for interrupts, disable all DMA sound by placing a 0x00 in the sound control register. Next, check bit 7 of the GPIP port at location 0xFFFA01. If a monochrome monitor is connected the bit will be 0. The bit will be 1 if a color monitor is connected.

Bit 7 of the MFP's active edge register (at 0xFFFA03) should be set to the opposite of the GPIP port's bit 7. This will cause an interrupt to trigger at the end of every frame. Use **Mfpint()** to set the location of your interrupt handler and **Jenabint()** to enable interrupts. From this point, interrupts will be generated at the end of every frame playing in 'play once' mode or repeat mode until the interrupt is disabled.

The MICROWIRE Interface

The STe and TT030 computers use the MICROWIRE interface to control volume, mixing of the PSG and DMA output, and tone control. The original ST is limited to amplitude control through the use of the appropriate PSG register. The Falcon030 supports new **XBIOS** calls which allow volume and mixing control.

The MICROWIRE interface is a write-only device accessed using two hardware registers 0xFFFF8924 (mask) and 0xFFFF8922 (data). To write a command to the MICROWIRE you must first place the value 0x07FF into the mask register and then write the appropriate command to the data register. The format for the data **WORD** is shown below:



Bits labeled 'x' will be ignored. Bits 9 and 10 should always be %10 to correctly specify the device address which is a constant. Bits labeled 'c' specify the command and bits labeled 'd' contain the appropriate data for the command. The following table explains the valid MICROWIRE commands:

Command	'ccc'	'dddddd'	
Set Master Volume	011	**Example Value**	**Result**
		%000000	-80dB Attenuation
		%010100	-40dB Attenuation
		%101000	0dB Attenuation (Maximum)
Set Left Channel Volume	101	**Example Value**	**Result**
		%000000	-40dB Attenuation
		%001010	-20dB Attenuation
		%010100	0dB Attenuation (Maximum)
Set Right Channel Volume	100	**Example Value**	**Result**
		%000000	-40dB Attenuation
		%001010	-20dB Attenuation
		%010100	0dB Attenuation (Maximum)
Set Treble	010	**Example Value**	**Result**
		%000000	-12dB Attenuation
		%000110	0dB Attenuation
		%001100	+12dB Attenuation (Maximum)
Set Bass	001	**Example Value**	**Result**
		%000000	-12dB Attenuation
		%000110	0dB Attenuation
		%001100	+12dB Attenuation (Maximum)
Set PSG/DMA Mix	000	**Example Value**	**Result**
		%000000	-12dB Attenuation
		%000001	Mix PSG sound output.
		%000010	Don't Mix PSG sound output.

When configuring multiple settings at once, you should program a delay between writes since the MICROWIRE takes at least 16µsec to completely read the data register. During a read the MICROWIRE rotates the mask register one bit at a time. You will know a read operation has completed when the mask register returns to 0x07FF. The following assembly segment illustrates this by setting the left and right channel volumes to their maximum values:

```
MWMASK      EQU     $FFFF8924
MWDATA      EQU     $FFFF8922

MASKVAL     EQU     $7FF
HIGHLVOL    EQU     $554
HIGHRVOL    EQU     $514

            .text

maxvol:
            move.w  MASKVAL,MWMASK      ; First write the mask and data values
            move.w  #HIGHLVOL,MWDATA
mwwrite:
            cmp.w   MASKVAL,MWMASK
            bne.s   mwwrite             ; loop until MWMASK reaches $7FF again
            move.w  #HIGHRVOL,MWDATA    ; ok, safe to write second value
            rts

            .end
```

Video Hardware

Video Resolutions

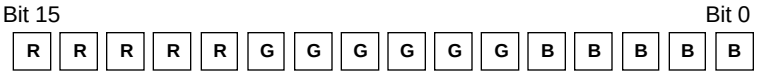
Atari computers support a wide range of video resolutions as shown in the following tables:

Computer System	Modes (width ´ height ´ colors)	Possible Colors
ST, Mega ST	320x200x16 640x200x4 640x400x2	512
STe, Mega STe	320x200x16 640x200x4 640x400x2	4096
STacy	640x400x2	N/A
TT030	320x200x256 640x200x4 640x400x2 320x480x256 640x480x16	4096
Falcon030	See below.	262,144

Falcon030 Video Modes

The Falcon030 is equipped with a much more flexible video controller than earlier Atari computers. The display area may be output on a standard television, an Atari color or monochrome monitor, or a VGA monitor. Overscan is supported with all monitor configurations with the exception of VGA. Also, hardware support for NTSC and PAL monitors is software configurable.

The Falcon030 supports graphic modes of 40 or 80 columns (320 or 640 pixels across) containing 1, 2, 4, 8, or 16 bits per pixel resulting in 2, 4, 16, 256, or 262,144 colors respectively. All modes except the 16 bit per pixel mode supply the video shifter with palette indexes. The 16 bit per pixel mode is a 'true-color' mode where each 16 bit value determines the color rather than being an index into a palette. Each 16 bit **WORD** value is arranged as follows:



Falcon030 True-Color Video Word

The 'R', 'G', and 'B', represent the red, green, and blue components of the color. Because red and blue are each allocated five bits, they can represent a color range of 0-31. The green component is allocated six bits so it can represent a color range of 0-63.

The Falcon030 also supports an overlay mode (see **VsetMask()**) where certain colors can be defined as transparent to a connected Genlock (or similar) device. In this mode, the least signifigant green bit (Bit #5) is treated as the transparent flag bit and the resolution of the green

color component is slightly reduced. If the transparent flag bit of a pixel is set, that pixel will display video from the Falcon030's video shifter, otherwise the external video source will be responsible for its display.

Another feature of the Falcon030's video shifter is an optional interlace/double-line mode. When operating on a VGA monitor, this mode doubles the pixel height effectively reducing the vertical screen resolution by half. On any other video display, this mode engages interlacing which increases the video resolution.

The operating system calls **VsetMode()** or **VsetScreen()** can be used to manipulate the operating mode of the Falcon030's video shifter. These calls do not, however, do any checking to ensure the selected video mode is actually attainable on the connected monitor or that the mode is legal. In particular, you should not attempt to set the video shifter to either 40 column mode with only one bit per pixel or 80 column VGA mode with 16 bits per pixel.

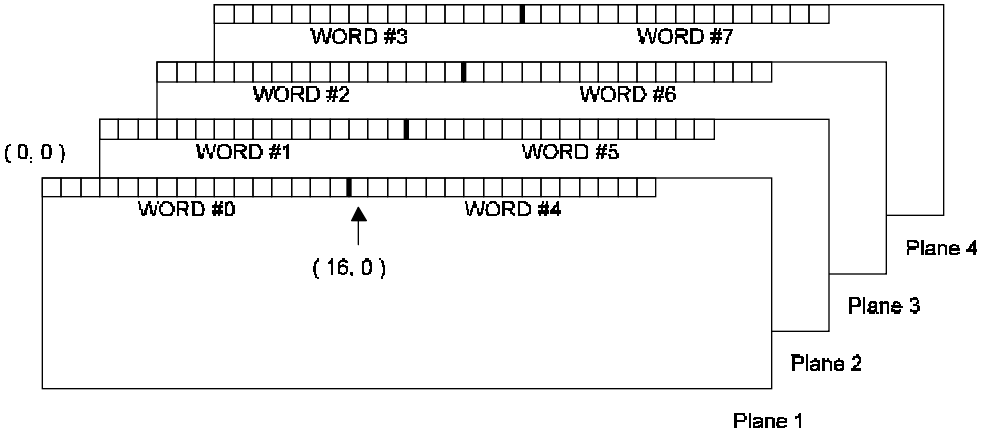
Video Memory

Most of the available video modes are palette-based. The number of bits required per pixel depends on the number of palette entries as shown in the table below. The Falcon030 also offers a true color video mode which requires 16 bits per pixel.

Palette Entries	Bits per Pixel
2	1
4	2
16	4
256	8

Directly accessing video memory is normally not recommended because it may create compatibility problems with future machines and wreak havoc with other system applications. The **VDI** provides a rich set of function calls which should be used when outputting to the screen. The function call **vr_trnfm()**, for instance, can be useful in transforming video images into a pattern compatible with the current video shifter. Certain software, however, does need exclusive access to video memory.

With the exception of the 16-bit true color mode of the Falcon030, all video images are stored in memory in **WORD** interleaved format. The video shifter grabs one at a time from each plane present as shown in the following diagram which represents a 16-color (four plane) screen layout:



The Falcon030's 16-bit true color mode is pixel-packed so that **WORD** #0 in memory is the complete color **WORD** for the pixel at (0, 0), **WORD** #1 is the complete color **WORD** for the pixel at (1, 0), etc.

Fine Scrolling

All Atari computers except the original ST and Mega ST support both horizontal and vertical fine scrolling in hardware. To accomplish this, an application must place a special handler in the vertical blank vector (at 0x00000070) which resets the scroll registers and video base address as needed.

The following registers are manipulated during the vertical-blank period to shift the screen across any number of virtual 'screens':

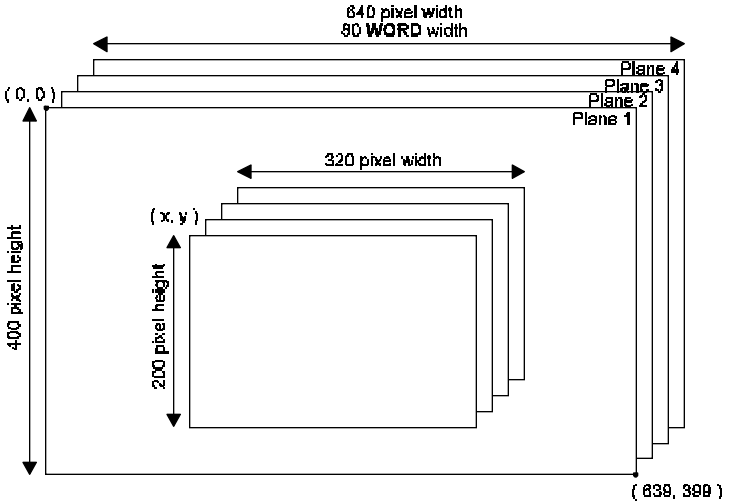
Register	Address	Contents
VBASEHI	0xFFFF8200	Low byte contains bits 23-16 of the video display base address.
VBASEMID	0xFFFF8202	Low byte contains bits 15-8 of the video display base address.
VBASELO	0xFFFF820C	Low byte contains bits 7-0 of the video display base address.
LINEWID	0xFFFF820E	Number of extra **WORD**s per scanline (normally 0).
HSCROLL	0xFFFF8264	Low four bits contain the bitwise offset (0-15) of the screen (normally 0 unless scrolling is in effect).
VCOUNTHI	0xFFFF8204	Low byte contains bits 23-16 of the current video refresh address (use with care).
VCOUNTMID	0xFFFF8206	Low byte contains bits 15-8 of the current video refresh address (use with care).
VCOUNTLO	0xFFFF8208	Low byte contains bits 7-0 of the current video refresh address (use with care).

To accommodate virtual screens wider than the display can show, set ***LINEWID*** to the number of extra **WORD**s per scanline. For instance, to create a virtual display two screens wide for a 320x200 16-color display, set ***LINEWID*** to 80.

To scroll vertically, simply alter the video base address by adding or subtracting the number of **WORD**s per scanline for each line you wish to scroll during the vertical blank.

To scroll horizontally, alter the video base address in **WORD** increments to move the physical screen left and right over the virtual screen. This by itself will cause the screen to skip in 16 pixel jumps. To scroll smoothly, use the ***HSCROLL*** register to shift the display accordingly. When ***HSCROLL*** is non-zero, subtract one from ***LINEWID*** for each plane.

To illustrate this more clearly, imagine a physical screen of 320x200 (16 colors) which is laid out over 4 virtual screens in a 2x2 grid. The following diagram and table shows example values to move the physical screen to the desired virtual coordinates:



Sample Values			
Virtual Coordinates	***VBASE* Address**	***LINEWID***	***HSCROLL***
(0, 0)	0x80000	80	0
(16, 0)	0x80004	80	0
(0, 1)	0x80140	80	0
(1, 0)	0x80000	76	1
(0, 10)	0x80B40	80	0
(100, 100)	0x87BE4	76	4

– CHAPTER 6 –

AES

Overview

The Application Environment Services (**AES**) compose the highest level of the operating system. The **AES** uses the **VDI**, **GEMDOS**, and **XBIOS** to provide a global utility library of calls which provide applications with the **GEM** interface. Usage of the **AES** makes application development simpler and makes user interfaces more consistent. The services provided by the **AES** include:

- Application Control/Interaction
- Event Management
- Menu Services
- Object Rendering/Manipulation
- Form Management
- Graphic Utility Functions
- Scrap (Clipboard) Management
- Common Dialog Display
- Window Management
- Resource Management
- Shell (Desktop) Interaction

System-specific **AES** information and variables may be determined through reserved fields in the application's global array (see **appl_init()**) or by using the various modes of **appl_getinfo()**.

Process Handling

The **AES** manages two types of user programs. Normal **GEM** applications have file extensions of '.PRG', '.APP', or '.GTP'. Desk Accessories have file extensions of '.ACC'.

Without **MultiTOS**, the **AES** can have a maximum of one application and six desk accessories (four desk accessories under **TOS** 1.0) executing concurrently. The currently running application (or the Desktop if no application is running) is given primary control over the system. Desk accessories are allocated processor time *only* when the foreground application releases control by calling one of the event library functions. An application which does not have a standard event loop (as illustrated below) will cause desk accessories to stop functioning while it is being executed.

Under **MultiTOS**, an unlimited amount of applications and desk accessories may be loaded concurrently[1]. **MultiTOS** is a pre-emptive system where all system processes are given time regardless of other applications.

Applications

When an application is launched, **GEM** allocates *all* remaining system memory and loads the application into this area[2]. It is the responsibility of the application to free whatever memory it doesn't immediately need for its text, data, bss, and stack area. Most high level languages do this for you in the startup stub linked with every application.

GEM applications begin with an **appl_init()** function call. This call will return a valid application ID if the process can be successfully registered or a -1 if it fails. If the call fails, the application should immediately exit without making any **AES** calls. Upon success, however, the ID should be stored for future use within the application. Applications running under **MultiTOS** should call **menu_register()** to display the program title in the application list rather than the filename.

The next steps a **GEM** application will follow are variable, however, most **GEM** applications will initialize themselves further by performing some or all of the following steps:

- Open a **VDI** workstation.
- Verify that the computer the application is being run on has the minimum requirements (screen resolution, OS versions, memory needs, hardware features) necessary to continue.
- Load the application '.RSC' file and fix it up as necessary.
- Display the menu bar.
- Change the mouse form to an arrow (the **AES** defaults to a **BUSY_BEE** shape).
- Enter the application's main event loop.

The following represents a basic skeleton for an **AES** application:

```
#include <AES.H>
#include <VDI.H>
#include <OSBIND.H>
#include <VDIWORK.H>
#include "skel.h"

#define CNTRL_Q  0x11
```

[1] Some **MultiTOS** versions limit this based upon the available space in the leftmost menu.

[2] **TOS** 5.0 does allow the user to set limits on the amount of memory allowed to an application.

```
int main(int, char *[]);

extern int _AESglobal[15];

short ap_id;
VDI_Workstation ws;       /* See entry for V_Opnvwk() in VDI docs */
OBJECT *mainmenu;

char RSCname[] = "skeleton.rsc";
char menu_title[] = "  Skeleton";

int
main(int argc, char *argv[])
{
       char *altNoVDIWork = "[3][GEM is unable to|allocate a workstation.|The
       program       must abort.][ OK ]";
       char *altNoRSC = "[3][The program cannot locate|SKELETON.RSC. Please
             ensure|that it resides in the|same directory as|SKELETON.PRG.][ OK ]";
       short ret,msg[8],kc,quit,dum;

       ap_id = appl_init();
       if(ap_id == -1)
             return -1;

       if(!OpenVwork(&ws))
       {
             graf_mouse( ARROW, 0L );
             form_alert(1, altNoVDIWork );
             appl_exit();
             return -1;
       }

       if(!rsrc_load( RSCname ))
       {
             graf_mouse( ARROW, 0L );
             form_alert(1, altNoRSC );
             v_clsvwk(ws.handle);
             appl_exit();
             return -1;
       }

       if(_AESglobal[1] == -1)                          /* MultiTOS present?
       */
             menu_register(ap_id, menu_title);      /* Yes, make name pretty. */

       rsrc_gaddr( R_TREE, MAINMENU, &mainmenu);

       menu_bar(mainmenu,1);
       graf_mouse( ARROW, 0L );

       quit = FALSE;
       while(!quit)
       {
             ret = evnt_multi(MU_MESAG|MU_KEYBD,2,1,1,0,0,0,0,0,0,0,0,0,0,msg,0,0,
                              &dum,&dum,&dum,&dum,&kc,&dum);

             if(ret & MU_MESAG)
             {
```

```
                switch(msg[0])
                {
                    case MN_SELECTED:
                        switch(msg[3])
                        {
                            .       /* Other menu selections */
                            .
                            .

                            case mmExit:                  /* Defined in SKEL.H */
                                quit = TRUE;
                                break;
                        }
                        break;
                    }
                }
            }

            if(ret & MU_KEYBD)
            {
                switch(kc & 0xFF)
                {
                    .           /* Other keyboard equivalents */
                    .
                    .
                    case CNTRL_Q:
                        quit = TRUE;
                        break;
                }
            }
        }

        menu_bar( mainmenu, 0 );
        v_clsvwk(ws.handle);
        rsrc_free();
        appl_exit();
        return 0;
}
```

The Command Line

GEM applications, like **TOS** applications, may be started with a command line (for a detailed description of command line processing, see *Chapter 2:* ***GEMDOS***). '.PRG' files and '.APP' files will have items on the command line if a document file which was registered with the application was double-clicked or if a valid document file was dropped over the application's icon in the Desktop. Launching a '.GTP' application will cause the Desktop to prompt the user for a command line in the same manner as '.TTP' programs are handled. Applications which find one or more valid document names on their command line should automatically load them on program start.

Desk Accessories

Upon bootup, any files with the extension '.ACC' found in the root directory of the user's boot drive will be loaded and executed up until their first event library call. **MultiTOS** allows desk accessories to be loaded and unloaded after bootup.

Unlike applications, desk accessories are not given all of available system memory on startup. They are only allocated enough memory for their text, data, and bss segments. No stack space is allocated for a desk accessory either. Many high level language stubs reserve space in the BSS or overwrite startup code to provide a stack but keep in mind that desk accessory stacks are usually small compared to applications.

As with applications, **GEM** desk accessories should begin with an **appl_init()** function call. Upon success, the ID should be stored and used within a **menu_register()** call to place the applications' name on the menu bar.

Desk accessories, unlike applications, do not begin user interaction immediately. Most desk accessories initialize themselves and enter a message loop waiting for an **AC_OPEN** message. Some desk accessories wait for timer events or custom messages from another application. After being triggered, they usually open a window in which user interaction may be performed (dialogs and alerts may also be presented but are not recommended because they prevent shuffling between other system processes).

Desk accessories should not use a menu bar and should never exit (unless **appl_init()** fails) after calling **menu_register()**. If an error condition occurs which would make the accessory unusable, simply enter an indefinite message loop.

Any resources loaded by an accessory should be loaded prior to entering the first event loop and should never be freed after the accessory has called **menu_register()**. Resource data for desk accessories should be embedded in the executable rather than being soft-loaded because memory allocated to a desk accessory is not freed during a resolution change on **TOS** versions less than 2.06. This causes resource memory allocated by **rsrc_load()** to be lost to the system after a resolution change and will likely cause memory fragmentation.

An **AC_CLOSE** message is sent to an accessory when it is being closed at the request of the OS. At this point, it should perform any cleanup necessary to release system resources and close files opened at **AC_OPEN** (accessory windows will be closed automatically by the **AES**). After cleanup, the event loop should be reentered to wait for subsequent **AC_OPEN** messages.

The following code represents a basic skeleton for an **AES** desk accessory:

```
#include <AES.H>
#include <VDI.H>
#include <OSBIND.H>
#include <VDIWORK.H>
```

```
int main(int, char *[]);

short ap_id;
VDI_Workstation ws;       /* See entry for V_Opnvwk() in VDI docs */

char menu_title[] = "  Skeleton";

int
main(int argc, char *argv[])
{
       char *altNoVDIWork = "[3][GEM is unable to|allocate a workstation.|The
       program       must abort.][ OK ]";
       short ret,msg[8],kc,dum;

       ap_id = appl_init();
       if(ap_id == -1)
            return -1;

       if(!OpenVwork(&ws))
       {
        form_alert(1, altNoVDIWork);
            appl_exit();
            return -1;
       }

       menu_id = menu_register(ap_id, menu_title );     /* Place name on menu bar
       */

       for(;;)
       {
            evnt_mesag(msg);

            switch( msg[0] )
            {
                case AC_OPEN:
                    if(msg[3] == menu_id)
                        OpenAccessoryWindow();
                    break;
                case AC_CLOSE:
                    if(msg[3] == menu_id)
                    {
                        v_clsvwk(ws.handle);
                        break;
                    }
            }
        }
}
```

The Environment String

One **AES** environment string exists in the system. This environment string is the one initially allocated for the **AES** by **GEMDOS**. The **AES** environment string should not be confused with **GEMDOS** environment strings. Each **GEMDOS** process receives its own environment string when launched. This string may have been purposely altered (or omitted) by its parent.

The **AES** environment string is a collection of variables which the AES (and other processes) may use as global system variables. Environment data may be set by a CPX designed to configure the environment, in the user's GEM.CNF file, or by an application.

In actuality, the environment string is actually one or many string entries separated by **NULL** bytes with the full list being terminated by a double **NULL** byte. Examples of environment string entries include:

```
PATH=C:\;D:\;E:\BIN\
TEMP=C:\
AE_SREDRAW=0
```

The environment variable name is followed by an equal sign which is followed by the variable data. Multiple arguments (such as path names) may be separated by semicolons or commas[3].

The **AES** call **shel_envrn()** may be used to search for an environment variable and new modes of **shel_write()** (after **AES** version 4.0) may be used to alter environment variables or copy the entire environment string.

Most versions of the **AES** contain a bug which causes the 'PATH' environment variable to be set incorrectly upon bootup to 'PATH=*[nul]*A:*[nul][nul]*'. If an environment string like this is found it may be safely reset or simply ignored.

The Event Dispatcher

Most **GEM** applications and all desk accessories rely on one of the **AES** event processing calls to direct program flow. After program initialization, an application enters a message loop which waits for and reacts to messages sent by the **AES**. Five basic types of events are generated by the **AES** and each can be read by a specialized event library call as follows:

Event Type	AES Function
Message	**evnt_mesag()**
Mouse Button	**evnt_button()**
Keyboard	**evnt_keybd()**
Timer	**evnt_timer()**

[3]The **AES** only began recognizing commas as valid argument separators (for the PATH environment variable) as of **AES** version 1.4.

Mouse Movement	**evnt_mouse()**

In addition to these five basic calls, the **AES** offers one multi-purpose call which waits for any combination of the above events called **evnt_multi()**. The **evnt_multi()** call is often the most important function call in any **GEM** application. A typical message loop follows:

```
#include <AES.H>

void
MessageLoop( void )
{
       short mx, my;          /* Mouse Position */
       short mb, mc;          /* Mouse button/# clicks */
       short ks, kc;          /* Key state/code */
       short quit;            /* Exit flag */
       short msg[8];          /* Message buffer */
       short events;          /* What events are valid? */

/* Mask for all events */
#define ALL_EVENTS   (MU_MESAG|MU_BUTTON|MU_KEYBD|MU_TIMER|MU_M1|MU_M2)

       quit = FALSE;
       while(!quit)
       {
            events = evnt_multi( ALL_EVENTS,
                                 2, 1, 1,             /* Single/double clicks */
                                 0, 0, 0, 128, 128,   /* M1 event */
                                 1, 0, 0, 128, 128,   /* M2 event */
                                 msg,                 /* Pointer to msg */
                                 1000, 0,             /* MU_TIMER every 1 sec. */
                                 &mx, &my, &ks, &kc,
                                 &mc );

            if( events & MU_MESAG )
            {
                switch( msg[0] )     /* msg[0] is message type */
                {
                    case MN_SELECTED:
                        HandleMenuClick( msg );
                        break;
                    case WM_CLOSED:
                        CloseWindow( msg[3] );
                        break;
                    /*
                     * more message events...
                     */
                }
            }

            if( events & MU_BUTTON )
            {
                /*
                 * Handle mouse button event.
                 */
            }

            if( events & MU_KEYBD )
```

```
            {
                /*
                 * Handle keyboard events.
                 */
            }

            if( events & MU_TIMER )
            {
                /*
                 * Handle Timer events.
                 */
            }

            if( events & MU_M1 )
            {
                /*
                 * Handle mouse rectangle event 1.
                 */
            }

            if( events & MU_M2 )
            {
                /*
                 * Handle mouse rectangle event 2.
                 */
            }
        }

        /* Loop will terminate here when 'quit' is set to TRUE. */
}
```

When an event library function is called, the program is effectively halted until a message which is being waited for becomes available. Not all applications will require all events so the above code may be considered flexible.

Message Events

Each standard **GEM** message event (**MU_MESAG**) uses some or all of an 8 **WORD** message buffer. Each entry in this buffer is assigned as follows:

msg[x]	Meaning
0	Message type.
1	The application identifier of the process sending the message.
2	The length of the message *beyond* 16 bytes (in bytes). For all standard **GEM** messages, this values is 0.
3	Depends on message.
4	Depends on message.
5	Depends on message.
6	Depends on message.
7	Depends on message.

The entry for **evnt_mesag()** later in this chapter has a comprehensive list of all system messages and the action that should be taken when they are received.

User-Defined Message Events

Applications may write customized messages to other applications (or themselves) using **appl_write()**. The structure of the message buffer should remain the same as shown above. If more than the standard eight **WORD**s of data are sent, however, **appl_read()** must be used to read the additional bytes. It is recommended that user-defined messages be set to a multiple of 8 bytes.

You can use this method to send your own application standard messages by filling in the message buffer appropriately and using **appl_write()**. This method is often used to force redraw or window events.

Mouse Button Events

When a mouse button (**MU_BUTTON**) event happens, the **evnt_button()** or **evnt_multi()** call is returned with the mouse coordinates, the number of clicks that occurred, and the keyboard shift state.

Keyboard Events

Keyboard events (**MU_KEYBD**) are generated whenever a key is struck. The IKBD scan code (see *Appendix F: **IKBD Scan Codes***) and current key shift state are returned by either **evnt_keybd()** or **evnt_multi()**. If your application is designed to run on machines in other countries, you might consider translating the scan codes using the tables returned by the **XBIOS** call **Keytbl()**.

Timer Events

evnt_timer() or **evnt_multi(MU_TIMER**, ... **)** can be used to request a timer event(s) be scheduled in a certain number of milliseconds. The time between the actual function call and the event may, however, be greater than the time specified.

Mouse Rectangle Events

Mouse rectangle events (**MU_M1** and/or **MU_M2**) are generated by **evnt_mouse()** and **evnt_multi()** when the mouse pointer enters or leaves (depending on how you program it) a specified rectangle.

Resources

GEM resources consist of object trees, strings, and bitmaps used by an application. They encapsulate the user interface and make internationalization easier by placing all program strings in a single file. Resources are generally created using a Resource Construction Set (RCS) and saved to a .RSC file (see *Appendix C:* ***Native File Formats***) which is loaded by **rsrc_load()** at program initialization time.

Resources may also be embedded as data structures in source code (some utility programs convert .RSC files to source code). Desk accessories often do this to avoid complications they have in loading .RSC files.

Resources contain pointers and coordinates which must be fixed up before being used. **rsrc_load()** does this automatically, however if you use an embedded resource you must use **rsrc_rcfix()** if available or **rsrc_obfix()** on each object in each object tree to convert the initial character coordinates of to screen coordinates. This allows resources designed on screens with different aspect ratios and system fonts to appear the same. In any case, you should test your resources on several different screens, especially screen resolutions with different aspect ratios such as ST Medium and ST High.

Once a resource is loaded use **rsrc_gaddr()** to obtain pointers to individual object trees which can then be manipulated directly or with the **AES** Object Library. Replacing resources after they're loaded is accomplished with **rsrc_saddr()**.

Objects

Objects can be boxes, buttons, text, images, and more. An object tree is an array of **OBJECT** structures linked to form a structured relationship to each other. The **OBJECT** structure format is as follows:

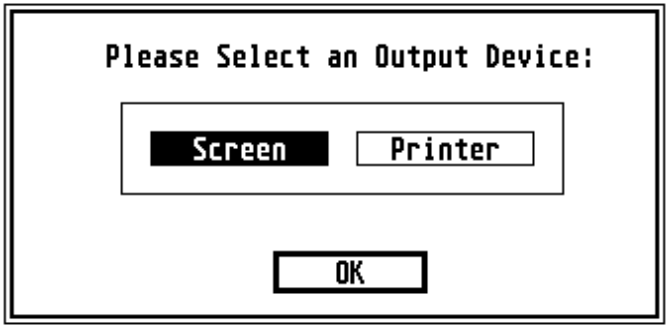
```
typedef struct object
{
       WORD      ob_next;
       WORD      ob_head;
       WORD      ob_tail;
       UWORD     ob_type;
       UWORD     ob_flags;
       UWORD     ob_state;
       VOIDP     ob_spec;
       WORD      ob_x;
       WORD      ob_y;
       WORD      ob_width;
       WORD      ob_height;
} OBJECT;
```

Normally **OBJECT**s are loaded in an application resource file but it is possible to create and manipulate them on-the-fly using the **objc_add()**, **objc_delete()**, and **objc_order()** commands.

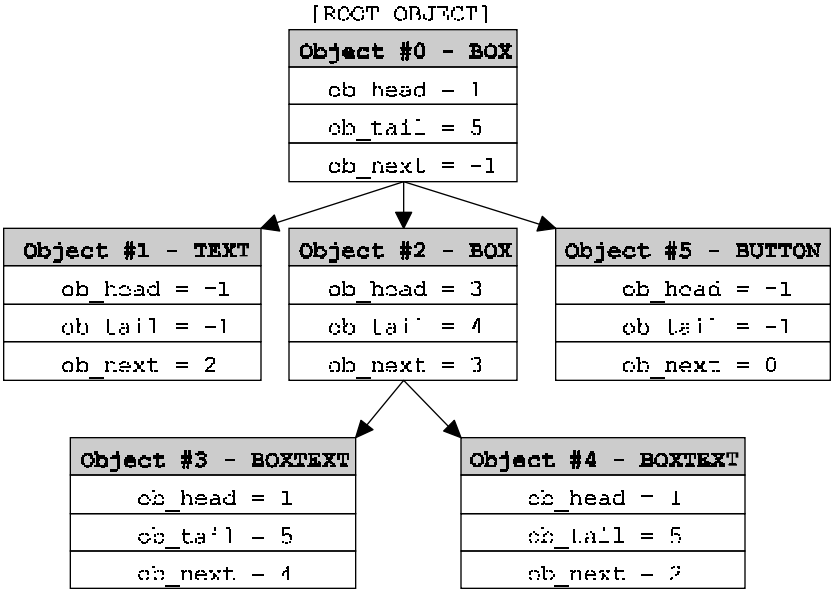
The first object in an **OBJECT** tree is called the **ROOT** object (**OBJECT** #0). It's coordinates are relative to the upper-left hand corner of the screen.

The **ROOT** object can have any number of children and each child can have children of their own. In each case, the **OBJECT**'s coordinates, *ob_x*, *ob_y*, *ob_width*, and *ob_height* are relative to that of its parent. The **AES** call **objc_offset()** can, however, be used to determine the exact screen coordinates of a child object. **objc_find()** is used to determine the object at a given screen coordinate.

The *ob_next*, *ob_head*, and *ob_tail* fields determine this relationship between parent **OBJECT**s and child **OBJECT**s. The following alert box is an example of an **OBJECT** tree:



The tree structure this object has can be represented as follows:



The exact usage of *ob_head*, *ob_next*, and *ob_tail* are as follows:

Element	Usage
ob_head	This member gives the exact index from the first object in the **OBJECT** tree to the first child of the current object. If the object has no children then this value should be -1.
ob_tail	This member gives the exact index from the first object in the **OBJECT** tree to the last child of the current object. If the object has no children then this value should be -1.
ob_next	This member gives the exact index from the first object in the **OBJECT** tree to the next child at the same level. The **ROOT** object should be set to -1. The last child at any given nesting level should be set to the index of its parent.

The low byte of the *ob_type* field specifies the object type as follows:

Name	*ob_type* & 0xFF	Meaning
G_BOX	20	Box
G_TEXT	21	Formatted Text
G_BOXTEXT	22	Formatted Text in a Box
G_IMAGE	23	Monochrome Image
G_PROGDEF	24	Programmer-Defined Object.

G_IBOX	25	Invisible Box
G_BUTTON	26	Push Button w/String
G_BOXCHAR	27	Character in a Box
G_STRING	28	Unformatted Text
G_FTEXT	29	Editable Formatted Text
G_FBOXTEXT	30	Editable Formatted Text in a Box
G_ICON	31	Monochrome Icon
G_TITLE	32	Menu Title
G_CICON	33	Color Icon (Available as of **AES** v3.3)

Object Flags

The *ob_flags* field of the **OBJECT** structure is a bitmask of different flags that can be applied to any object as follows:

Name	Bit(s)	Mask	Meaning
SELECTABLE	0	0x0001	Object's selected state may be toggled by clicking on it with the mouse.
DEFAULT	1	0x0002	An **EXIT** object with this bit set will have a thicker outline and be triggered when the user presses RETURN.
EXIT	2	0x0004	Clicking on this **OBJECT** and releasing the mouse button while still over it will cause the dialog to exit.
EDITABLE	3	0x0008	Set for **FTEXT** and **FBOXTEXT** objects to indicate that they may receive edit focus.
RBUTTON	4	0x0010	This object is one of a group of radio buttons. Clicking on it will deselect any selected objects at the same tree level that also have the **RBUTTON** flag set. Likewise, it will be deselected automatically when any other object is selected.
LASTOB	5	0x0020	This flag signals to the **AES** that the current **OBJECT** is the last in the object tree. (Required!)
TOUCHEXIT	6	0x0040	Setting this flag causes the **OBJECT** to return an exit state immediately after being clicked on with the mouse.
HIDETREE	7	0x0080	This **OBJECT** and all of its children will not be drawn.
INDIRECT	8	0x0100	This flag cause the *ob_spec* field to be interpreted as a pointer to the *ob_spec* value rather than the value itself.
FL3DIND	9	0x0200	Setting this flag causes the **OBJECT** to be drawn as a 3D indicator. This is appropriate for radio and toggle buttons. This flag is only recognized as of **AES** version 3.4.
FL3DACT	10	0x0400	Setting this flag causes the **OBJECT** to be drawn as a 3D activator. This is appropriate for **EXIT** buttons. This flag is only recognized as of **AES** version 3.4.

FL3DBAK	9 & 10	0x0600	If these bits are set, the object is treated as an **AES** background object. If it is **OUTLINED**, the outlined is drawn in a 3D manner. If its color is set to **WHITE** and its fill pattern is set to 0 then the **OBJECT** will inherit the default 3D background color. This flag is only recognized as of **AES** version 3.4.
SUBMENU	11	0x0800	This bit is set on menu items which have a sub-menu attachment. This bit also indicates that the high byte of the *ob_type* field is being used by the menu system.

Object States

The *ob_state* field determines the display state of the **OBJECT** as follows:

Name	Bit	Mask	Meaning
SELECTED	0	0x0001	The object is selected. An object with this bit set will be drawn in inverse video except for **G_CICON** which will use its 'selected' image.
CROSSED	1	0x0002	An **OBJECT** with this bit set will be drawn over with a white cross (this state can only usually be seen over a colored or **SELECTED** object).
CHECKED	2	0x0004	An **OBJECT** with this bit set will be displayed with a checkmark in its upper-left corner.
DISABLED	3	0x0008	An **OBJECT** with this bit set will ignore user input. Text objects with this bit set will draw in a dithered pattern.
OUTLINED	4	0x0010	**G_BOX**, **G_IBOX**, **G_BOXTEXT**, **G_FBOXTEXT**, and **G_BOXCHAR** **OBJECT**s with this bit set will be drawn with a double border.
SHADOWED	5	0x0020	**G_BOX**, **G_IBOX**, **G_BOXTEXT**, **G_FBOXTEXT**, and **G_BOXCHAR** **OBJECT**s will be drawn with a shadow.

The **AES** supports the **objc_change()** call which can be used to change the state of an object and (optionally) redraw it.

The Object-Specific Field

The *ob_spec* field contains different data depending on the object type as indicated in the table below:

Object	Contents of *ob_spec*
G_BOX	The low 16 bits contain a **WORD** containing color information for the **OBJECT**. Bits 23-16 contain a signed **BYTE** representing the border thickness of the box.
G_TEXT	The *ob_spec* field contains a pointer to a **TEDINFO** structure.
G_BOXTEXT	The *ob_spec* field contains a pointer to a **TEDINFO** structure.
G_IMAGE	The *ob_spec* field points to a **BITBLK** structure.
G_PROGDEF	The *ob_spec* field points to a **APPLBLK** structure.
G_IBOX	The low 16 bits contain a **WORD** containing color information for the **OBJECT**. Bits 23-16 contain a signed **BYTE** representing the border thickness of the box.
G_BUTTON	The *ob_spec* field contains a pointer to the text to be contained in the button.
G_BOXCHAR	The low 16 bits contain a **WORD** containing color information for the **OBJECT**. Bits 23-16 contain a signed **BYTE** representing the border thickness of the box. Bits 31-24 contain the ASCII value of the character to display.
G_STRING	The *ob_spec* field contains a pointer to the text to be displayed.
G_FTEXT	The *ob_spec* field contains a pointer to a **TEDINFO** structure.
G_FBOXTEXT	The *ob_spec* field contains a pointer to a **TEDINFO** structure.
G_ICON	The *ob_spec* field contains a pointer to an **ICONBLK** structure.
G_TITLE	The *ob_spec* field contains a pointer to the text to be used for the title.
G_CICON	The *ob_spec* field contains a pointer to a **CICONBLK** structure.

Object-Specific Structures

Almost all objects reference a **WORD** containing the object color as defined below (note the definition below may need to be altered depending upon the bit ordering of your compiler).

```
typedef struct objc_colorword
{
       UWORD     borderc  : 4;     /* Bits 15-12 contain the border color */
       UWORD     textc    : 4;     /* Bits 11-8 contain the text color */
       UWORD     opaque   : 1;     /* Bit 7 is 1 if opaque or 0 if transparent */
       UWORD     pattern  : 3;     /* Bits 6-4 contain the fill pattern index */
       UWORD     fillc    : 4;     /* Bits 3-0 contain the fill color */
} OBJC_COLORWORD;
```

Available colors for fill patterns, text, and borders are listed below:

Name	Value	Color
WHITE	0	White
BLACK	1	Black
RED	2	Red
GREEN	3	Green
BLUE	4	Blue
CYAN	5	Cyan
YELLOW	6	Yellow
MAGENTA	7	Magenta
LWHITE	8	Light Gray
LBLACK	9	Dark Gray
LRED	10	Light Red
LGREEN	11	Light Green
LBLUE	12	Light Blue
LCYAN	13	Light Cyan
LYELLOW	14	Light Yellow
LMAGENTA	15	Light Magenta

TEDINFO

G_TEXT, **G_BOXTEXT**, **G_FTEXT**, and **G_FBOXTEXT** objects all reference a **TEDINFO** structure in their *ob_spec* field. The **TEDINFO** structure is defined below:

```
typedef struct text_edinfo
{
       char *    te_ptext;
       char *    te_ptmplt;
       char *    te_pvalid;
       WORD      te_font;
       WORD      te_fontid;
       WORD      te_just;
       WORD      te_color;
       WORD      te_fontsize;
       WORD      te_thickness;
       WORD      te_txtlen;
       WORD      te_tmplen;
} TEDINFO;
```

The three character pointer point to text strings required for **G_FTEXT** and **G_FBOXTEXT** objects. *te_ptext* points to the actual text to be displayed and is the only field used by all text objects. *te_ptmplt* points to the text template for editable fields. For each character that the user can enter, the text string should contain a tilde character (ASCII 126). Other characters are displayed but cannot be overwritten by the user. *te_pvalid* contains validation characters for each character the user may enter. The current acceptable validation characters are:

Character	Allows
9	Digits 0-9
A	Uppercase letters A-Z plus SPACE
a	Upper and lowercase letters plus SPACE

N	Digits 0-9, uppercase letters A-Z, and SPACE
n	Digits 0-9, upper and lowercase letters A-Z, and SPACE
F	Valid **GEMDOS** filename characters plus question mark and asterisk
P	Valid **GEMDOS** pathname characters plus backslash, colon, question mark, and asterisk
p	Valid **GEMDOS** pathname characters plus backslash and colon
X	All characters

As an example the following diagram shows the correct text, template, and validation strings for obtaining a **GEMDOS** filename from the user.

String	Contents
te_ptext	'\0' (**NULL** char)
te_ptmplt	_____.___
te_pvalid	FFFFFFFFFFF

te_font may be set to any of the following values:

Name	*te_font*	Meaning
GDOS_PROP	0	Use a **SpeedoGDOS** font (valid only with an **AES** version of at least 4.0 and **SpeedoGDOS** installed).
GDOS_MONO	1	Use a **SpeedoGDOS** font (valid only with an **AES** version of at least 4.1 and **SpeedoGDOS** installed) and force monospaced output.
GDOS_BITM	2	Use a **GDOS** bitmap font (valid only with an **AES** version of at least 4.1 and **SpeedoGDOS** installed).
IBM	3	Use the standard monospaced system font.
SMALL	5	Use the small monospaced system font.

When using a value of **GDOS_PROP**, **GDOS_MONO**, or **GDOS_BITM**, *te_fontsize* specifies the font size in points and *te_fontid* specifies the **SpeedoGDOS** font identification number. Selecting the **IBM** or **SMALL** font will cause *te_fontsize* and *te_fontid* to be ignored.

te_just sets the justification of the text output as follows:

Name	*te_just*	Meaning
TE_LEFT	0	Left Justify
TE_RIGHT	1	Right Justify
TE_CNTR	2	Center

te_thickness sets the border thickness (positive and negative values are acceptable) of the **G_BOXTEXT** or **G_FBOXTEXT** object. *te_txtlen* and *te_tmplen* should be set to the length of the starting text and template length respectively.

BITBLK

G_IMAGE objects contain a pointer to a **BITBLK** structure in their *ob_spec* field. The **BITBLK** structure is defined as follows:

```
typedef struct bit_block
{
       WORD         *bi_pdata;
       WORD         bi_wb;
       WORD         bi_hl;
       WORD         bi_x;
       WORD         bi_y;
       WORD         bi_color;
} BITBLK;
```

bi_pdata should point to a monochrome bit image. *bi_wb* specifies the width (in bytes) of the image. All **BITBLK** images must be a multiple of 16 pixels wide therefore this value must be even.

bi_hl specifies the height of the image in scan lines (rows). *bi_x* and *bi_y* are used as offsets into *bi_pdata*. Any data occurring before these coordinates will be ignored. *bi_color* is a standard color **WORD** where the fill color specifies the color in which the image will be rendered.

ICONBLK

The *ob_spec* field of **G_ICON** objects point to an **ICONBLK** structure as defined below:

```
typedef struct icon_block
{
       WORD *      ib_pmask;
       WORD *      ib_pdata;
       char *      ib_ptext;
       WORD        ib_char;
       WORD        ib_xchar;
       WORD        ib_ychar;
       WORD        ib_xicon;
       WORD        ib_yicon;
       WORD        ib_wicon;
       WORD        ib_hicon;
       WORD        ib_xtext;
       WORD        ib_ytext;
       WORD        ib_wtext;
       WORD        ib_htext;
} ICONBLK;
```

ib_pmask and *ib_pdata* are pointers to the monochrome mask and image data respectively. *ib_ptext* is a string pointer to the icon text. *ib_char* defines the icon character (used for drive icons) and the icon foreground and background color as follows:

ib_char		
Bits 15-12	**Bits 11-8**	**Bits 7-0**
Icon Foreground Color	Icon Background Color	ASCII Character (or 0 for no character).

ib_xchar and *ib_ychar* specify the location of the icon character relative to *ib_xicon* and *ib_yicon*. *ib_xicon* and *ib_yicon* specify the location of the icon relative to the *ob_x* and *ob_y* of the object. *ib_wicon* and *ib_hicon* specify the width and height of the icon in pixels. As with images, icons must be a multiple of 16 pixels in width.

ib_xtext and *ib_ytext* specify the location of the text string relative to the *ob_x* and *ob_y* of the object. *ib_wtext* and *ib_htext* specify the width and height of the icon text area.

CICONBLK

The **G_CICON** object (available as of **AES** version 3.3) defines its *ob_spec* field to be a pointer to a **CICONBLK** structure as defined below:

```
typedef struct cicon_blk
{
       ICONBLK      monoblk;
       CICON *      mainlist;
} CICONBLK;
```

monoblk contains a monochrome icon which is rendered if a color icon matching the display parameters cannot be found. In addition, the icon text, character, size, and positioning data from the monochrome icon are always used for the color one. *mainlist* points to the first **CICON** structure in a linked list of color icons for different resolutions. **CICON** is defined as follows:

```
typedef struct cicon_data
{
       WORD                 num_planes;
       WORD *               col_data;
       WORD *               col_mask;
       WORD *               sel_data;
       WORD *               sel_mask;
       struct cicon_data *  next_res;
} CICON;
```

num_planes indicates the number of bit planes this color icon contains. *col_data* and *col_mask* point to the icon data and mask for the unselected icon respectively. Likewise, *sel_data* and *sel_mask* point to the icon data and mask for the selected icon. *next_res* points to the next color icon definition or **NULL** if no more are available. Bitmap data pointed to by these variables should be in **VDI** device-dependent format (they are stored as device-independent images in a .RSC file).

The **AES** searches the **CICONBLK** object for a color icon that has the same number of planes in the display. If none is found, the **AES** simply uses the monochrome icon.

APPLBLK

G_PROGDEF objects allow programmers to define custom objects and link them transparently in the resource. The *ob_spec* field of **G_PROGDEF** objects contains a pointer to an **APPLBLK** as defined below:

```
typedef struct appl_blk
{
       WORD        (*ab_code)(PARMBLK *);
       LONG        ab_parm;
} APPLBLK;
```

ab_code is a pointer to a user-defined routine which will draw the object. The routine will be passed a pointer to a **PARMBLK** structure containing the information it needs to render the object. The routine must be defined with stack checking off and expect to be passed its parameter on the stack. *ab_parm* is a user-defined value which is copied into the **PARMBLK** structure as defined below:

```
typedef struct parm_blk
{
       OBJECT      *tree;
       WORD        pb_obj;
       WORD        pb_prevstate;
       WORD        pb_currstate;
       WORD        pb_x;
       WORD        pb_y;
       WORD        pb_w;
       WORD        pb_h;
       WORD        pb_xc;
       WORD        pb_yc;
       WORD        pb_wc;
       WORD        pb_hc;
       LONG        pb_parm;
} PARMBLK;
```

tree points to the **OBJECT** tree of the object being drawn. The object is located at index *pb_obj*.

The routine is passed the old *ob_state* of the object in *pb_prevstate* and the new *ob_state* of the object in *pb_currstate*. If *pb_prevstate* and *pb_currstate* is equal then the object should be drawn completely, otherwise only the drawing necessary to redraw the object from *pb_prevstate* to *pb_currstate* are necessary.

pb_x, *pb_y*, *pb_w*, and *pb_h* give the screen coordinates of the object. *pb_xc*, *pb_yc*, *pb_wc*, and *pb_hc* give the rectangle to clip to. *pb_parm* contains a copy of the *ap_parm* value in the **APPLBLK** structure.

The custom routine should return a **WORD** containing any remaining *ob_state* bits you wish the **AES** to draw over your custom object.

Because the drawing routing will be called from the context of the **AES**, using the stack heavily or defining many local variables is not recommended.

Dialogs

Dialog boxes are modal forms of user input. This means that no other interaction can occur between the user and applications until the requirements of the dialog have been met and it is exited. A normal dialog box consists of an **OBJECT** tree with a **BOX** as its root object and any number of other controls that accept user input. Both alert boxes and the file selector are examples of **AES** provided dialog boxes.

The **AES form_do()** function is the simplest method of using a dialog box. Simply construct an **OBJECT** tree with at least one **EXIT** or **TOUCHEXIT** object and call **form_do()**. All interaction with the dialog like editable fields, radio buttons, and selectable objects will be maintained by the **AES** until the user strikes an **EXIT** or **TOUCHEXIT** object. The proper method for displaying a dialog box is shown in the example below:

```
WORD
do_dialog( OBJECT *tree, WORD first_edit )
{
        GRECT g;
        WORD ret;

        /* Reserve screen/mouse button */
        wind_update( BEG_UPDATE );
        wind_update( BEG_MCTRL );

        /* Center dialog on screen and put clipping rectangle in g */
        form_center( tree, &g.g_x, &g.g_y, &g.g_w, &g.g_h );

        /* Reserve screen space and draw growing box */
        form_dial( FMD_START, 0, 0, 0, 0, g.g_x, g.g_y, g.g_w, g.g_h );
        form_dial( FMD_GROW, g.g_x + g.g_w/2, g.g_y + g.g_h/2, 0, 0, g.g_x, g.g_y,
                  g.g_w, g.g_h );

        /* Draw the dialog box */
        objc_draw( tree, ROOT, MAX_DEPTH, g.g_x, g.g_y, g.g_w, g.g_h );

        /* Handle dialog */
        ret = form_do( tree, first_edit );

        /* Deselect EXIT button */
        tree[ret].ob_state &= ~SELECTED;

        /* Draw shrinking box and release screen area */
        form_dial( FMD_SHRINK, g.g_x + g.g_w/2, g.g_y + g.g_h/2, 0, 0, g.g_x, g.g_y,
                  g.g_w, g.g_h );
        form_dial( FMD_FINISH, 0, 0, 0, 0, g.g_x, g.g_y, g.g_w, g.g_h );

        /* Release screen/mouse control. */
        wind_update( END_MCTRL );
        wind_update( END_UPDATE );
```

```
        /* Return the object selected */
        return ret;
}
```

You may wish to create your own specialized dialog handling routines or place dialog boxes in windows to create modeless input. This can be accomplished by using the **form_button()**, **form_keybd()**, and **objc_edit() AES** calls. Specific information about these calls may be found in the ***Function Reference***.

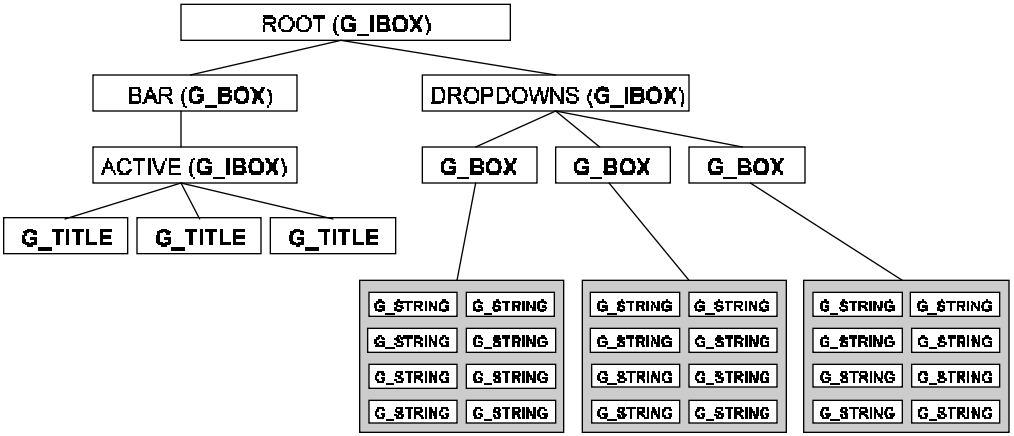
GEM also provides two generic dialog boxes through the **form_alert()** and **form_error()** calls. **form_alert()** displays an alert dialog with a choice between icons and user-defined text and buttons. **form_error()** displays an alert based on predefined system error codes.

Menus

Most **GEM** applications use a menu bar to allow the user to navigate through program options. In addition, newer versions of the **AES** now allow popup menus and drop-down list boxes (a special form of a popup menu). Menus are simply specially designed **OBJECT** trees activated using special **AES** calls.

The Menu Bar

The menu bar is a special **OBJECT** which is usually registered in the beginning stages of a **GEM** program which contains choices which the user may select to trigger a special menu event (**MN_SELECTED**) to be sent to the application's message loop. Normally, you will use a resource construction set to create a menu but if you are designing an **RCS** or must create a menu bar by hand, the format for the **OBJECT** structure of a **GEM** menu bar is shown below:



The **ROOT** object is a **G_IBOX** and should be set to the same width and height of the screen. It has two children, the **BAR** object and the **DROPDOWNS** object.

The **BAR** object is a **G_BOX** which should be the width of the screen and the height of the system font plus two pixels for a border line. The **DROPDOWNS** object is a **G_IBOX** and should be of a size large enough to encompass all of the drop-down menu boxes.

The **BAR** object has one child, the **ACTIVE** object, it should be the width of the screen and the height of the system font. It has as many **G_TITLE** children as there are menu titles.

The **DROPDOWNS** object has the same number of **G_BOX** child objects as the **ACTIVE** object has **G_TITLE** children. Each box must be high enough to support the number of **G_STRING** menu items and wide enough to support the longest item. Each **G_BOX** must be aligned so that it falls underneath its corresponding **G_TITLE**. In addition, each **G_STRING** menu item should be the same length as its parent **G_BOX** object.

Each **G_STRING** menu item should be preceded by two spaces. Each **G_TITLE** should be preceded and followed by one space. The first **G_BOX** object should appear under a **G_TITLE** object named 'Desk' and should contain eight children. The first child **G_STRING** is application defined (it usually leads to the 'About...' program credits), the second item should be a disabled separator ('----------') line. The next six items are dummy objects used by the **AES** to display program and desk accessory titles.

Utilizing a Menu Bar

Menu bars can be displayed and their handling initiated by calling **menu_bar()**. In addition, using this command, a menu bar may be turned off or replaced with another menu bar at any time.

Individual menu items may be altered with three **AES** calls. **menu_icheck()** sets or removes a checkmark from in front of menu items. **menu_ienable()** enables or disables a menu item. **menu_itext()** alters the text of a menu item. After receiving a message indicating that a menu item has been clicked, perform the action appropriate to the menu item and then call **menu_tnormal()** to return the menu title text to normal video.

Hierarchical Menus

AES versions 3.3 and above support hierarchical submenus. When a submenu is attached to a regular menu item, a right arrow is appended to the end of the menu item text and a submenu is displayed whenever the mouse is positioned over the menu item. The user may select submenu items which cause an extended version of the **MN_SELECTED** message to be delivered (containing the menu object tree).

Up to 64 submenu attachments may be in effect at any time per process. Attaching a single submenu to more than one menu item counts as only one attachment.

Submenus should be **G_BOX** objects with as many **G_STRING** (or other) child objects as necessary. One or several submenus may be contained in a single **OBJECT** tree. If the submenu's scroll flag is set, scroll arrows will appear and the menu will be scrollable if it

contains more items than the currently set system scroll value. Submenus containing user-defined objects should not have their scroll flag set.

Submenus are attached and removed with the **menu_attach()** call. A serious bug exists in **AES** versions lower than 4.0 which causes **menu_attach()** to crash the system if you use it to remove or inquire the state of an existing submenu. This means that submenus may only be removed in **AES** versions 4.0 and above. Submenus may be nested to up to four levels though only one level is recommended.

Submenus may not be attached to menu items in the left-most 'Desk' menu. Individual submenu items may be aligned with the parent object by using **menu_istart()**.

Popup Menus

AES versions 3.3 and above support popup menus. Popup menus share the same **OBJECT** structure as hierarchical menus but are never attached to a parent menu item. They may be displayed anywhere on the screen and are often called in response to selecting a special dialog item (see *Chapter 11: **GEM User Interface Guidelines***). Popup menus are displayed with the **AES** call **menu_popup()**.

Menu Settings

The **AES** call **menu_settings()** may be used to adjust certain global defaults regarding the appearance and timing delays of submenus and popup menus. Because this call affects all system applications it should only be utilized by a system configuration utility and not by individual applications.

Drop-Down List Boxes

AES versions 4.0 and later support a special type of popup menu called a drop-down list box. Setting the menu scroll flag to a value of -1 will cause a popup menu to be displayed as a drop-down list instead.

A drop-down list reveals up to eight items from a multiple item list to the user. A slider bar is displayed next to the list and is automatically handled during the **menu_popup()** call. Several considerations must be taken when using a drop-down list box:

- Drop-down lists may only contain **G_STRING** objects.
- If you want to force the AES to always draw scroll bars for the list box, the **OBJECT** tree must contain at least eight **G_STRING** objects. If less than that number of items exist, pad the remaining items with blanks and set the object's **DISABLED** flag.
- As long as the **OBJECT** tree has at least eight **G_STRING** objects, it should not be padded with any additional objects since the size of the slider is based on the number of objects.

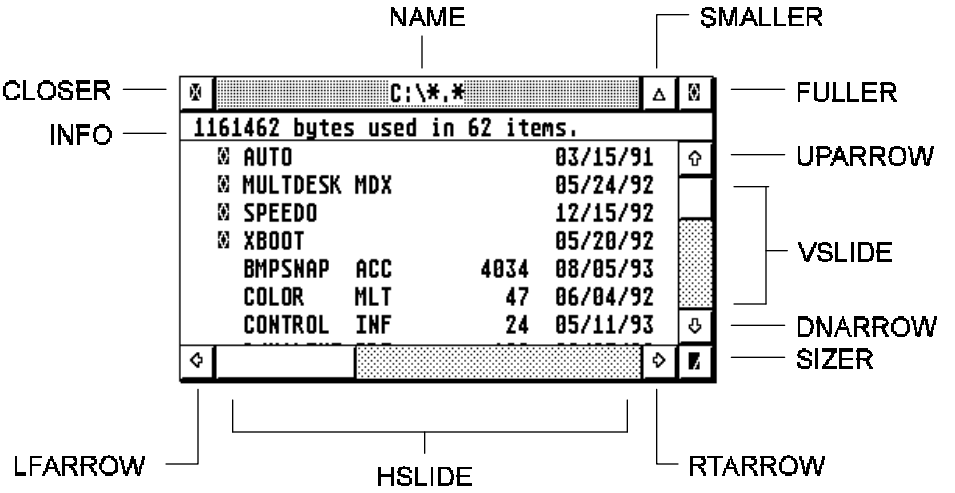
The Menu Buffer

A special memory area is allocated by the **AES** so that it may reserve the screen area underneath displayed menus. A pointer to this memory and its length may be obtained by calling **wind_get(WF_SCREEN**, ... **)**. Menu buffer memory may be used as a temporary holding arena for applications as long as the following rules are maintained:

- The application must not use a menu bar or it must be locked with **wind_update(BEG_UPDATE)**.
- Access to the menu buffer in a multitasking environment is not controlled so information stored by one application may be overwritten by another. It is therefore recommended that the menu buffer should not be used under **MultiTOS**.

Windows

GEM applications usually maintain most user-interaction in windows. Windows are workspaces created with **wind_create()** with any of several predefined gadgets (controls) illustrated in the diagram and table below:



Name	Mask	Meaning
NAME	0x0001	Using this mask will cause the **AES** to display the window with a title bar containing a name that the application should set with **wind_set(WF_NAME,** ... **)**.
CLOSER	0x0002	This mask will attach a closer box to the window which, when pressed, will send a **WM_CLOSED** message to the application.
FULLER	0x0004	This mask displays a fuller box with the window which, when pressed, will cause a **WM_FULLED** message to be sent to the application.
MOVER	0x0008	This mask allows the user to move the window by clicking and dragging on the window's title bar. This action will generate a **WM_MOVED** message.
INFO	0x0010	This mask creates an information line just below the title bar which can contain any user-defined information as set with **wind_set(WF_INFO**, ...**)**.
SIZER	0x0020	This mask attaches a sizer object to the window which, when clicked and dragged to a new location, will generate a **WM_SIZED** message.
UPARROW	0x0040	This mask attaches an up arrow object to the window which, when pressed, will generate a **WM_ARROWED** message to the application.
DNARROW	0x0080	This mask attaches a down arrow object to the window which, when pressed, will generate a **WM_ARROWED** message to the application.
VSLIDE	0x0100	This mask attaches a vertical slider object to the window which, when clicked and dragged, will generate a **WM_VSLID** message. Clicking on the exposed area of the slider will also generate this message.
LFARROW	0x0200	This mask attaches a left arrow object to the window which, when pressed, will generate a **WM_ARROWED** message to the application.
RTARROW	0x0400	This mask attaches a right arrow object to the window which, when pressed, will generate a **WM_ARROWED** message to the application.

HSLIDE	0x0800	This mask attaches a horizontal slider object to the window which, when clicked and dragged, will generate a **WM_HSLID** message. Clicking on the exposed area of the slider will also generate this message.
SMALLER	0x4000	This mask attaches a smaller object which, when clicked, will generate a **WM_ICONIFIED** message. If the object is CTRL-clicked, a **WM_ALLICONIFY** message will be generated. This object is only valid in **AES** v4.1 and higher.

wind_create() returns a window handle which should be stored as it must be referenced on any further calls that open, alter, close, or delete the window. **wind_create()** may fail if too many windows are already open. Different versions of the **AES** impose different limits on the number of concurrently open windows.

Calling **wind_create()** does not automatically display the window. **wind_open()** displays a window named by its window handle. Any calls needed to initialize the window (such as setting the window title, etc.) should be made between the **wind_create()** and **wind_open()** calls.

wind_set() and **wind_get()** can be used to set and retrieve many various window attributes. Look for their documentation in the function reference for further details.

wind_close() may be used to remove a window from the screen. The window itself and its attributes are not deleted as a result of this call, however. A subsequent call to **wind_open()** will restore a window to the state it was in prior to the **wind_close()** call. The **wind_delete()** function is used to physically delete a window and free any memory it was using.

Two other utility functions for use in dealing with windows are provided by the **AES**. **wind_calc()** will return the border rectangle of a window given the desired work area or the work area of a window given the desired border area. The call takes into account the sizes of the various window gadgets.

wind_find() returns the handle of the window currently under the mouse.

The Desktop Window

The desktop window encompasses the entire screen. It has a constant window handle of **DESK** (0) so information about it can be inquired with **wind_get()**. Calling **wind_get()** with a parameter of **WF_CURRXYWH** will return the size of the screen. Calling **wind_get()** with a parameter of **WF_WORKXYWH** will return the size of the screen minus the size of the menu bar.

The desktop draws a custom **OBJECT** tree in its work area. This tree results in the fill pattern and color seen on screen. An application may create its own custom desktop object tree by using **wind_set()** with a parameter of **WF_DESKTOP**. The **OBJECT** tree specified should be the exact size of the desktop work area.

MultiTOS will switch between these object trees as applications are switched. The desktop's object tree will be visible whenever an application doesn't specify one of its own.

The Rectangle List

Whenever a window receives a redraw message or needs to update its window because of its reasons, it should always constrain output to its current rectangle list. The **AES** will calculate the size and position of a group of rectangles that compromise the area of your window not covered by other overlapping windows.

wind_get() with parameters of **WF_FIRSTXYWH** and **WF_NEXTXYWH** is used to return the current rectangle list. Redrawing inside a window should also only be attempted when the window semaphore is locked with **wind_update(BEG_UPDATE)**. This prevents the rectangle list from changing during the redraw and prevents the user from dropping down menus which might be overwritten. The following code sample illustrates a routine that correctly steps through the rectangle list:

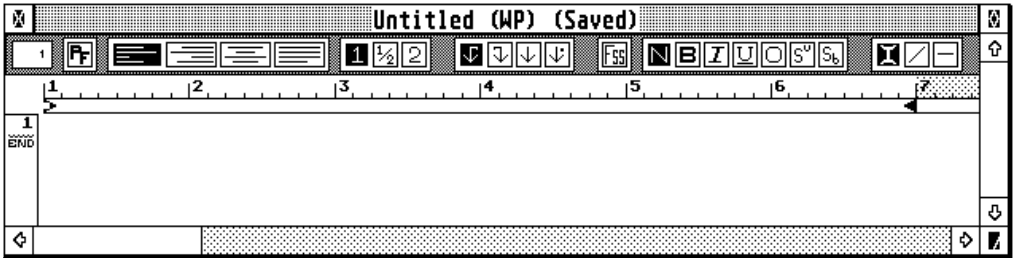
```
.
.
. Application Event Loop
.
case WM_REDRAW:
      RedrawWindow( msg[3], (GRECT *)&msg[4] );
      break;
.
.
```

```
VOID
RedrawWindow( WORD winhandle, GRECT *dirty )
{
       GRECT rect;

       wind_update( BEG_UPDATE );

       wind_get( winhandle, WF_FIRSTXYWH, &rect.g_x, &rect.g_y, &rect.g_w,
       &rect.g_h);
       while( rect.g_w && rect.g_h )
       {
```

```
            if( rc_intersect( dirty, &rect ) )
            {
                /*
                 * Do your drawing here...constrained to the rectangle in g.
                 */
            }

            wind_get( winhandle, WF_NEXTXYWH, &rect.g_x, &rect.g_y, &rect.g_w,
                    &rect.g_h);
        }

        wind_update( END_UPDATE );
}
```

Window Toolbars

AES versions 4.0 and later support window toolbar attachments. Toolbars are **OBJECT** trees containing a number of **TOUCHEXIT** objects. They are attached to a window using **wind_set()** with a parameter of **WF_TOOLBAR**. The following diagram shows a window with a toolbar:



Example from Atari Works 2.1

Window toolbars are automatically redrawn whenever necessary and their **ROOT** objects are automatically repositioned and resized with the window. If any special redrawing is necessary (ex: changing the visual state of an object after a click), the application may obtain a special toolbar rectangle list by using **wind_get()** with parameters of **WF_FTOOLBAR** and **WF_NTOOLBAR**.

If toolbar objects must be modified on **WM_SIZED** events, simply modify them prior to calling **wind_set(** handle, **WM_CURRXYWH**, ... **)**.

A special note about windows with toolbars concerns the usage of **wind_calc()**. **wind_calc()** doesn't understand the concept of toolbars. The information it returns must be modified by adjusting the height of its output rectangles according to the current height of the toolbar object tree.

The Graphics Library

The Graphics Library contain many functions which can be used to provide visual clues to the user. This library also contains functions to inquire and set information about the mouse pointer.

graf_movebox(), **graf_shrinkbox()**, and **graf_growbox()** display animations that can be used to indicate an impending change in the screen display. **graf_dragbox()**, **graf_rubberbox()**, and **graf_slidebox()** display visual effects that are interactively changed by the mouse position.

graf_mkstate() is used to inquire the current state of the mouse buttons and mouse position. **graf_mouse()** can be used to change the shape of the system mouse. **graf_handle()** is used to return the physical handle of the screen (needed to open a **VDI** workstation) and the metrics of the system default text font.

The File Selector Library

Two routines are provided by the **AES** to display and handle the common system file selector. **AES** versions less than 1.4 do not support **fsel_exinput()**. All **AES** versions support **fsel_input()**.

Both calls take a **GEMDOS** pathname and filename as parameters. The pathname should include a complete path specification including a drive letter, colon, path, and filemask. The filemask may (and usually does include wildcard characters). The application may also pass a default filename to the selector.

fsel_exinput() allows the application to specify a replacement title for the file selector which reminds the user about the action they are taking such as 'Select a .DOC file to open...'.

The Scrap Library

The **scrp_read()** and **scrp_write()** calls are provided by the **AES** to return and set the current clipboard path. The clipboard is a global resource in which applications can share data. Applications supporting the clipboard contain an 'Edit' menu title which has at least the following four items, 'Cut', 'Copy', 'Paste', and 'Delete'. An appropriate action for each is listed below:

Implementing 'Cut' and 'Copy'

When the user selects 'Cut' or 'Copy' from the 'Edit' menu and an object is selected ('Cut' and 'Copy' should only be enabled in the menu when an object is selected which may be transferred to the clipboard) the following steps may be used to transfer the data to the system clipboard:

1. Call **scrp_read()** to return the name of the current scrap directory. If the returned string is empty, no clipboard directory has been defined since the computer has

been started. The directory string returned may need to be reformatted. A proper directory string ends in a backslash, however some applications incorrectly append a filename to this string.

2. If no clipboard directory was returned or the one specified is invalid, create a directory in the user's boot drive called '\CLIPBRD' and write the pathname back using **scrp_write()**. For example, if the user's boot drive was 'C:' then your parameter to **scrp_write()** would be 'C:\CLIPBRD\'.
3. Search and delete files in the current clipboard directory with the mask 'SCRAP.*'.
4. Now write a disk file for the selected data to a file named SCRAP.??? where '???' is the proper file extension for an object of its type. If the object can be represented in more than one format by your application, write as many formats as possible all named 'SCRAP' with the proper file extension.
5. If the menu choice was 'Cut' rather than 'Copy,' delete the object from your data structures and update your application as necessary.

Implementing 'Paste'

'Paste' is used to read a file and insert it appropriately into an application that supports data of its type. To implement 'Paste' follow the steps below:

1. Call **scrp_read()** to obtain the current system clipboard directory. If the returned string is empty, no data is in the clipboard.
2. Format the string returned by **scrp_read()** into a usable pathname and search for files called 'SCRAP' in that path having a file extension of data that your application supports. Remember, more than one SCRAP.??? file may be present.
3. Load the data and insert it in your application as appropriate.

MultiTOS Notes

The **AES**, when running under **MultiTOS**, will create a **MiNT** semaphore named '_SCP' which should be used to provide negotiated access to the scrap directory. Access to this semaphore should be obtained from MiNT prior to any clipboard operation and must be released as soon as it is complete. Applications should not attempt to destroy this semaphore.

The Shell Library

The Shell Library was originally intended to provide **AES** support to the Desktop application. Many of the routines, however, are useful to other **GEM** applications. Some functionality of the Shell Library was discussed earlier in this chapter in 'The Environment String'.

The Shell Buffer

The Desktop application loads the DESKTOP.INF or NEWDESK.INF file (depending on the **TOS** version) into the shell buffer. Prior to **TOS** 2.00, the shell buffer was 1024 bytes long meaning that was the maximum length of the DESKTOP.INF file. **AES** versions 2.00 to 3.30 allocate a buffer 4096 bytes long. **AES** versions 3.30 and above support variable-length buffers.

The shell buffer contains the 'working' copy of the above mentioned system files. The information in this buffer may be copied by using **shel_get()**. Likewise, information can be written to this buffer using **shel_put()**. Extreme care must be used with these functions as their misuse can confuse or possibly even crash the Desktop.

Miscellaneous Shell Library Functions

shel_find() is used to locate data files associated with an application. The **AES** uses this call to locate application resource files during **rsrc_load()**.

shel_read() returns information about the process which called the application (usually the Desktop).

shel_write() was originally used only to spawn new applications. With newer **AES** versions, though, **shel_write()** has taken on an enormous functionality and its documentation should be consulted for more information.

The GEM.CNF File

When running under **MultiTOS**, the **AES** will load and process an ASCII text file called 'GEM.CNF' which contains command lines that set environment and **AES** system variables and may run **GEM** programs. In addition, a replacement shell program may be specified in this file (see *Chapter 9: **Desktop*** for more information).

AES environment variables may be set in the 'GEM.CNF' file with the command 'setenv' as in the following example:

```
setenv TOSRUN=c:\multitos\miniwin.app
```

Several **AES** system variables may also be set in this file as shown in the following example:

```
AE_FONTID=3
```

Currently recognized **AES** system variables that may be set are shown in the following table:

Variable	Meaning
AE_FONTID	This variable may be set to any valid Speedo outline font ID which will be used as the **AES** default text font. This feature is only valid as of **AES** version 4.1.
AE_PNTSIZE	This variable defines the size of the **AES** default text font in points. This feature is only valid as of **AES** version 4.1.
AE_SREDRAW	Setting this variable to 1 causes the **AES** to send a full-screen redraw message whenever an application starts. Setting it to 0 disables this feature. The default is 1.
AE_TREDRAW	Setting this variable to 1 causes the **AES** to send a full-screen redraw message whenever an application terminates. Setting it to 0 disables this feature. The default is 1.

The 'GEM.CNF' file may also be used to automatically start applications as shown in the following example:

```
run c:\multitos\tclock.prg
```

AES Function Calling Procedure

The **GEM AES** is accessed through a 680x0 TRAP #2 statement. Upon calling the TRAP, register d0 should contain the magic number 0xC8 and register d1 should contain a pointer to the **AES** parameter block. The *global* data array member of the parameter block is filled in with information about the **AES** after an **appl_init()** call (see **appl_init()** for more details). The **AES** parameter block is a structure containing pointers to several arrays defined as follows:

```
struct aespb
{
        WORD *contrl;
        WORD *global;
        WORD *intin;
        WORD *intout;
        LONG *addrin;
        LONG *addrout;
};
```

The *control* array is filled in prior to an **AES** call with information about the number of parameters the function is being passed, the number of return values the function expects, and the opcode of the function itself as follows:

contrl[x]	Contents
0	Function opcode.
1	Number of *intin* elements the function is being sent.
2	Number of *intout* elements the function is being sent.
3	Number of *addrin* elements the function returns.
4	Number of *addrout* elements the function returns.

The *intin* array and *addrin* arrays are used to pass integer and address parameters respectively (consult each individual binding for details).

Upon return from the call, the *intout* and *addrout* arrays will be filled in with any appropriate output values.

To add a binding for the **AES** to your compiler you will usually write a short procedure that provides an interface to the **AES** arrays. The following example illustrates the binding to **graf_dragbox()** in this manner:

```
WORD
graf_dragbox( WORD width, WORD height, WORD start_x, WORD start_y,
                WORD box_x, WORD box_y, WORD box_w, WORD box_h,
                WORD *end_x, WORD *end_y )
{
        contrl[0] = 71;
        contrl[1] = 8;
        contrl[2] = 3;
        contrl[3] = 0;
        contrl[4] = 0;

        intin[0] = width;
        intin[1] = height;
        intin[2] = start_x;
        intin[3] = start_y;
        intin[4] = box_x;
        intin[5] = box_y;
        intin[6] = box_w;
        intin[7] = box_h;

        aes();

        *end_x = intout[1];
        *end_y = intout[2];

        return intout[0];
}
```

The following code is the assembly language function **aes()** used by the function above:

```
              .globl       _aes

              .text
_aes:
              lea          _aespb,a0
              move.l       a0,d1
              move.w       #$C8,d0
              trap         #2
              lea          _intout,a0
              move.w       (a0),d0
              rts

              .data

_aespb:       .dc.l        _contrl, _global, _intin, _intout, _addrin, _addrout

              .bss

_contrl:      .ds.w        5
_global:      .ds.w        15
_intin:       .ds.w        16
_intout:      .ds.w        7
_addrin:      .ds.l        2
_addrout:     .ds.l        1

              .end
```

The bindings in the ***AES Function Reference*** call a specialized function called **crys_if()** to actually call the **AES**. Many compilers use this method as well (Lattice C calls the function **_AESif()**).

crys_if() properly fills in the *contrl* array and calls the **AES**. It is passed one **WORD** parameter in d0 which contains the opcode of the function minus ten multiplied by four (for quicker table indexing). This gives an index into a table from which the *contrl* array data may be loaded. The **crys_if()** function is listed below:

```
* Note that this binding depends on the fact that no current AES call utilizes
* the addrout array

              .globl   _crys_if
              .globl   _aespb
              .globl   _contrl
              .globl   _global
              .globl   _intin
              .globl   _addrin
              .globl   _intout
              .globl   _addrout

              .text

_crys_if:
              lea      table(pc),a0     ; Table below
```

```
            move.l   0(a0,d0.w),d0        ; Load four packed bytes into d0
            lea      _aespb,a0          ; Load address of _aespb into a0
            movea.l  (a0),a1            ; Move address of contrl into a1
            movep.l  d0,1(a1)           ; Move four bytes into WORDs at 1(contrl)
            move.l   a0,d1              ; Move address of _aespb into d1
            move.w   #$C8,d0            ; AES magic number
            trap     #2                 ; Call GEM
            lea      _intout,a0         ; Get return value
            move.w   (a0),d0            ; Put it into d0
            rts

* Table of AES opcode/control values
* Values are: opcode, intin, intout, addrin
* As stated before, addrout is left at 0 since no AES calls use it

table:
            .dc.b       10, 0, 1, 0     ; appl_init
            .dc.b       11, 2, 1, 1     ; appl_read
            .dc.b       12, 2, 1, 1     ; appl_write
            .dc.b       13, 0, 1, 1     ; appl_find
            .dc.b       14, 2, 1, 1     ; appl_tplay
            .dc.b       15, 1, 1, 1     ; appl_trecord
            .dc.b       16, 0, 0, 0     ;
            .dc.b       17, 0, 0, 0     ;
            .dc.b       18, 1, 3, 1     ; appl_search (v4.0)
            .dc.b       19, 0, 1, 0     ; appl_exit
            .dc.b       20, 0, 1, 0     ; evnt_keybd
            .dc.b       21, 3, 5, 0     ; evnt_button
            .dc.b       22, 5, 5, 0     ; evnt_mouse
            .dc.b       23, 0, 1, 1     ; evnt_mesag
            .dc.b       24, 2, 1, 0     ; evnt_timer
            .dc.b       25, 16, 7, 1    ; evnt_multi
            .dc.b       26, 2, 1, 0     ; evnt_dclick
            .dc.b       27, 0, 0, 0     ;
            .dc.b       28, 0, 0, 0     ;
            .dc.b       29, 0, 0, 0     ;
            .dc.b       30, 1, 1, 1     ; menu_bar
            .dc.b       31, 2, 1, 1     ; menu_icheck
            .dc.b       32, 2, 1, 1     ; menu_ienable
            .dc.b       33, 2, 1, 1     ; menu_tnormal
            .dc.b       34, 1, 1, 2     ; menu_text
            .dc.b       35, 1, 1, 1     ; menu_register
            .dc.b       36, 2, 1, 2     ; menu_popup (v3.3)
            .dc.b       37, 2, 1, 2     ; menu_attach (v3.3)
            .dc.b       38, 3, 1, 1     ; menu_istart (v3.3)
            .dc.b       39, 1, 1, 1     ; menu_settings (v3.3)
            .dc.b       40, 2, 1, 1     ; objc_add
            .dc.b       41, 1, 1, 1     ; objc_delete
            .dc.b       42, 6, 1, 1     ; objc_draw
            .dc.b       43, 4, 1, 1     ; objc_find
            .dc.b       44, 1, 3, 1     ; objc_offset
            .dc.b       45, 2, 1, 1     ; objc_order
            .dc.b       46, 4, 2, 1     ; objc_edit
            .dc.b       47, 8, 1, 1     ; objc_change
            .dc.b       48, 4, 3, 0     ; objc_sysvar (v3.4)
            .dc.b       49, 0, 0, 0     ;
            .dc.b       50, 1, 1, 1     ; form_do
            .dc.b       51, 9, 1, 0     ; form_dial
            .dc.b       52, 1, 1, 1     ; form_alert
```

```
.dc.b       53, 1, 1, 0      ; form_error
.dc.b       54, 0, 5, 1      ; form_center
.dc.b       55, 3, 3, 1      ; form_keybd
.dc.b       56, 2, 2, 1      ; form_button
.dc.b       57, 0, 0, 0      ;
.dc.b       58, 0, 0, 0      ;
.dc.b       59, 0, 0, 0      ;
.dc.b       60, 0, 0, 0      ;
.dc.b       61, 0, 0, 0      ;
.dc.b       62, 0, 0, 0      ;
.dc.b       63, 0, 0, 0      ;
.dc.b       64, 0, 0, 0      ;
.dc.b       65, 0, 0, 0      ;
.dc.b       66, 0, 0, 0      ;
.dc.b       67, 0, 0, 0      ;
.dc.b       68, 0, 0, 0      ;
.dc.b       69, 0, 0, 0      ;
.dc.b       70, 4, 3, 0      ; graf_rubberbox
.dc.b       71, 8, 3, 0      ; graf_dragbox
.dc.b       72, 6, 1, 0      ; graf_movebox
.dc.b       73, 8, 1, 0      ; graf_growbox
.dc.b       74, 8, 1, 0      ; graf_shrinkbox
.dc.b       75, 4, 1, 1      ; graf_watchbox
.dc.b       76, 3, 1, 1      ; graf_slidebox
.dc.b       77, 0, 5, 0      ; graf_handle
.dc.b       78, 1, 1, 1      ; graf_mouse
.dc.b       79, 0, 5, 0      ; graf_mkstate
.dc.b       80, 0, 1, 1      ; scrp_read
.dc.b       81, 0, 1, 1      ; scrp_write
.dc.b       82, 0, 0, 0      ;
.dc.b       83, 0, 0, 0      ;
.dc.b       84, 0, 0, 0      ;
.dc.b       85, 0, 0, 0      ;
.dc.b       86, 0, 0, 0      ;
.dc.b       87, 0, 0, 0      ;
.dc.b       88, 0, 0, 0      ;
.dc.b       89, 0, 0, 0      ;
.dc.b       90, 0, 2, 2      ; fsel_input
.dc.b       91, 0, 2, 3      ; fsel_exinput
.dc.b       92, 0, 0, 0      ;
.dc.b       93, 0, 0, 0      ;
.dc.b       94, 0, 0, 0      ;
.dc.b       95, 0, 0, 0      ;
.dc.b       96, 0, 0, 0      ;
.dc.b       97, 0, 0, 0      ;
.dc.b       98, 0, 0, 0      ;
.dc.b       99, 0, 0, 0      ;
.dc.b       100, 5, 1, 0     ; wind_create
.dc.b       101, 5, 1, 0     ; wind_open
.dc.b       102, 1, 1, 0     ; wind_close
.dc.b       103, 1, 1, 0     ; wind_delete
.dc.b       104, 2, 5, 0     ; wind_get
.dc.b       105, 6, 1, 0     ; wind_set
.dc.b       106, 2, 1, 0     ; wind_find
.dc.b       107, 1, 1, 0     ; wind_update
.dc.b       108, 6, 5, 0     ; wind_calc
.dc.b       109, 0, 0, 0     ; wind_new
.dc.b       110, 0, 1, 1     ; rsrc_load
.dc.b       111, 0, 1, 0     ; rsrc_free
```

```
            .dc.b       112, 2, 1, 0     ; rsrc_gaddr
            .dc.b       113, 2, 1, 1     ; rsrc_saddr
            .dc.b       114, 1, 1, 1     ; rsrc_obfix
            .dc.b       115, 0, 0, 0     ; rsrc_rcfix (v4.0)
            .dc.b       116, 0, 0, 0     ;
            .dc.b       117, 0, 0, 0     ;
            .dc.b       118, 0, 0, 0     ;
            .dc.b       119, 0, 0, 0     ;
            .dc.b       120, 0, 1, 2     ; shel_read
            .dc.b       121, 3, 1, 2     ; shel_write
            .dc.b       122, 1, 1, 1     ; shel_get
            .dc.b       123, 1, 1, 1     ; shel_put
            .dc.b       124, 0, 1, 1     ; shel_find
            .dc.b       125, 0, 1, 2     ; shel_envrn
            .dc.b       126, 0, 0, 0     ;
            .dc.b       127, 0, 0, 0     ;
            .dc.b       128, 0, 0, 0     ;
            .dc.b       129, 0, 0, 0     ;
            .dc.b       130, 1, 5, 0     ; appl_getinfo (v4.0)

            .data

_aespb:     .dc.l       _contrl, _global, _intin, _intout, _addrin, _addrout
_contrl:    .dc.l       0, 0, 0, 0, 0

            .bss

* _contrl = opcode
* _contrl+2 = num_intin
* _contrl+4 = num_addrin
* _contrl+6 = num_intout
* _contrl+8 = num_addrout

_global     .ds.w       15
_intin      .ds.w       16
_intout     .ds.w       7
_addrin     .ds.l       2
_addrout    .ds.l       1

            .end
```

AES Function Reference

Application Services Library

The *Application Services Library* provides general use functions used in locating and working with other resident applications in addition to providing **AES** initialization and termination code. The members of the *Application Services Library* are:

- **appl_exit()**
- **appl_find()**
- **appl_getinfo()**
- **appl_init()**
- **appl_read()**
- **appl_search()**
- **appl_tplay()**
- **appl_trecord()**
- **appl_write()**

appl_exit()

WORD appl_exit(VOID)

appl_exit() should be called at the termination of any program initialized with **appl_init()**.

OPCODE 19 (0x13)

AVAILABILITY All **AES** versions.

BINDING

```
return crys_if(0x13);
```

RETURN VALUE **appl_exit()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS The proper procedure for handling an error from this function is currently undefined.

SEE ALSO **appl_init()**

appl_find()

WORD appl_find(*fname*)
CHAR **fname*;

appl_find() searches the **AES**'s current process list for a program named *fname* and, if present, returns the application identifier of the process.

OPCODE 13 (0x0D)

AVAILABILITY All **AES** versions.

PARAMETERS *fname* is a pointer to a null-terminated ASCII string containing a valid **GEMDOS** filename (not including an extension) padded with blanks to be exactly 8 characters long (not including the **NULL**).

BINDING

```
addrin[0] = fname;
return crys_if(0x0D);
```

RETURN VALUE **appl_find()** returns the application identifier of the process if it is found or -1 otherwise.

VERSION NOTES **AES** versions from 4.0 add several extensions to this call for the benefit of **MultiTOS** as follows:

- If the upper word of the **CHAR** * is 0xFFFF, the lower word is assumed to be the **MiNT** id and **appl_find()** will return the **AES** application identifier.
- If the upper word of the **CHAR** * is 0xFFFE, the lower word is assumed to be the **AES** application identifier and the **MiNT** id is returned.
- If the upper word of the **CHAR** * is 0x0000, the current processes' application identifier is returned.

This functionality only exists if the **AES** version is 4.0 and above and **appl_getinfo()** indicates that it is available.

SEE ALSO **appl_write()**, **appl_init()**

appl_getinfo()

WORD appl_getinfo(*ap_gtype, ap_gout1, ap_gout2, ap_gout3, ap_gout4*)
WORD *ap_gtype*;
WORD **ap_gout1, *ap_gout2, *ap_gout3, *ap_gout4*;

appl_getinfo() returns information about the **AES**.

OPCODE 130 (0x82)

AVAILABILITY Available as of **AES** version 4.00.

PARAMETERS *ap_gtype* specifies the type of information to be returned in the shorts pointed to by *ap_gout1*, *ap_gout2*, *ap_gout3*, and *ap_gout4* as follows:

Name	Value	Returns
AES_LARGEFONT	0	**AES Large Font Information** *ap_gout1* is filled in with the **AES** font's point size. *ap_gout2* is filled in with the font id. *ap_gout3* is a code indicating the type of font: **SYSTEM_FONT** (0) is the system font **OUTLINE_FONT** (1) is an outline font *ap_gout4* is unused.
AES_SMALLFONT	1	**AES Large Font Information** Same as above for the current small font.

<table>
<tr><td>AES_SYSTEM</td><td>2</td><td>AES System Specifics

ap_gout1 is filled in with the resolution number (as would be returned by Getrez()).

ap_gout2 is filled in with the number of colors supported by the AES object library.

ap_gout3 is 0 if color icons are not supported or 1 if they are.

ap_gout4 is 0 to indicate that the extended resource file format is not supported or 1 if it is.</td></tr>
<tr><td>AES_LANGUAGE</td><td>3</td><td>AES Globalization

ap_gout1 is filled in with the current AES language code as follows:

<table>
<tr><th>Name</th><th>ap_gout1</th><th>Language</th></tr>
<tr><td>AESLANG_ENGLISH</td><td>0</td><td>English</td></tr>
<tr><td>AESLANG_GERMAN</td><td>1</td><td>German</td></tr>
<tr><td>AESLANG_FRENCH</td><td>2</td><td>French</td></tr>
<tr><td>—</td><td>3</td><td>(Reserved)</td></tr>
<tr><td>AESLANG_SPANISH</td><td>4</td><td>Spanish</td></tr>
<tr><td>AESLANG_ITALIAN</td><td>5</td><td>Italian</td></tr>
<tr><td>AESLANG_SWEDISH</td><td>6</td><td>Swedish</td></tr>
</table>

ap_gout2, ap_gout3, and ap_gout4 are unused.</td></tr>
<tr><td>AES_PROCESS</td><td>4</td><td>AES Multiple Process Support

ap_gout1 is 0 to indicate the use of non-pre-emptive multitasking and 1 to indicate the use of pre-emptive multitasking.

ap_gout2 is 0 if appl_find() cannot convert between MiNT and AES id’s and 1 to indicate that it can.

ap_gout3 is 0 if appl_search() is not implemented and 1 if it is.

ap_gout4 is 0 if rsrc_rcfix() is not implemented and 1 if it is.</td></tr>
<tr><td>AES_PCGEM</td><td>5</td><td>AES PC-GEM Features

ap_gout1 is 0 if objc_xfind() is not implemented and 1 if it is.

ap_gout2 is currently reserved.

ap_gout3 is 0 if menu_click() is not implemented and 1 if it is.

ap_gout4 is 0 if shel_rdef() and shel_wdef() are not implemented and 1 if they are.</td></tr>
</table>

AES_INQUIRE	6	**AES Extended Inquiry Functions** *ap_gout1* is 0 if -1 is not a valid *ap_id* parameter to **appl_read()** or 1 if it is. *ap_gout2* is 0 if -1 is not a valid length parameter to **shel_get()** or 1 if it is. *ap_gout3* is 0 if -1 is not a valid *mode* parameter to **menu_bar()** or 1 if it is. *ap_gout4* is 0 if **MENU_INSTL** is not a valid *mode* parameter to **menu_bar()** or 1 if it is.
–	7	Currently reserved.
AES_MOUSE	8	**AES Mouse Support** *ap_gout1* is 0 to indicate that *mode* parameters of 258-260 are not supported by **graf_mouse()** and 1 if they are. *ap_gout2* is 0 to indicate that the application has control over the mouse form and 1 to indicate that the mouse form is maintained by the **AES** on a per-application basis. *ap_gout3* and *ap_gout4* are currently unused.
AES_MENU	9	**AES Menu Support** *ap_gout1* is 0 to indicate that sub-menus are not supported and 1 if **MultiTOS** style sub-menus are. *ap_gout2* is 0 to indicate that popup menus are not supported and 1 if **MultiTOS** style popup menus are. *ap_gout3* is 0 to indicate that scrollable menus are not supported and 1 if **MultiTOS** style scrollable menus are. *ap_gout4* is 0 to indicate that the **MN_SELECTED** message does not contain object tree information in *msg*[5-7] and 1 to indicate that it does.

AES_SHELL	10	**AES Shell Support** *ap_gout1* & 0x00FF indicates the highest legal value for the *mode* parameter of **shel_write()**. *ap_gout1* & 0xFF00 indicate which extended **shel_write()** *mode* bits are supported. *ap_gout2* is 0 if **shel_write()** with a *mode* parameter of 0 launches an application or 1 if it cancels the previous **shel_write()**. *ap_gout3* is 0 if **shel_write()** with a *mode* parameter of 1 launches an application immediately or 1 if it takes effect when the current application exits. *ap_gout4* is 0 if ARGV style parameter passing is not supported or 1 if it is.
AES_WINDOW	11	**AES Window Features** *ap_gout1* is a bitmap of extended modes supported by **wind_get()** and **wind_set()** (if a bit is set, it is supported) as follows: **Bit** ***mode*** 0 **WF_TOP** returns window below the top also. 1 **wind_get(WF_NEWDESK**, ... **)** supported. 2 **WF_COLOR** get/set. 3 **WF_DCOLOR** get/set. 4 **WF_OWNER** get/set. 5 **WF_BEVENT** get/set. 6 **WF_BOTTOM** set. 7 **WF_ICONIFY** set. 8 **WF_UNICONIFY** set. 9-15 Unused *ap_gout2* is current unused. *ap_gout3* is a bitmap of supported window behaviors (if a bit is set, it is supported) as follows: **Bit** **Behaviour** 0 Iconifier gadget present. 1 Bottomer gadget present. 2 SHIFT-click sends window to bottom. 3 “hot” close box supported. 4-15 Unused *ap_gout4* is currently unused.

<table>
<tr><td>AES_MESSAGE</td><td>12</td><td>AES Extended Messages

ap_gout1 is a bitmap of extra messages supported (if a bit is set, it is supported) as follows:

<u>Bit</u> <u>Message</u>
0 WM_NEWTOP is meaningful.
1 WM_UNTOPPED is sent.
2 WM_ONTOP is sent.
3 AP_TERM is sent.
4 Shutdown and resolution change messages.
5 CH_EXIT is sent.
6 WM_BOTTOM is sent.
7 WM_ICONIFY is sent.
8 WM_UNICONIFY is sent.
9 WM_ALLICONIFY is sent.
10-15 Unused

ap_gout2 is a bitmap of extra messages supported. Current all bits are unused.

ap_gout3 is a bitmap indicating message behaviour (if a bit is set, the behaviour exists) as follows:

<u>Bit</u> <u>Message</u>
0 WM_ICONIFY message gives coordinates.
1-15 Unused

ap_gout4 is currently unused.</td></tr>
<tr><td>AES_OBJECT</td><td>13</td><td>AES Extended Objects

ap_gout1 is 0 if 3D objects are not supported or 1 if they are.

ap_gout2 is 0 if objc_sysvar() is not present, 1 if MultiTOS v1.01 objc_sysvar() is present, or 2 if extended objc_sysvar() is present.

ap_gout3 is 0 if the system font is the only font supported or 1 if GDOS fonts are also supported.

ap_gout4 is reserved for OS extensions.</td></tr>
<tr><td>AES_FORM</td><td>14</td><td>AES Form Support

ap_gout1 is 0 if ‘flying dialogs’ are not supported or 1 if they are.

ap_gout2 is 0 if keyboard tables are not supported or 1 if Mag!X style keyboard tables are supported.

ap_gout3 is 0 if the last cursor position from objc_edit() is not returned or 1 if it is.

ap_gout4 is currently reserved.</td></tr>
</table>

BINDING

```
intin[0] = ap_gtype;

crys_if(0x82);

*ap_gout1 = intout[1];
*ap_gout2 = intout[2];
*ap_gout3 = intout[3];
*ap_gout4 = intout[4];

return intout[0];
```

RETURN VALUE **appl_getinfo()** returns 1 if an error occurred or 0 otherwise.

VERSION NOTES Using an *ap_gtype* value of 4 and above is only supported as of **AES** version 4.1.

COMMENTS Many of the *ap_gtype* return values identify features of **TOS** not supported by Atari but for the benefit of third-party vendors. You should contact the appropriate third-party for documentation on these functions.

SEE ALSO **appl_init()**

appl_init()

WORD appl_init(VOID)

appl_init() should be the first function called in any application that intends to use **GEM** calls.

OPCODE 10 (0x0A)

AVAILABILITY All **AES** versions.

PARAMETERS The function as prototyped accepts no parameters, however, all 'C' compilers use this call to set up internal information as well as to update the applications' global array.

BINDING

```
return crys_if(0x0A);
```

RETURN VALUE **appl_init()** returns the applications' global identifier if successful or -1 if the AES cannot register the application. If successful, the global identifier should be stored in a global variable for later use.

Besides the return value, the **AES** fills in the application's global array (to reference the global array see your programming languages' manual).

Name	*global[x]*	Meaning

_AESversion	0	**AES** version number.
_AESnumapps	1	Number of concurrent applications possible (normally 1). **MultiTOS** will return -1.
_AESapid	2	Application identifier (same as **appl_init()** return value).
_AESappglobal	3-4	**LONG** global available for use by the application.
_AESrscfile	5-6	Pointer to the base of the resource loaded via **rsrc_load()**.
—	7-12	Reserved
_AESmaxchar	13	Current maximum character used by the **AES** to do **vst_height()** prior to writing to the screen. This entry is only present as of **AES** version 0x0400.
_AESminchar	14	Current minimum character used by the **AES** to do **vst_height()** prior to writing to the screen. This entry is only present as of **AES** version 0x0400.

VERSION NOTES See above.

SEE ALSO **appl_exit()**

appl_read()

WORD appl_read(*ap_id, length, message*)
WORD *ap_id, length*;
VOIDP *message*;

appl_read() is designed to facilitate inter-process communication between processes running under the **AES**. The call will halt the application until a message of sufficient length is available (see version notes below).

OPCODE 11 (0x0B)

AVAILABILITY All **AES** versions.

PARAMETERS *ap_id* is your application identifier as returned by **appl_init()**. *length* is the length (in bytes) of the message to read. *message* is a pointer to a memory buffer where the incoming message should be copied to.

BINDING

```
intin[0] = ap_id;
intin[1] = length;

addrin[0] = message;

return crys_if(0x0B);
```

RETURN VALUE **appl_read()** returns 0 if an error occurred or non-zero otherwise.

VERSION NOTES If the **AES** version is 4.0 or higher and **appl_getinfo()** indicates that this feature is supported, *ap_id* takes on an additional meaning. If **APR_NOWAIT** (-1) is passed instead of *ap_id*, **appl_read()** will return immediately if no message is currently waiting.

COMMENTS Normally this call is not used. **evnt_multi()** or **evnt_mesag()** is used instead for standard message reception. **appl_read()** is required for reading messages that are long and/or of variable length.

It is recommended that message lengths in multiples of 16 bytes be used.

SEE ALSO **appl_write()**

appl_search()

WORD appl_search(*mode, fname, type, ap_id*)
WORD *mode*;
CHAR **fname*;
WORD **type,*ap_id*;

appl_search() provides a method of identifying all of the currently running processes.

OPCODE 18 (0x12)

AVAILABILITY Available only in **AES** versions 4.0 and above when **appl_getinfo()** indicates its presence.

PARAMETERS *mode* specifies the search mode as follows:

Name	*mode*	Meaning
APP_FIRST	0	Return the filename of the first process
APP_NEXT	1	Return the filename of subsequent processes

fname should point to a memory location at least 9 bytes long to hold the 8 character process filename found and the **NULL** byte. *type* is a pointer to a **WORD** into which will be placed the process type as follows:

Name	*type*	Meaning
APP_SYSTEM	0x01	System process
APP_APPLICATION	0x02	Application
APP_ACCESSORY	0x04	Accessory
APP_SHELL	0x08	

The *type* parameter is actually a bit mask so it is possible that a process containing more than one characteristic will appear. The currently running shell process (usually the desktop) will return a value of **APP_APPLICATION** | **APP_SHELL** (0x0A).

ap_id is a pointer to a word into which will be placed the processes' application identifier.

BINDING

```
intin[0] = mode;

addrin[0] = fname;
addrin[1] = type;
addrin[2] = ap_id;

return crys_if(0x12);
```

RETURN VALUE **appl_search()** returns 0 if no more applications exist or 1 when more processes exist that meet the search criteria.

appl_tplay()

WORD appl_tplay(*mem, num, scale*)
VOIDP *mem*;
WORD *num, scale*;

appl_tplay() plays back events originally recorded with **appl_trecord()**.

OPCODE 14 (0x0E)

AVAILABILITY All **AES** versions.

PARAMETERS *mem* is a pointer to an array of **EVNTREC** structures (see **appl_trecord()**). *num* indicates the number of **EVNTREC**'s to play back.

scale indicates on a scale of 1 to 10000 how fast the **AES** will *attempt* to play back your recording. A value of 100 will play it back at recorded speed. A value of 200 will play the events back at twice the recorded speed, and 50 will play back the events at half of the recorded speed. Other values will respond accordingly.

BINDING

```
intin[0] = num;
intin[1] = scale;

addrin[0] = mem;

return crys_if(0x0E);
```

RETURN VALUE **appl_tplay()** always returns 1 meaning no error occurred.

CAVEATS This function does not work correctly on **AES** versions less than 1.40 without a patch program available from Atari Corp.

SEE ALSO **appl_trecord()**

appl_trecord()

WORD appl_trecord(***mem, num*** **)**
VOIDP *mem*;
WORD *num*;

appl_trecord() records **AES** events for later playback.

OPCODE 15 (0x0F)

AVAILABILITY All **AES** versions.

PARAMETERS *mem* points to an array of *num* **EVNTREC** structures into which the **AES** will record events as indicated here:

```
typedef struct pEvntrec
{
       WORD ap_event;
       LONG ap_value;
} EVNTREC;
```

ap_event defines the required interpretation of *ap_value* as follows:

Name	*ap_event*	Event	*ap_value*
APPEVNT_TIMER	0	Timer	Elapsed Time (in milliseconds)
APPEVNT_BUTTON	1	Button	low word = state (1 = down) high word = # of clicks
APPEVNT_MOUSE	2	Mouse	low word = X pos high word = Y pos
APPEVNT_KEYBOARD	3	Keyboard	bits 0-7: ASCII code bits 8-15: scan code bits 16-31: shift key state

BINDING

```
intin[0] = num;

addrin[0] = mem;

return crys_if(0x0F);
```

RETURN VALUE **appl_trecord()** returns the number of events actually recorded.

CAVEATS This function does not work correctly on **AES** versions less than 1.40 without a patch program available from Atari Corp.

SEE ALSO **appl_tplay()**

appl_write()

WORD appl_write(***ap_id, length, msg*** **)**
WORD ***ap_id, length*****;**
VOIDP ***msg*****;**

appl_write() can be used to send a message to a valid message pipe.

OPCODE 12 (0x0C)

AVAILABILITY All **AES** versions.

PARAMETERS *ap_id* is the application identifier of the process to which you wish to send the message. *length* specifies the number of bytes present in the message. *msg* is a pointer to a memory buffer with at least *length* bytes available.

BINDING

```
intin[0] = ap_id;
intin[1] = length;

addrin[0] = msg;

return crys_if(0x0C);
```

RETURN VALUE **appl_write()** returns 0 if an error occurred or greater than 0 if the message was sent successfully.

VERSION NOTES As of **AES** version 1.40, desk accessories may send **MN_SELECTED** messages to the desktop to trigger desktop functions.

As of **AES** version 4.00 you can use **shel_write(**7,...**)** to 'broadcast' a message to all processes running with the exception of the **AES** itself, the desktop, and your own application. See **shel_write()** for details.

COMMENTS It is recommended that you always send messages in 16 byte blocks using a **WORD** array of 8 elements as the **AES** does.

SEE ALSO **appl_read()**, **shel_write()**

Event Library

The *Event Library* consists of a group of system calls which are used to monitor system messages including mouse clicks, keyboard usage, menu bar interaction, timer calls, and mouse tracking. The library consists of the following calls:

- **evnt_button()**
- **evnt_dclick()**
- **evnt_keybd()**
- **evnt_mesag()**
- **evnt_mouse()**
- **evnt_multi()**
- **evnt_timer()**
- **evnt_button()**

evnt_button()

WORD evnt_button(***clicks, mask, state, mx, my, button, kstate*** **)**
WORD ***clicks, mask, state*****;**
WORD ****mx, *my, *button, *kstate*****;**

evnt_button() releases control to the operating system until the specified mouse button event has occurred.

OPCODE 21 (0x15)

AVAILABILITY All **AES** versions.

PARAMETERS *clicks* specifies the number of mouse-clicks that must occur before returning. *mask* specifies the mouse buttons to wait for as follows:

Name	*mask*	Meaning
LEFT_BUTTON	0x01	Left mouse button
RIGHT_BUTTON	0x02	Right mouse button
MIDDLE_BUTTON	0x04	Middle button (this button would be the first button to the left of the rightmost button on the device).
—	0x08 . .	Other buttons (0x08 is the mask for the button to the immediate left of the middle button. Masks continue leftwards).

state specifies the button state that must occur before returning as follows:

mask	Meaning
0x00	All buttons released
0x01	Left button depressed
0x02	Right button depressed
0x04	MIddle button depressed
0x08 . .	etc...

mx is a pointer to a **WORD** which upon return will contain the x-position of the mouse pointer at the time of the event. *my* is a pointer to a **WORD** which upon return will contain the y-position of the mouse pointer at the time of the event.

button is a pointer to a **WORD** which upon return will contain the mouse button state as defined in *state*.

kstate is a pointer to a **WORD** which upon return will contain the current status

of the keyboard shift keys. The value is a bit-mask defined as follows:

Name	Mask	Key
K_RSHIFT	0x01	Right Shift
K_LSHIFT	0x02	Left Shift
K_CTRL	0x04	Control
K_ALT	0x08	Alternate

BINDING

```
intin[0] = clicks;
intin[1] = mask;
intin[2] = state;

crys_if(0x15);

*mx = intout[1];
*my = intout[2];
*button = intout[3];
*kstate = intout[4];

return intout[0];
```

RETURN VALUE Upon exit, **evnt_button()** returns a **WORD** indicating the number of times the mouse button state matched *state*.

COMMENTS A previously undocumented feature of this call is accessed by logically OR'ing the *mask* parameter with 0x100. This causes the call to return when independent buttons are depressed. For example, a *mask* value of 0x03 will return when both the left and right mouse buttons are depressed. A *mask* value of 0x103 will cause the call to return when either button is depressed.

SEE ALSO **evnt_multi()**

evnt_dclick()

WORD evnt_dclick(*new*, *flag*)
WORD *new*, *flag*;

evnt_dclick() sets the mouse double-click response rate. This call is global, and thus, affects all applications.

OPCODE 26 (0x1A)

AVAILABILITY All **AES** versions.

PARAMETERS If *flag* is **EDC_INQUIRE** (0), *new* is ignored and the current double-click rate is returned. If *flag* is **EDC_SET** (1), *new* specifies the new double-click rate as

follows:

flag	Response
0	Slowest
1	
2	
3	
4	Fastest

BINDING

```
intin[0] = new;
intin[1] = flag;

return crys_if(0x1A);
```

RETURN VALUE **evnt_dclick()** returns the newly set or current double-click rate based on *flag*.

COMMENTS Because this setting is global for all applications, Atari has strongly recommended that developers use this call *only* where appropriate (such as in a configuration CPX like the General Setup CPX included with **XCONTROL**).

evnt_keybd()

WORD evnt_keybd(VOID)

evnt_keybd() relinquishes program control to the operating system until a valid keypress is available in the applications' message pipe.

OPCODE 20 (0x14)

AVAILABILITY All **AES** versions.

PARAMETERS None

BINDING

```
return crys_if(0x14);
```

RETURN VALUE **evnt_keybd()** returns a 16-bit value containing the ASCII code of the key entered in the lower eight bits and the scan code in the upper 8-bits.

VERSION NOTES **TOS** versions released at or above 2.06 and 3.06 disabled reception of keys 1 through 9 on the numeric keypad when used in conjunction with the alternate key. Users may now enter the full range of ASCII values by holding down ALT, typing in the decimal ASCII code, and then releasing the ALT key. These keys, therefore, should not be used by applications. The standard numeric keypad is still available.

SEE ALSO **evnt_multi()**

evnt_mesag()

WORD evnt_mesag(*msg*)
WORD **msg*;

evnt_mesag() releases control to the operating system until a valid system message is available in the applications' message pipe.

OPCODE 23 (0x17)

AVAILABILITY All **AES** versions.

PARAMETERS *msg* is a pointer to an array of 8 **WORD's** to be used as a message buffer.

BINDING

```
addrin[0] = msg
return crys_if(0x17);
```

RETURN VALUE The return value is currently reserved by Atari and currently is defined as 1. The array *msg* is filed in with the following values:

Index	Description	Possible Values	#
msg[0]	Message Type	**MN_SELECTED**	10
		WM_REDRAW	20
		WM_TOPPED	21
		WM_CLOSED	22
		WM_FULLED	23
		WM_ARROWED	24
		WM_HSLID	25
		WM_VSLID	26
		WM_SIZED	27
		WM_MOVED	28
		WM_UNTOPPED	30
		WM_ONTOP	31
		WM_BOTTOM	33
		WM_ICONIFY	34
		WM_UNICONIFY	35
		WM_ALLICONIFY	36
		WM_TOOLBAR	37
		AC_OPEN	40
		AC_CLOSE	41
		AP_TERM	50
		AP_TFAIL	51
		AP_RESCHG	57
		SHUT_COMPLETED	60
		RESCH_COMPLETED	61
		AP_DRAGDROP	63
		SH_WDRAW	72
		CH_EXIT	90
msg[1]	The application identifier of the sending application.	Any valid *ap_id*.	
msg[2]	The length of the message *beyond* 16 bytes (use **appl_read()** to read the excess).	Currently all system messages return 0 in this slot. Only user-defined messages utilize a higher value.	

Each system message can be interpreted as follows:

Message	Extended Information
MN_SELECTED	A menu item has been selected by the user. *msg[3]* contains the object number of the menu title and *msg[4]* contains the object number of the menu item. As of **AES** version 4.0 (and when indicated by **appl_getinfo()**), *msg[5]* and *msg[6]* contain the high and low word, respectively, of the object tree of the menu item. *msg[7]* contains the parent object index of the menu item.
WM_REDRAW	This message alerts an application that a portion of the screen needs to be redrawn. *msg[3]* contains the handle of the window to redraw. *msg[4-7]* are the x, y, w, and h respectively of the 'dirtied' area. When the message is received the window contents should be drawn (or a representative icon if the window is iconified).
WM_TOPPED	This message is sent when an application window which is currently not the top window is clicked on by the user. *msg[3]* contains the handle of the window. You should use **wind_set(** handle, **WF_TOP**, *msg[3]*, 0, 0, 0**)** to actually cause the window to be topped.
WM_CLOSED	This message is sent when the user clicks on a windows' close box. *msg[3]* contains the handle of the window to close. You should react to this message with **wind_close()**.
WM_FULLED	This message is sent when the user clicks on a windows' full box. If the window is not at full size, the window should be resized using **wind_set(**handle, **WF_CURRXYWH**,... to occupy the entire screen minus the menu bar (see **wind_get()**). If the window was previously 'fulled' and has not been resized since, the application should return the window to its previous size.

<table>
<tr><td>WM_ARROWED</td><td>This message is sent to inform an application that one of its slider gadgets has been clicked on.

A row or column message is sent when a slider arrow is selected. A ‘page’ message is sent when a darkened area of the scroll bar is clicked. This usually indicates that the application should adjust the window’s contents by a larger amount than with the row or column messages.

msg[3] indicates which action was actually selected as follows:

<table>
<tr><th>Name</th><th>Value</th><th>Meaning</th></tr>
<tr><td>WA_UPPAGE</td><td>0</td><td>Page Up</td></tr>
<tr><td>WA_DNPAGE</td><td>1</td><td>Page Down</td></tr>
<tr><td>WA_UPLINE</td><td>2</td><td>Row Up</td></tr>
<tr><td>WA_DNLINE</td><td>3</td><td>Row Down</td></tr>
<tr><td>WA_LFPAGE</td><td>4</td><td>Page Left</td></tr>
<tr><td>WA_RTPAGE</td><td>5</td><td>Page Right</td></tr>
<tr><td>WA_LFLINE</td><td>6</td><td>Column Left</td></tr>
<tr><td>WA_RTLINE</td><td>7</td><td>Column Right</td></tr>
</table>
</td></tr>
<tr><td>WM_HSLID</td><td>This message indicates that the horizontal slider has been moved. msg[3] contains the new slider position ranging from 0 to 1000.

Note: Slider position is relative and not related to slider size.</td></tr>
<tr><td>WM_VSLID</td><td>This message indicates that the vertical slider has been moved. msg[3] contains the new slider position ranging from 0 to 1000.

Note: Slider position is relative and not related to slider size.</td></tr>
<tr><td>WM_SIZED</td><td>This message occurs when the user drags the window sizing gadget. msg[3] contains the window handle. msg[4-7] indicate the x, y, w, and h respectively of the new window location.

Use wind_set(handle, WF_CURRXYWH,... to actually size the window.

WM_SIZED and WM_MOVED usually share common handling code.</td></tr>
<tr><td>WM_MOVED</td><td>This message occurs when the user moves the window by dragging the windows’ title bar. msg[3] contains the handle of the window being moved. msg[4-7] indicate the x, y, w, and h respectively of the new window location.

Use wind_set(handle, WF_CURRXYWH,...) to actually move the window.

WM_MOVED and WM_SIZED usually share common handling code.</td></tr>
<tr><td>WM_UNTOPPED</td><td>This message is sent when the current window is sent behind one or more windows as the result of another window being topped. msg[3] contains the handle of the window being untopped.

The application need take no action. The message is for informational use only.</td></tr>
</table>

WM_ONTOP	This message is sent when an applications' window is brought to the front on a multitasking **AES**. *msg[3]* is the handle of the window being brought to the front. This message requires no action, it is for informational purposes only.
WM_BOTTOM	This message is sent when the user shift-clicks on the window's (specified in *msg*[3]) mover bar to indicate that the window should be sent to the bottom of the window stack by using **wind_set()** with a parameter of **WF_BOTTOM**.
WM_ICONIFY	This message is sent when the user clicks on the **SMALLER** window gadget. *msg*[3] indicates the handle of the window to be iconified. *msg*[4-7] indicate the x, y, w, and h of the iconified window. If the iconified window represents a single window this message should be responded to by using **wind_set()** with a parameter of **WF_ICONIFY**.
WM_UNICONIFY	This message is sent when the user double-clicks on an iconified window. *msg*[3] indicates the handle of the window to be iconified. *msg*[4-7] indicate the x, y, w, and h of the original window. This message should be responded to by using **wind_set()** with a parameter of **WF_UNICONIFY**.
WM_ALLICONIFY	This message is sent when the user CTRL-clicks on the **SMALLER** window gadget. *msg*[3] indicates which window's gadget was clicked. *msg*[4-7] indicates the position at which the new iconified window should be placed. The application should respond to this message by closing all open windows and opening a new iconified window at the position indicated which represents the application.
WM_TOOLBAR	This message is sent when a toolbar object is clicked. *msg*[3] contains the handle of the window containing the toolbar. *msg*[4] contains the object index of the object clicked. *msg*[5] contains the number of clicks. *msg*[6] contains the state of the keyboard shift keys at the time of the click (as in **evnt_keybd()**).
AC_OPEN	This message is sent when the user has selected a desk accessory to open. *msg[4]* contains the application identifier (as returned by **appl_init()**) of the accessory to open.
AC_CLOSE	This message is sent to a desk accessory when the accessory should be closed. *msg[3]* is the application identifier (as returned by **appl_init()**) of the accessory to close. Do not close any windows your accessory had open, the system will do this for you. Also, do not require any feedback from the user when this is received. Treat this message as a 'Cancel' from the user.

AP_TERM	This message is sent when the system requests that the application terminate. This is usually the result of a resolution change but may also occur if another application sends this message to gain total control of the system. The application should shut down immediately after closing windows, freeing resources, etc... *msg[5]* indicates the reason for the shut down as follows: **AP_TERM** (50) = Just shut down. **AP_RESCHG** (57) = Resolution Change. If for some reason, your process can not shut down you must inform the **AES** by sending an **AP_TFAIL** (51) message by using **shel_write()** mode 10 (see **shel_write()**). Note: Desk Accessories wil always be sent **AC_CLOSE** messages, not **AP_TERM**.
AP_TFAIL	This message should be sent to the system (see **shel_write()**) when an application has received an **AP_TERM** (50) message and cannot shut down. *msg[0]* should contain **AP_TFAIL** and *msg[1]* should contain the application error code.
AP_RESCHG	This message is actually a sub-command and is only found as a possible value in the **AP_TERM** (50) message (see above).
SHUT_COMPLETED	This message is sent to the application which requested a shutdown when the shutdown is complete and was successful.
RESCH_COMPLETED	This message is sent to an application when a resolution change it requested is completed. *msg[3]* contains 1 if the resolution change was successful and 0 if an error occurred.
AP_DRAGDROP	This message indicates that another application wishes to initiate a drap and drop session. *msg*[3] indicates the handle of the window which had an object dropped on it or -1 if no specific window was targeted. *msg*[4-5] contains the X and Y position of the mouse when the object was 'dropped'. *msg*[6] indicates the keyboard shift state at the time of the drop (as in **evnt_keybd()**). *msg*[7] is a two-byte ASCII packed pipe identifier which gives the file extension of the pipe to open. For more information about the drag & drop protocal, see *Chapter 2: **GEMDOS***.
SH_WDRAW	This message is sent to the Desktop to ask it to update an open drive window. *msg*[3] should contain the drive number to update (0 = A:, 1 = B:) or -1 to update all windows.
CH_EXIT	This message is sent when a child process that the application has started, returns. *msg[3]* contains the child's application identifier and *msg[4]* contains its exit code.

VERSION NOTES **WM_UNTOPPED**, **WM_ONTOP**, **AP_TERM**, **AP_TFAIL**, **AP_RESCHG**, **SHUT_COMPLETED**, **RESCH_COMPLETED**, and **CH_EXIT** are new as of

AES version 4.0.

WM_BOTTOM, **WM_ICONIFY**, **WM_UNICONIFY**, **WM_ALLICONIFY**, and **WM_TOOLBAR** are new as of **AES** version 4.1.

No lower version **AES** will send these messages.

The existence (or acceptance) of these messages should also be checked for by using **appl_getinfo()**.

SEE ALSO **evnt_multi()**

evnt_mouse()

WORD evnt_mouse(***flag, x, y, w, h, mx, my, button, kstate*** **)**
WORD ***flag, x, y, w, h*****;**
WORD ****mx, *mx, *button, *kstate*****;**

evnt_mouse() releases control to the operating system until the mouse enters or leaves a specified area of the screen .

OPCODE 22 (0x16)

AVAILABILITY All **AES** versions.

PARAMETERS *flag* specifies the event to wait for as follows:

Name	Value	Meaning
MO_ENTER	0	Wait for mouse to enter rectangle.
MO_LEAVE	1	Wait for mouse to leave rectangle.

The rectangle to watch is specified in *x*, *y*, *w*, *h*. *mx* and *my* are **WORD** pointers which will be filled in with the final position of the mouse.

button is a **WORD** pointer which will be filled in upon return with the final state of the mouse button as defined in **evnt_button()**.

kstate is a **WORD** pointer which will be filled in upon return with the final state of the keyboard shift keys as defined in **evnt_button()**.

BINDING

```
intin[0] = flag;
intin[1] = x;
intin[2] = y;
intin[3] = w;
intin[4] = h;
```

```
crys_if(0x16);

*mx = intout[1];
*my = intout[2];
*button = intout[3];
*kstate = intout[4];

return intout[0];
```

RETURN VALUE The return value of this function is reserved. Currently it always returns 1.

COMMENTS The **evnt_multi()** function can be used to watch two mouse/rectangle events as opposed to one.

SEE ALSO **evnt_multi()**

evnt_multi()

WORD evnt_multi(***events, bclicks, bmask, bstate, m1flag, m1x, m1y, m1w, m1h, m2flag, m2x, m2y, m2w, m2h, msg, locount, hicount, mx, my, ks, kc, mc*** **)**
WORD ***events, bclicks, bmask, bstate, m1flag, m1x, m1y, m1w, m1h, m2flag, m2x, m2y, m2w, m2h*****;**
WORD ****msg*****;**
WORD ***locount, hicount*****;**
WORD ****mx, *my, *ks, *kc, *mc*****;**

evnt_multi() suspends the application until a valid message that the application is interested in occurs. This call combines the functionality of **evnt_button()**, **evnt_keybd()**, **evnt_mesag()**, **evnt_mouse()**, and **evnt_timer()** into one call.

This call is usually the cornerstone of all **GEM** applications that must process system events.

OPCODE 25 (0x19)

AVAILABILITY All **AES** versions.

PARAMETERS *events* is a bit mask which tells the function which events your application is interested in. You should logically 'OR' any of the following values together:

Name	Mask	Function
MU_KEYBD	0x01	Wait for a user keypress.
MU_BUTTON	0x02	Wait for the specified mouse button state.
MU_M1	0x04	Wait for a mouse/rectangle event as specified.
MU_M2	0x08	Wait for a mouse/rectangle event as specified.

MU_MESAG	0x10	Wait for a message.
MU_TIMER	0x20	Wait the specified amount of time.

For usage of *bclicks*, *bmask*, *bstate*, *mx*, *my*, *kc*, and *ks*, you should consult **evnt_button()**.

For usage of *m1flag*, *m1x*, *m1y*, *m1w*, *m1h*, *m2flag*, *m2x*, *m2y*, *m2w*, and *m2h*, consult **evnt_mouse()**.

For usage of *msg*, see **evnt_mesag()**.

For usage of *locount* and *hicount*, see **evnt_timer()**.

BINDING

```
intin[0] = events;
intin[1] = bclicks;
intin[2] = bmask;
intin[3] = bstate;
intin[4] = m1flag;
intin[5] = m1x;
intin[6] = m1y;
intin[7] = m1w;
intin[8] = m1h;
intin[9] = m2flag;
intin[10] = m2x;
intin[11] = m2y;
intin[12] = m2w;
intin[13] = m2h;
intin[14] = locount;
intin[15] = hicount;

addrin[0] = msg;

crys_if(0x19);

*mx = intout[1];
*my = intout[2];
*mb = intout[3];
*ks = intout[4];
*kc = intout[5];
*mc = intout[6];

return intout[0];
```

RETURN VALUE

The function returns a bit mask of which events actually happened as in *events*. This may be one or more events and your application should be prepared to handle each.

VERSION NOTES

The only facet of **evnt_multi()** which has changed from **AES** version 4.0 is that which relates to **evnt_mesag()**. For further information you should consult that section.

CAVEATS

Under **TOS** 1.0, calling this function from a desk accessory with the **MU_TIMER**

mask and *locount* and *hicount* being equal to 0 could hang the system.

SEE ALSO **evnt_button(), evnt_keybd(), evnt_mesag(), evnt_mouse(), evnt_timer()**

evnt_timer()

WORD evnt_timer(*locount, hicount*)
WORD *locount, hicount*;

evnt_timer() releases control to the operating system until a specified amount of time has passed.

OPCODE 24 (0x18)

AVAILABILITY All **AES** versions.

PARAMETERS *locount* is the low word of a 32-bit time value specified in milliseconds. *hicount* is the high portion of that 32-bit value.

BINDING

```
intin[0] = locount;
intin[1] = hicount;

return crys_if(0x18);
```

RETURN VALUE The return value is reserved and is currently always 1.

CAVEATS Under **TOS** 1.0, calling this function from a desk accessory with a both parameters having a value of 0 will hang the system.

COMMENTS This function should not be relyed on as an accurate clock. The time specified is used as a minimum time value only and the function will return at some point after that duration has passed.

SEE ALSO **evnt_multi()**

Form Library

The *Form Library* contains utility functions for the use and control of dialog boxes, alert boxes, and user input. The members of the *Form Library* are:

- **form_alert()**
- **form_button()**
- **form_center()**
- **form_dial()**
- **form_do()**
- **form_error()**
- **form_keybd()**

form_alert()

WORD form_alert(***default, alertstr*** **)**
WORD *default*;
CHAR **alertstr*;

form_alert() displays a standardized alert box and returns the user's selection.

OPCODE 52 (0x34)

AVAILABILITY All **AES** versions.

PARAMETERS *default* contains the number of the exit button which is to be made default (1-3). *alertstr* contains a formatted string as follows: "[#][Alert Text][Buttons]".

specifies the icon to display in the alert as follows:

#	Icon Displayed
0	No Icon
1	
2	
3	
4	
5	

'Alert Text' is a text string of as many as 5 lines composed of up to 30 characters each. Each line is separated by a '|' character.

'*Buttons'* is a text string to define as many as 3 buttons up to 10 characters each. If only one button is used, its text may be as long as 30 characters. Again, each button is separated by a '|' character

BINDING

```
intin[0] = default;

addrin[0] = alertstr;

return crys_if(0x34);
```

RETURN VALUE **form_alert()** returns a **WORD** indicating which button was used to exit by the user (A possible value of 1-3).

VERSION NOTES Icons #4-5 are only available as of **AES** version 4.1.

CAVEATS Several versions of the **AES** have special quirks related to this function. By following the quidelines below you should avoid any difficulty:

1. All **AES** versions below 1.06 have some difficulty formatting alert strings padded with spaces. If you want your alerts to look right on all **AES** versions, do not pad any button or line with spaces with the exception below.

2. Add one space to the end of the longest text line on an alert. This will prevent the right edge from touching the border in some **AES** versions.

form_button()

WORD form_button(***tree, obj, clicks, newobj*** **)**
OBJECT *_*tree*_*;
WORD ***obj, clicks, newobj*****;**

form_button() is a utility function designed to aid in the creation of a custom **form_do()** handler.

OPCODE 56 (0x38)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* is a pointer to a valid object tree in memory you wish to process button events for. *obj* is the object index into *tree* which was clicked on and which needs to be processed.

clicks is the number of times the mouse button was clicked.

newobj returns the next object to gain edit focus or 0 if there are no editable objects. If the top bit of *newobj* is set, this indicates that a **TOUCHEXIT** object was double-clicked.

BINDING

```
intin[0] = obj;
intin[1] = clicks;
```

```
addrin[0] = tree;

crys_if(0x38);

*newobj = intout[1];

return intout[0];
```

RETURN VALUE **form_button()** returns a 0 if it exits finding an **EXIT** or **TOUCHEXIT** object selected or 1 otherwise.

COMMENTS To use this function properly, the application should take the following steps:

1. Monitor mouse clicks with **evnt_multi()** or **evnt_button()**.

2. When a click occurs, use **objc_find()** to determine if the click occurred over the object.

3. If so, call **form_button()** with the appropriate values.

This function was not originally documented by Atari. You may have to add bindings for this function to some earlier 'C' compilers.

SEE ALSO **form_do(), form_keybd()**

form_center()

WORD form_center(*tree, x, y, w, h*)
OBJECT ****tree***;**
WORD ****x, *y, *w, *h*;

form_center() is used to modify an object's coordinates so that it will appear in the center of the display screen.

OPCODE 54 (0x36)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* points to a valid **OBJECT** structure (see discussion of resources) which the application wishes to have centered. *x*, *y*, *w*, and *h*, return a clipping rectangle suitable for use in **objc_draw()**.

BINDING

```
addrin[0] = tree;

crys_if(0x36);
```

```
*x = intout[1];
*y = intout[2];
*w = intout[3];
*h = intout[4];

return intout[0];
```

RETURN VALUE The return value is currently reserved. Currently it equals 1.

COMMENTS The values that **form_center()** returns in *x*, *y*, *w*, and *h*, are not necessarily the same as the object's. These values take into account negative borders, outlining, and shadowing. This is meant to provide a suitable clipping rectangle for **objc_draw()**

SEE ALSO **objc_draw()**

form_dial()

WORD form_dial(*mode, x1, y1, w1, h1, x2, y2, w2, h2*)
WORD *mode, x1, y1, w1, h1, x2, y2, w2, h2*;

form_dial() is used to reserve and release screen space for dialog usage. In addition, it also optionally provides grow/shrink box effects.

OPCODE 51 (0x33)

AVAILABILITY All **AES** versions.

PARAMETERS *mode* specifies the action to take and the meaning of remaining parameters as follows:

Name	#	Action
FMD_START	0	This mode reserves the screen space for a dialog. *x2*, *y2*, *w2*, and *h2*, contain the coordinates of the dialog to be used (usually obtained through **form_center()**).
FMD_GROW	1	This mode draws an expanding box from the coordinates specified in *x1*, *y1*, *w1*, and *h1* to the coordinates specified in *x2*, *y2*, *w2*, and *h2*. This call is optional and is not required to display a dialog.
FMD_SHRINK	2	This mode draws a shrinking box from the coordinates specified in *x2*, *y2*, *w2*, and *h2* to the coordinates specified in *x1*, *y1*, *w1*, and *h1*. This call is optional and is not required to display a dialog.
FMD_FINISH	3	This mode releases the screen space for a dialog (previously reserved with mode 0). *x2*, *y2*, *w2*, and *h2* contain the coordinates of the space to release. One of the side-effects of this call is a **WM_REDRAW** message sent to any window which the dialog was covering.

BINDING

```
intin[0] = mode;
intin[1] = x1;
intin[2] = y1;
intin[3] = w1;
intin[4] = h1;
intin[5] = x2;
intin[6] = y2;
intin[7] = w2;
intin[8] = h2;

return crys_if(0x33);
```

RETURN VALUE The function returns 0 is an error occurred or non-zero otherwise.

VERSION NOTES The **AES** does not currently make use of mode **FMD_START**. The call should, however, still be executed for upward compatibility.

SEE ALSO **graf_growbox()**, **graf_shrinkbox()**

form_do()

WORD form_do(***tree*****,** ***editobj*** **)**
OBJECT *****tree***;**
WORD ***editobj*****;**

form_do() provides an automated dialog handling function to the calling application. It suspends program control, handling all radio buttons, selectable objects, etc... until an object with the **TOUCHEXIT** or **EXIT** flag is selected.

OPCODE 50 (0x32)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* is a pointer to a valid object tree (see the discussion on objects in this chapter) which contains a dialog with at least one **EXIT** or **TOUCHEXIT** button or object.

editobj is the object index into tree which specifies the desired initial location of the edit cursor (the object must be flagged as **EDITABLE**). If the form has no text editable fields, you should use 0.

BINDING

```
intin[0] = editobj;

addrin[0] = tree;

return crys_if(0x32);
```

RETURN VALUE **form_do()** returns the object index of the **EXIT** or **TOUCHEXIT** button which

was selected. If the object was double clicked, bit 15 will be set. This means that to obtain the actual object number you should mask off the result with 0x7FFF.

form_error()

WORD form_error(*error*)
WORD *error*;

form_error() displays a pre-defined error alert box to the user.

OPCODE 53 (0x35)

AVAILABILITY All **AES** versions.

PARAMETERS *error* specifies a **MS-DOS** error code as follows:

Name	GEMDOS Error #	*error*	Message
FERR_FILENOTFOUND	-33	2	**File Not Found** The application can not find the folder or file that you tried to access.
FERR_PATHNOTFOUND	-34	3	**Path Not Found** The application cannot find the folder or file that you tried to access.
FERR_NOHANDLES	-35	4	**No More File Handles** The application does not have room to open another document. To make room, close any open document that you do not need.
FERR_ACCESSDENIED	-36	5	**Access Denied** An item with this name already exists in the directory, or this item is set to read-only status.
FERR_LOWMEM	-39	8	**Insufficient Memory** There is not enough memory for the application you just tried to run.
FERR_BADENVIRON	-41	10	**Invalid Environment** There is not enough memory for the application you just tried to run.
FERR_BADFORMAT	-42	11	**Invalid Format** There is not enough memory for the application you just tried to run.

FERR_BADDRIVE	-46	15	**Invalid Drive Specification** The drive you specified does not exist.
FERR_DELETEDIR	-47	16	**Attempt To Delete Working Directory** You cannot delete the folder in which you are working.
FERR_NOFILES	-49	18	**No More Files** The application can not find the folder or file that you tried to access.

The **GEMDOS** error number can be translated into a **MS-DOS** code by subtracting 31 from the absolute value of the error code.

BINDING

```
intin[0] = error;

return crys_if(0x35);
```

RETURN VALUE The function returns the exit button clicked as in **form_alert()**. It is, however, insignifigant as all of the error alerts have only one button.

CAVEATS Not every **GEMDOS** error code has a matching alert box.

SEE ALSO **form_alert()**

form_keybd()

WORD form_keybd(***tree, obj, nextobj, kc, newobj, keyout*** **)**
OBJECT * ***tree*****;**
WORD ***obj, nextobj, kc*****;**
WORD * ***newobj, *keyout*****;**

form_keybd() processes keyboard input for dialog box control. It handles special keys such as return, escape, tab, etc... It is only of real use if you are writing a customized **form_do()** routine.

OPCODE 55 (0x37)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* points to a valid **OBJECT** tree containing the dialog you wish to process. *obj* is the object index of the object which currently has edit focus (0 if none). *nextobj* is reserved and should be 1.

kc is the value returned from **evnt_keybd()** or **evnt_multi()** which represents the keypresses' scan code and ASCII value.

newobj is a **WORD** pointer which is filled in on function exit to be the new object with edit focus unless the RETURN key was pressed with a default object present in which case it equals the object index of the object that was the default.

keyout is the value ready to be passed on to **objc_edit()** if no processing was required or 0 if the key was processed and handled by the call.

BINDING

```
intin[0] = obj;
intin[1] = nextobj;
intin[2] = kc;

addrin[0] = tree;

crys_if(0x37);

*newobj = intout[1];
*keyout = intout[2];

return intout[0];
```

RETURN VALUE

form_keybd() returns 0 if a default **EXIT** object was triggered by this call or 1 if the dialog should continue to be processed.

COMMENTS

This function was not originally documented by Atari. You may need to add bindings for this function into some older 'C' compilers.

SEE ALSO

objc_edit(), **form_do(), form_button()**

File Selector Library

The *File Selector Library* contains two functions for displaying the system file selector (or currently installed alternate file selector) and prompting the user to select a file. The members of this library are:

- **fsel_exinput()**
- **fsel_input()**

fsel_exinput()

WORD fsel_exinput(***path, file, button, title*** **)**
CHAR * ***path, *file*****;**
WORD * ***button*****;**
CHAR * ***title*****;**

fsel_exinput() displays the system file selector and offers the user an opportunity to choose a complete **GEMDOS** path specification.

OPCODE 91 (0x5B)

AVAILABILITY Available from **AES** version 1.40.

PARAMETERS *path* should be a pointer to a character buffer at least 128 bytes long (applications wishing to access CD-ROM's should allocate at least 200 bytes). On input the buffer should contain a complete **GEMDOS** path specification including a drive specifier, path string, and wildcard mask as follows: 'drive:\path\mask'. The mask can be any valid **GEMDOS** wildcard (usually *.*).

On function exit, *path* contains final path of the selected file (you will have to strip the mask).

file should point to a character buffer 13 bytes long (12 character filename plus **NULL**). On input its contents will be placed on the filename line of the selector (usually this value can simply be a empty string). On function exit, *file* contains the filename which the user selected.

button is a short pointer which upon function exit will contain **FSEL_CANCEL** (0) if the user selected **CANCEL** or **FSEL_OK** (1) if **OK**.

title should be a pointer to a character string up to 30 characters long which contains the title to appear in the file selector (usually indicates which action the user is about to take).

BINDING

```
addrin[0] = path;
addrin[1] = file;
addrin[2] = label;

crys_if(0x5B);

*button = intout[1];

return intout[0];
```

RETURN VALUE **fsel_exinput()** returns 0 if an error occured and 1 otherwise.

VERSION NOTES Some 'C' compilers (Lattice for example) provide a special function which allows **fsel_exinput()** to be used even on earlier **AES** versions.

COMMENTS The path parameter to this function should be validated to ensure that the path actually exists prior to calling this function to prevent confusing the user.

This call should always be used as opposed to **fsel_input()** when it is available. Otherwise, the user has no reminder as to what function s/he is actually undertaking.

SEE ALSO **fsel_input()**

fsel_input()

WORD fsel_input(***path, file, button*** **)**
CHAR ***path, *file*;**
WORD ***button*;**

fsel_input() displays the system file selector and allows the user to select a valid **GEMDOS** path and file.

OPCODE 90 (0x5A)

AVAILABILITY All **AES** versions.

PARAMETERS All parameters are consistent with **fsel_exinput()** with the notable lack of *title*.

BINDING

```
addrin[0] = path;
addrin[1] = file;

crys_if(0x5A);

*button = intout[1];

return intout[0];
```

RETURN VALUE **fsel_input()** returns a 0 if an error occurred or 1 otherwise.

COMMENTS You should never use this function in place of **fsel_exinput()** when **fsel_exinput()** is available.

SEE ALSO **fsel_exinput()**

Graphics Library

The *Graphics Library* provides applications with a variety of utility functions which serve to provide common screen effects, mouse control, and the obtaining of basic screen attributes. The functions of the *Graphics Library* are as follows:

- **graf_dragbox()**
- **graf_growbox()**
- **graf_handle()**
- **graf_mkstate()**
- **graf_mouse()**
- **graf_movebox()**
- **graf_rubberbox()**
- **graf_shrinkbox()**
- **graf_slidebox()**
- **graf_watchbox()**

graf_dragbox()

WORD graf_dragbox(*w, h, sx, sy, bx, by, bw, bh, endx, endy*)
WORD *w, h, sx, sy, bx, by, bw, bh*;
WORD **endx, **endy*;

graf_dragbox() allows the user to move a box frame within the constraints of a bounding rectangle. This call is most often used to give the user a visual 'clue' when an object is being moved on screen.

OPCODE 71 (0x47)

AVAILABILITY All **AES** versions.

PARAMETERS *w* and *h* specify the initial width and height of the box to draw. *sx* and *sy* specify the starting *x* and *y* screen coordinates.

bx, *by*, *bw*, and *bh*, give the coordinates of the bounding rectangle.

endx and *endy* are **WORD** pointers which, on function exit, will be filled in with the ending x and y position of the box.

BINDING

```
intin[0] = w;
intin[1] = h;
intin[2] = sx;
intin[3] = sy;
intin[4] = bx;
intin[5] = by;
intin[6] = bw;
intin[7] = bh;

crys_if(0x47);

*endx = intout[1];
*endy = intout[2];

return intout[0];
```

RETURN VALUE **graf_dragbox()** returns a 0 if an error occurred during execution or greater than zero otherwise.

COMMENTS This call should be made only when the mouse button is depressed. The call returns when the mouse button is released.

SEE ALSO **graf_slidebox()**

graf_growbox()

WORD graf_growbox(*x1, y1, w1, h1, x2, y2, w2, h2*)
WORD *x1, y1, w2, h2, x2, y2, w2, h2*;

graf_growbox() is used to provide a visual 'clue' to a user by animating an outline of a box from one set of coordinates to another. It is the complement function to **graf_shrinkbox()**.

OPCODE 73 (0x49)

AVAILABILITY All **AES** versions.

PARAMETERS *x1*, *y1*, *w1*, and *h1* are the screen coordinates of the starting rectangle (where the outline will grow from).

x2, *y2*, *w2*, and *h2* are the screen coordinates of the ending rectangle (where the outline will grow to).

BINDING

```
intin[0] = x1;
intin[1] = y1;
intin[2] = w1;
intin[3] = h1;
intin[4] = x2;
intin[5] = y2;
intin[6] = w2;
intin[7] = h2;

return crys_if(0x49);
```

RETURN VALUE **graf_growbox()** returns 0 if an error occured or non-zero otherwise.

CAVEATS There is currently no defined method of handling an error generated by this function.

COMMENTS This function is what is called by **GEM**'s **form_dial(FMD_GROW**,...

SEE ALSO **form_dial(), graf_shrinkbox()**

graf_handle()

WORD graf_handle(*wcell, hcell, wbox, hbox*);
WORD **wcell, *hcell, *wbox, *hbox*;

graf_handle() returns important information regarding the physical workstation

currently in use by the **AES**.

OPCODE 77 (0x4D)

AVAILABILITY All **AES** versions.

PARAMETERS *wcell* and *hcell* are **WORD** pointers which on function exit will be filled in with the width and height, respectively, of the current system character set.

wbox and *hbox* are **WORD** pointers which on function exit will be filled in with the width and height, respectively, of the minimum bounding box of a **BOXCHAR** character.

BINDING

```
crys_if(0x4D);

*charw = intout[1];
*charh = intout[2];
*boxw = intout[3];
*boxh = intout[4];

return intout[0];
```

RETURN VALUE This function returns the **VDI** handle for the current physical workstation used by the **AES**.

CAVEATS There is currently no defined method of handling an error generated by this function.

COMMENTS The return value of this function is required to open a virtual screen workstation.

SEE ALSO **v_opnvwk()**

graf_mkstate()

WORD graf_mkstate(*mx, my, mb, ks*)
WORD **mx, *my, *mb, *ks*;

graf_mkstate() returns information about the current state of the mouse pointer, buttons, and keyboard shift-key state.

OPCODE 79 (0x4F)

AVAILABILITY All **AES** versions.

PARAMETERS *mx* and my are **WORD** pointers, which, on function exit will be filled in with the current x and y coordinates of the mouse pointer. *mb* is a **WORD** pointer, which,

on function exit will be filled in with the current button state of the mouse as defined in **evnt_button()**.

BINDING

```
crys_if(0x4F);

*mx = intout[1];
*my = intout[2];
*mb = intout[3];
*ks = intout[4];

return intout[0];
```

RETURN VALUE The function return is currently reserved and currently equals 1.

SEE ALSO **evnt_button()**, **vq_mouse()**

graf_mouse()

WORD graf_mouse(*mode*, *formptr*)
WORD *mode*;
VOIDP *formptr*;

graf_mouse() alters the appearance of the mouse form and can be used to hide and display the mouse pointer from the screen.

OPCODE 78 (0x4E)

AVAILABILITY All **AES** versions.

PARAMETERS *mode* is defined as follows:

mode	#	Meaning	Shape
ARROW	0	Change the current mouse cursor shape.	
TEXT_CRSR	1	Change the current mouse cursor shape.	
BUSY_BEE	2	Change the current mouse cursor shape.	
POINT_HAND	3	Change the current mouse cursor shape.	

FLAT_HAND	4	Change the current mouse cursor shape.	
THIN_CROSS	5	Change the current mouse cursor shape.	
THICK_CROSS	6	Change the current mouse cursor shape.	
OUTLN_CROSS	7	Change the current mouse cursor shape.	
USER_DEF	255	Change the current mouse cursor shape.	Form is defined below.
M_OFF	256	Remove the mouse cursor from the screen.	No shape change.
M_ON	257	Display the mouse cursor.	No shape change.
M_SAVE	258	Save the current mouse form in an **AES** provided buffer. Check **appl_getinfo()** for the presence of this feature.	No shape change.
M_LAST	259	Restore the most recently saved mouse form. Check **appl_getinfo()** for the presence of this feature.	Changes the shape as indicated.
M_RESTORE	260	Restore the mouse form to its last shape. Check **appl_getinfo()** for the presence of this feature.	Changes the shape as indicated.

If *mode* is equal to **USER_DEF**, *formptr* must point to a **MFORM** structure as defined below (if *mode* is different than **USER_DEF**, *formptr* should be **NULL**):

```
typedef struct {
       short mf_xhot;
       short mf_yhot;
       short mf_nplanes;
       short mf_fg;
       short mf_bg;
       short mf_mask[16];
       short mf_data[16];
} MFORM;
```

mf_xhot and *mf_yhot* are the location of the mouse 'hot-spot'. These values should be in the range 0 to 15 and define what offset into the bitmap is actually the 'point'.

mf_nplanes specifies the number of bit-planes used by the mouse pointer. Currently, the value of 1 is the only legal value.

mf_fg and *mf_bg* are the mask and data colors of the mouse specified as palette

indexes. Usually these values will be 0 and 1 respectively.

mf_mask is an array of 16 **WORD'**s which define the mask portion of the mouse form. *mf_data* is an array of 16 **WORD'**s which define the data portion of the mouse form.

As of **AES** 4.0 and beyond, the **AES** may not allow a mouse form to change to benefit another application. If it is absolutely necessary for the application to display its mouse form, logically OR the mode parameter with **M_FORCE** (0x8000) and make the call.

This will force the **AES** to change to your mouse form. It should, however, be done within the scope of a **wind_update()** sequence.

BINDING

```
intin[0] = mode;

addrin[0] = formptr;

return crys_if(0x4E);
```

RETURN VALUE **graf_mouse()** returns a 0 if an error occurred or non-zero otherwise.

CAVEATS There is currently no defined method of handling an error generated by this function.

SEE ALSO **vsc_form()**

graf_movebox()

WORD graf_movebox(*bw, bh, sx, sy, ex, ey*)
WORD *bw, bh, sx, sy, ex, ey*;

graf_movebox() animates a moving box between two points on the screen. It is used to give the user a visual 'clue' to an action undertaken by the application.

OPCODE 72 (0x48)

AVAILABILITY All **AES** versions.

PARAMETERS *bw* and *bh* specify the width and height, respectively, of the box to animate. *sx* and *sy* specify the starting coordinates of the box. *ex* and *ey* specify the ending coordinates of the box.

BINDING

```
intin[0] = bw;
intin[1] = bh;
intin[2] = sx;
```

```
intin[3] = sy;
intin[4] = ex;
intin[5] = ey;

return crys_if(0x48);
```

RETURN VALUE The return value is 0 if an error occured or non-zero otherwise.

CAVEATS There is currently no defined method for handling an error generated by this call.

COMMENTS Some older 'C' bindings referred to this call as **graf_mbox()**. If your compiler still uses this call you should update it.

graf_rubberbox()

WORD graf_rubberbox(***bx, by, minw, minh, endw, endh*** **)**
WORD ***bx, by, minw, minh*****;**
WORD ****endw, *endh*****;**

graf_rubberbox() allows the user to change the size of a box outline with a fixed starting point.

OPCODE 70 (0x46)

AVAILABILITY All **AES** versions.

PARAMETERS *bx* and *by* define the fixed upper-left corner of the box to stretch or shrink.

minw and *minh* specify the minimum width and height that the rectangle can be shrunk to.

endw and *endh* are **WORD** pointers which will be filled in with the ending width and height of the box when the mouse button is released.

BINDING

```
intin[0] = bx;
intin[1] = by;
intin[2] = minw;
intin[3] = minh;

crys_if(0x46);

*endw = intout[1];
*endh = intout[2];

return intout[0];
```

RETURN VALUE **graf_rubberbox()** returns 0 if an error occurred or non-zero otherwise.

CAVEATS There is currently no defined method for handling an error generated by this call.

COMMENTS This function should only be entered when the user has depressed the mouse button as it returns when the mouse button is released.

SEE ALSO **graf_dragbox(), graf_slidebox()**

graf_shrinkbox()

WORD graf_shrinkbox(***x1, y1, w1, h1, x2, y2, w2, h2*** **)**
WORD ***x1, y1, w1, h1, x2, y2, w2, h2*****;**

graf_shrinkbox() displays an animated box shrinking from one rectangle to another. It should be used to provide the user with a visual 'clue' to an action. It is the complement function to **graf_growbox()**.

OPCODE 74 (0x4A)

AVAILABILITY All **AES** versions.

PARAMETERS *x1*, *y1*, *w1*, and *h1* are the coordinates of the rectangle to shrink to.

x2, *y2*, *w2*, and *h2* are the coordinates of the rectangle to shrink from.

BINDING

```
intin[0] = x1;
intin[1] = y1;
intin[2] = w1;
intin[3] = h1;
intin[4] = x2;
intin[5] = y2;
intin[6] = w2;
intin[7] = h2;

return crys_if(0x4A);
```

RETURN VALUE The function returns 0 if an error occurred or non-zero otherwise

CAVEATS There is currently no defined method of handling an error from this call.

COMMENTS This function is essentially the same as **form_dial(FMD_SHRINK**,...

SEE ALSO **form_dial(), graf_growbox()**

graf_slidebox()

WORD graf_slidebox(***tree, parent, obj, orient*** **)**
OBJECT * ***tree*****;**
WORD ***parent, obj,orient*****;**

graf_slidebox() allows the user to slide a child object within the bounds of its parent. It is often used to implement slider controls.

OPCODE 76 (0x4C)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* is pointer to the object tree containing the child and parent objects.

parent is the object index of an object which bounds the movement of the child. *child* is the object index of the object which can be moved within the bounds of *parent*.

orient specifies the orientation of the allowed movement. 0 is horizontal (left-right), 1 is vertical (up-down).

BINDING

```
intin[0] = parent;
intin[1] = child;
intin[2] = orient;

addrin[0] = tree;

return crys_if(0x4C);
```

RETURN VALUE The function returns a value specifying the relative offset of the child within the parent as a number between 0 and 1000.

COMMENTS This call can be used easily with sliders built into dialogs by making the slider bar a **TOUCHEXIT** and calling this function when it is clicked. This call should only be made when the mouse button is depressed as it returns when it is released.

SEE ALSO **graf_movebox()**

graf_watchbox()

WORD graf_watchbox(***tree, obj, instate, outstate*** **)**
OBJECT * ***tree*****;**
WORD ***obj, instate, outstate*****;**

graf_watchbox() modifies the given state of a specified object depending on whether the pointer is within the bounds of the object or outside the bounds of the object as long as the left mouse button is held down.

OPCODE 75 (0x4B)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* is a pointer to the **ROOT** object of the tree which contains the object you wish to watch. *obj* is the object index of the object to watch.

instate is the *ob_state* (see **objc_change()**) to apply while the mouse is inside of the bounds of the object.
outstate is the *ob_state* to apply while the mouse is outside of the bounds of the object.

BINDING

```
intin[0] = obj;
intin[1] = instate;
intin[2] = outstate;

addrin[0] = tree;

return crys_if(0x4B);
```

RETURN VALUE **graf_watchbox()** returns a 0 if the mouse button was released outside of the object or a 1 if the button was released inside of the object.

COMMENTS As this call returns when the mouse button is released, it should only be made when the mouse button is depressed. This call is used internally by **form_button()** and **form_do()** and is usually only necessary if you are replacing one of these handlers.

SEE ALSO **form_button()**

Menu Library

The *Menu Library* assists in the handling of system menu bars and popup menus. In addition, individual control of menu items can also be handled through these functions. The members of the *Menu Library* are:

- **menu_attach()**
- **menu_bar()**
- **menu_icheck()**
- **menu_ienable()**
- **menu_istart**
- **menu_popup()**
- **menu_register()**
- **menu_settings()**
- **menu_text()**
- **menu_tnormal()**

menu_attach()

WORD menu_attach(*flag, tree, item, mdata*)
WORD *flag*;
OBJECT **tree*;
WORD *item*;
MENU **mdata*;

menu_attach() allows an application to attach, change, or remove a sub-menu. It also allows the application to inquire information regarding a currently defined sub-menu.

OPCODE

37 (0x25)

AVAILABILITY

This function is only available from **AES** version 3.30 and above. In **AES** versions 4.0 and greater, **appl_getinfo()** should be used to determine its exact functionality.

PARAMETERS

flag indicates the action the application desires as follows:

#	Define	Meaning
0	**ME_INQUIRE**	Return information on a sub-menu attached to the menu item designated by *tree* and *item* in *mdata*.
1	**ME_ATTACH**	Attach or change a sub-menu. *mdata* should be initialized by the application. *tree* and *item* should be the **OBJECT** pointer and index to the menu which is to have the sub-menu attached. If *mdata* is **NULLPTR**, any sub-menu attached will be removed.
2	**ME_REMOVE**	Remove a sub-menu. *tree* and *item* should be the **OBJECT** pointer and index to the menu item which a sub-menu was attached to. *mdata* should be **NULLPTR**.

In all cases except **ME_REMOVE**, *mdata* should point to a **MENU** structure as defined here:

```
typedef struct
{
       OBJECT    *mn_tree;
       WORD      mn_menu;
       WORD      mn_item;
       WORD      mn_scroll;
       WORD      mn_keystate;
} MENU;
```

The **MENU** structure members are defined as follows:

Member	Meaning
mn_tree	Points to the **OBJECT** tree of the sub-menu.
mn_menu	Is an index to the parent object of the menu items.
mn_item	Is the starting menu item.
mn_scroll	If **SCROLL_NO** (0), the menu will not scroll. If **SCROLL_YES** (1), and the number of menu items exceed the menu scroll height, arrows will appear which allow the user to scroll selections.
mn_keystate	This member is unused and should be 0 for this call.

BINDING

```
intin[0] = flag;
intin[1] = item;

addrin[0] = tree;
addrin[1] = mdata;

return crys_if(0x25);
```

RETURN VALUE

menu_attach() returns 0 if an error occurred and the sub-menu could not be attached or 1 if the operation was successful.

CAVEATS

AES versions supporting **menu_attach()** less than 4.1 contain a bug which causes the **AES** to crash when changing or removing a sub-menu attachment.

At present, if you wish to attach a scrolling menu, the menu items must be **G_STRING'**s.

COMMENTS

If a menu bar having attachments is removed with **menu_bar**(**NULL**, **MENU_REMOVE**) those attachments are removed by the system and must be reattached with this call if the menu is redisplayed at a later time.

Several recommendations regarding sub-menus should be adhered to:

1. Menu items which will have sub-menus attached to them should be padded with blanks to the end of the menu.
2. Menu items which will have sub-menus attached to them should not have a keyboard equivalent.
3. Sub-menus will display faster if a byte-boundary is specified.
4. Sub-menus will be shifted vertically to align the start object with the main menu item which it is attached to.
5. Sub-menus will always be adjusted to automatically fit on the screen.
6. There can be a maximum of 64 sub-menu attachments per process (attaching a sub-menu to more than one menu item counts as only one attachment).
7. Do not attach a sub-menu to itself.
8. As a user-interface guideline, there should only be one level of sub-menus, though it is possible to have up to four levels currently.
9. **menu_istart()** works only on sub-menus attached with **menu_attach()**.

SEE ALSO **menu_istart()**, **menu_settings()**, **menu_popup()**

menu_bar()

WORD menu_bar(*tree*, *mode*)
OBJECT **tree*;
WORD *mode*;

menu_bar() displays a specialized **OBJECT** tree on the screen as the application menu. It can also be used to determine the owner of the currently displayed menu bar in a multitasking **AES**.

OPCODE 30 (0x1E)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* is a pointer to an **OBJECT** tree which has been formatted for use as a system menu (for more information on the **OBJECT** format of a menu see the discussion on objects in this chapter).

mode is a flag indicating the action to take as follows:

Name	*mode*	Meaning
MENU_REMOVE	0	Erase the menu bar specified in *tree*.
MENU_INSTALL	1	Display the menu bar specified in *tree*.
MENU_INQUIRE	-1	Return the **AES** application identifier of the process which owns the currently displayed system menu. *tree* can be set to **NULL**. The **AES** version must be greater than 4.0 and **appl_getinfo()** must indicate that this is feature is supported.

BINDING

```
intin[0] = mode;

addrin[0] = tree;

return crys_if(0x1E);
```

RETURN VALUE If *mode* is **MENU_REMOVE** (0) or **MENU_INSTALL** (1), the return value indicates an error condition where >0 means no error and 0 means an error occurred. In inquiry mode (*mode* = **MENU_INQUIRE** (-1)), **menu_bar()** returns the application identified of the process which owns the currently displayed menu bar.

COMMENTS The safest way to redraw an application's menu bar is to redraw it only if you are

sure it is currently the active menu bar. In a non-multitasking **AES**, this is a certainty, however, in a multitasking **AES** you should first inquire the menu bar's owner within the scope of a **wind_update(BEG_UPDATE)** call to prevent the system from swapping active menu bars while in the process of redrawing.

SEE ALSO **menu_ienable()**, **menu_icheck()**

menu_icheck()

WORD menu_icheck(*tree, obj, check*)
OBJECT **tree*;
WORD *obj, check*;

menu_icheck() adds/removes a checkmark in front of a menu item.

OPCODE 31 (0x1F)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree of the current menu. *obj* should be the object index of a menu item. If *check* is **UNCHECK** (0), no checkmark will be displayed next to this item whereas if *check* is **CHECK** (1), a checkmark will be displayed.

BINDING

```
intin[0] = obj;
intin[1] = check;

addrin[0] = obj;

return crys_if(0x1F);
```

RETURN VALUE **menu_icheck()** returns 0 if an error occurred or non-zero otherwise.

SEE ALSO **objc_change()**

menu_ienable()

WORD menu_ienable(*tree, obj, flag*)
OBJECT **tree*;
WORD *obj, flag*;

menu_ienable() enables/disables menu items.

OPCODE 32 (0x20)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree of the menu to alter. *obj* is the object index of the menu item to modify. *flag* should be set to **DISABLE** (0) to disable the item or **ENABLE** (1) to enable it.

BINDING

```
intin[0] = obj;
intin[1] = flag;

addrin[0] = tree;

return crys_if(0x20);
```

RETURN VALUE **menu_icheck()** returns 0 if an error occurred or non-zero otherwise.

SEE ALSO **objc_change()**

menu_istart()

WORD menu_istart(***flag, tree, imenu, item*** **)**
WORD ***flag*****;**
OBJECT ****tree***;**
WORD ***imenu, item*****;**

menu_istart() shifts a sub-menu that is attached to a menu item to align vertically with the specified object in the sub-menu.

OPCODE 38 (0x26)

AVAILABILITY This function is only available with **AES** versions 3.30 and above.

PARAMETERS *flag* should be set to **MIS_SETALIGN** (1) to modify the alignment of a sub-menu and its parent menu item. If *flag* is set to **MIS_GETALIGN** (0), no modifications will be made, however the sub-menu item index which is currently aligned with its parent menu item is returned.

tree points to the object tree of the menu to alter. *imenu* specifies the object within the submenu which will be aligned with menu item *item*.

BINDING

```
intin[0] = flag;
intin[1] = imenu;
intin[2] = item;

addrin[0] = tree;

return crys_if(0x26);
```

RETURN VALUE **menu_istart()** returns 0 if an error occurred or the positive object index of the sub-menu item which is currently aligned with its parent menu item.

COMMENTS Generally, a sub-menu is aligned so that the currently selected sub-menu item is aligned with its parent menu.

SEE ALSO **menu_attach()**

menu_popup()

WORD menu_popup(***menu, xpos, ypos, mdata*** **)**
MENU * ***menu*****;**
WORD ***xpos, ypos*****;**
MENU * ***menu*****;**

menu_popup() displays a popup menu and returns the user's selection.

OPCODE 36 (0x24)

AVAILABILITY This function is only available with **AES** versions 3.30 and above.

PARAMETERS *menu* points to a **MENU** structure (defined under **menu_attach()**) containing the popup menu. *xpos* and *ypos* specify the location at which the upper-left corner of the starting object will be placed.

If the function returns a value of 1, the **MENU** structure pointed to by *mdata* will be filled in with the ending state of the menu (including the object the user selected).

As of **AES** version 4.1, if *menu.mn_scroll* is set to **SCROLL_LISTBOX** (-1) when this function is called, a drop-down list box will be displayed instead of a popup menu.

Drop-down list boxes will only display a scroll bar if at least eight entries exist. If you want to force the scroll bar to appear, pad the object with empty **G_STRING** objects with their **DISABLED** flag set.

BINDING

```
intin[0] = xpos;
intin[1] = ypos;

addrin[0] = menu;
addrin[1] = mdata;

return crys_if(0x24);
```

RETURN VALUE **menu_popup()** returns 0 if an error occurred or 1 if successful.

SEE ALSO **menu_attach(), menu_settings()**

menu_register()

WORD menu_register(*ap_id, title*)
WORD *ap_id*;
char ***title*;

menu_register() registers desk accessories in the 'Desk' menu and renames **MultiTOS** applications which appear there.

OPCODE 35 (0x23)

AVAILABILITY All **AES** versions.

PARAMETERS *ap_id* specifies the application identifier of the application to register. *title* points to a **NULL**-terminated string containing the title which is to appear in the 'Desk' menu for the accessory or application.

If *ap_id* is set to **REG_NEWNAME** (-1) then the process name given in *title* will be used as the new process name. The new process name should be exactly eight characters terminated with a **NULL**. Pad the string with space characters if necessary.

BINDING

```
intin[0] = ap_id;

addrin[0] = title;

return crys_if(0x23);
```

RETURN VALUE **menu_register()** returns a -1 if an error occurred or the menu identifier otherwise.

VERSION NOTES Applications other than desk accessories should not call this function unless they are running under **MultiTOS**.

COMMENTS Desk accessories should store the return value as this is the value that will be included with future **AC_OPEN** messages to identify the accessory.

Applications running under **MultiTOS** may use this function to provide a more functional title for the 'Desk' menu than the program's filename.

Calling **menu_register()** with a parameter of **REG_NEWNAME** is used to change the internal process name of the application returned by **appl_find()** and **appl_search()**. This is useful if you know another process will attempt to find your

application as a specific process name and the user may have renamed your application filename (normally used as the process name).

menu_settings()

WORD menu_settings(*flag*, *set*)
WORD *flag*;
MN_SET **set*;

menu_settings() changes the global settings for popup and scrollable menus.

OPCODE 39 (0x27)

AVAILABILITY This function is only available with **AES** versions 3.30 and above.

PARAMETERS If *flag* is 0, current settings are read into the **MN_SET** structure pointed to by *set*. If *flag* is 1, current settings are set from the **MN_SET** structure pointed to by *set*. **MN_SET** is defined as follows:

```
typedef struct
{
       /* Submenu-display delay in milliseconds */
       LONG display;

       /* Submenu-drag delay in milliseconds */
       LONG drag;

       /* Single-click scroll delay in milliseconds*/
       LONG delay;

       /* Continuous-scroll delay in milliseconds */
       LONG speed;

       /* Menu scroll height (in items) */
       WORD height;
} MN_SET;
```

BINDING

```
intin[0] = flag;

addrin[0] = set;

return crys_if(0x27);
```

RETURN VALUE **menu_settings()** always returns 1.

COMMENTS The defaults set by **menu_settings()** are global and not local to an application. You should therefore limit your use of this function to system applications like CPX's and so forth.

menu_text()

WORD menu_text(*tree, obj, text*)
OBJECT *tree;
WORD *obj;
char *text;

menu_text() changes the text of a menu item.

OPCODE 34 (0x22)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree of the menu bar. *obj* specifies the object index of the menu item to change. *text* points to a **NULL**-terminated character string containing the new text.

BINDING

```
intin[0] = obj;

addrin[0] = tree;
addrin[1] = text;

return crys_if(0x22);
```

RETURN VALUE **menu_text()** returns a 0 if an error occurred or non-zero otherwise.

COMMENTS The new menu item text must be no larger than the original menu item text.

menu_tnormal()

WORD menu_tnormal(*tree, obj, flag*)
OBJECT *tree;
WORD *obj, flag;

menu_tnormal() highlights/un-highlights a menu-title.

OPCODE 33 (0x21)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree of the menu. *obj* specifies the object index of the title to change. *flag* should be set to **HIGHLIGHT** (0) to display the title in reverse (highlighted) or **UNHIGHLIGHT** (1) to display it normally.

BINDING

```
intin[0] = obj
intin[1] = flag

addrin[1] = tree

return crys_if(0x21);
```

RETURN VALUE

menu_tnormal() returns 0 if an error occurred or non-zero otherwise.

COMMENTS

This call is usually called by an application after a **MN_SELECTED** message is received and processed to return the menu title to normal.

Object Library

The *Object Library* is responsible for the drawing and manipulation of **AES** objects such as boxes, strings, icons, etc. See earlier in this chapter for a complete discussion of **AES** objects. The *Object Library* includes the following functions:

- **objc_add()**
- **objc_change()**
- **objc_delete()**
- **objc_draw()**
- **objc_edit()**
- **objc_find()**
- **objc_offset()**
- **objc_order()**
- **objc_sysvar()**

objc_add()

WORD objc_add(*tree, parent, child*)
OBJECT ****tree***;**
WORD *parent, child*;

objc_add() establishes a child object's relationship to its parent.

OPCODE 40 (0x28)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree to modify. *parent* and *child* specify the parent and child object to update.

BINDING

```
intin[0] = parent;
intin[1] = child;

addrin[0] = tree;

return crys_if(0x28);
```

RETURN VALUE **objc_add()** returns a 0 if an error occurred or non-zero otherwise.

COMMENTS In order for this function to work, the object to be added must be already be a member of the **OBJECT** array. This function simply updates the *ob_next*, *ob_head*, and *ob_tail* structure members of **OBJECT**s in the object tree. These fields should be initialized to **NIL** (0) in the child to be added.

SEE ALSO **objc_order(), objc_delete()**

objc_change()

WORD objc_change(*tree, obj, rsvd, ox, oy, ow, oh, newstate, drawflag*)
OBJECT ****tree***;**
WORD *obj, rsvd, ox, oy, ow, oh, newstate, drawflag*;

objc_change() changes the display state of an object.

OPCODE 47 (0x2F)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree of the object to modify. *obj* specifies the object to

modify.

rsvd is reserved and should be 0.

ox, *oy*, *ow*, and *oh* specify the clipping rectangle if the object is to be redrawn.

newstate specifies the new state of the object (same as *ob_state*).

If *drawflag* is **NO_DRAW** (0) the object is not redrawn whereas if *drawflag* is **REDRAW** (1) the object is redrawn.

BINDING

```
intin[0] = obj;
intin[1] = rsvd;
intin[2] = ox;
intin[3] = oy;
intin[4] = ow;
intin[5] = oh;
intin[6] = newstate;
intin[7] = drawflag;

addrin[0] = tree;

return crys_if(0x2F);
```

RETURN VALUE **objc_change()** returns 0 if an error occurred and non-zero otherwise.

COMMENTS In general, if not redrawing the object, it is usually quicker to manipulate the object tree directly.

SEE ALSO **objc_draw()**

objc_delete()

WORD objc_delete(*tree*, *obj*)
OBJECT **tree*;
WORD *obj*;

objc_delete() removes an object from an object tree.

OPCODE 41 (0x29)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree of the object to delete. *obj* is the object to be deleted.

BINDING

```
intin[0] = obj;

addrin[0] = tree;
```

```
return crys_if(0x29);
```

RETURN VALUE **objc_delete()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS This function does not move other objects in the tree structure, it simply unlinks the specified object from the object chain by updating the other object's *ob_next*, *ob_head*, and *ob_tail* structure members.

SEE ALSO **objc_add()**

objc_draw()

WORD objc_draw(*tree, obj, depth, ox, oy, ow, oh*)
OBJECT **tree*;
WORD *obj, depth, ox, oy, ow, oh*;

objc_draw() renders an **AES** object tree on screen.

OPCODE 42 (0x2A)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree to draw. *obj* specifies the object index at which drawing is to begin.

depth specifies the maximum object depth to draw (a value of 1 searches only first generation objects, a value of 2 searches up to second generation objects, up to a maximum of 7 to search all objects).

ox, *oy*, *ow*, and *oh* specify an **AES** style rectangle which defines the clip rectangle to enforce during drawing.

BINDING

```
intin[0] = obj;
intin[1] = depth;
intin[2] = ox;
intin[3] = oy;
intin[4] = ow;
intin[5] = oh;

addrin[0] = tree;

return crys_if(0x2A);
```

RETURN VALUE **objc_draw()** returns 0 if an error occurred or non-zero otherwise.

objc_edit()

WORD objc_edit(*tree, obj, kc, idx, mode*)
OBJECT ****tree***;**
WORD *obj, kc;*
WORD ****idx*
WORD *mode;*

objc_edit() allows manual control of an editable text field.

OPCODE 46 (0x2E)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree containing the editable object *obj* to modify. mode specifies the action of the call and the meaning of the other parameters as follows:

mode	Value	Meaning
ED_START	0	Reserved for future use. Do not call.
ED_INIT	1	Display the edit cursor in the object specified. *kc* is ignored. The **WORD** pointed to by *idx* is filled in with the current index of the edit cursor in the field.
ED_CHAR	2	A key has been pressed that needs special processing. *kc* contains the keyboard scan code in the high byte and ASCII code in the low byte. *idx* points to the current index of the text cursor in the field. *idx* will be updated as a result of this call.
ED_END	3	Turn off the text cursor.

BINDING

```
intin[0] = obj;
intin[1] = kc;
intin[2] = *idx;
intin[3] = mode;

addrin[0] = tree;

crys_if(0x2E);

*idx = intout[1];
return intout[0];
```

RETURN VALUE **objc_edit()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS This function is usually used in conjunction with **form_keybd()** in a custom **form_do()** handler.

SEE ALSO **form_keybd()**

objc_find()

WORD objc_find(*tree, obj, depth, ox, oy*)
OBJECT *tree;
WORD *obj, depth, ox, oy;

objc_find() determines which object is found at a given coordinate.

OPCODE 43 (0x2B)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree containing the objects to search. The search starts from object index *obj* forward in the object tree.

depth specifies the depth in the tree to search (a value of 1 searches only first generation objects, a value of 2 searches up to second generation objects, up to a maximum of 7 to search all objects).

ox and *oy* specify the coordinate to search at.

BINDING

```
intin[0] = obj;
intin[1] = depth;
intin[2] = ox;
intin[3] = oy;

addrin[0] = tree;

return crys_if(0x2B);
```

RETURN VALUE **objc_find()** returns the object index of the object found at coordinates (*ox*, *oy*) or -1 if no object is found.

objc_offset()

WORD objc_offset(*tree, obj, ox, oy*)
OBJECT *tree;
WORD *obj;
WORD *ox, *oy;

objc_offset() calculates the true screen coordinates of an object.

OPCODE 44 (0x2C)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree containing *obj*. The **WORD**s pointed to by *ox* and *oy* will be filled in with the true X and Y screen position of object *obj*.

BINDING

```
intin[0] = obj;

addrin[0] = tree;

crys_if(0x2C);

*ox = intout[1];
*oy = intout[2];

return intout[0];
```

RETURN VALUE **objc_offset()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS The *ob_x* and *ob_y* structure members of objects give an offset from their parent as opposed to true screen location. This call is used to determine a true screen coordinate.

The values returned by **objc_offset()** coupled with the *ob_width* and *ob_height* members do not take into account negative borders, shadowing, or sculpturing. When redrawing an object you are responsible for using these values to and the object's state to compensate for a correct clipping rectangle.

SEE ALSO **objc_draw()**

objc_order()

WORD objc_order(***tree, obj, pos*** **)**
OBJECT **tree*;
WORD ***obj, pos*;**

objc_order() changes the position of an object relative to other child objects of the same parent.

OPCODE 45 (0x2D)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the object tree of object *obj* which is to be moved. *pos* specifies the new position of the object as follows:

Name	*pos*	Meaning
OO_LAST	-1	Make object the last child.
OO_FIRST	0	Make object the first child.
—	1	Make object the second child.
—	2–	etc...

BINDING

```
intin[0] = obj;
intin[1] = pos;

addrin[0] = tree;

return crys_if(0x2D);
```

RETURN VALUE **objc_order()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS **objc_order()** does not actually move structure elements in memory. It works by updating the **OBJECT** tree's *ob_head*, *ob_tail*, and *ob_next* fields to 'move' the **OBJECT** in the tree hierarchy.

objc_sysvar()

WORD objc_sysvar(*mode, which, in1, in2, out1, out2*)
WORD *mode, which, in1, in2*;
WORD **out1, *out2*;

objc_sysvar() returns/modifies information about the color and placement of 3D object effects.

OPCODE 48 (0x30)

AVAILABILITY Available as of **AES** version 3.40.

PARAMETERS *mode* determines whether attributes should be read or modified. A value of **SV_INQUIRE** (0) will read the current values whereas a value of **SV_SET** (1) will modify the current values. *which* determines what attribute you wish to read or modify.

When reading values, *in1* and *in2* are unused. The two return values are placed in the **WORD**s pointed to by *out1* and *out2*. When modifying values, *out1* and *out2* are unused. *in1* and *in2* specify the new values for the attribute.

The meanings of the two input/output values referred to as val1 and val2 are as follows:

Name	*which*	Values
LK3DIND	1	If val1 is 1, the text of indicator objects does move when selected, otherwise, if 0, it does not. If val2 is 1, the color of indicator objects does change when selected, otherwise, if 0, it does not.
LK3DACT	2	Same as **LK3DIND** for activator objects.
INDBUTCOL	3	val1 specifies the default color for indicator objects. val2 is unused.
ACTBUTCOL	4	val1 specifies the default color for activator objects. val2 is unused.
BACKGRCOL	5	val1 specifies the default color for background objects. val2 is unused.
AD3DVAL	6	val1 specifies the number of extra pixels on each horizontal side of an indicator or activator object needed to accomodate 3D effects. val2 specifies the number of extra pixels on each vertical side of an indicator or activator object needed to accomodate 3D effects. This setting may only be read, not modified.

BINDING

```
intin[0] = mode;
intin[1] = which;
intin[2] = in1;
intin[3] = in2;

crys_if(0x30);

*out1 = intout[1];
*out2 = intout[2];

return intout[0];
```

RETURN VALUE **objc_sysvar()** returns 0 if unsuccessful or non-zero otherwise.

COMMENTS Applications should not use **objc_sysvar()** to change these settings since all changes are global. Only **CPX**s or Desk Accessories designed to modify these parameters should.

Resource Library

The *Resource Library* is responsibe for the loading/unloading of resource files and the manipulation of resource objects in memory. The members of the *Resource Library* are:

- **rsrc_free()**
- **rsrc_gaddr()**
- **rsrc_load()**
- **rsrc_obfix()**
- **rsrc_rcfix()**
- **rsrc_saddr()**

rsrc_free()

WORD rsrc_free(VOID)

rsrc_free() releases memory allocated by **rsrc_load()** for an application's resource.

OPCODE 111 (0x6F)

AVAILABILITY All **AES** versions.

BINDING

```
return crys_if(0x6F);
```

RETURN VALUE **rsrc_free()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS **rsrc_free()** should be called before an application which loaded a resource using **rsrc_load()** exits.

SEE ALSO **rsrc_load()**

rsrc_gaddr()

WORD rsrc_gaddr(*type, index, addr*)
WORD *type, index*;
VOIDPP *addr*;

rsrc_gaddr() returns the address of an object loaded with **rsrc_load()**.

OPCODE 112 (0x70)

AVAILABILITY All **AES** versions.

PARAMETERS The pointer pointed to by *addr* will be filled in with the address of the *index*th resource object of type *type*. Valid values for *type* are as follows:

Name	*type*	Resource Object
R_TREE	0	Object tree
R_OBJECT	1	Individual object
R_TEDINFO	2	**TEDINFO** structure
R_ICONBLK	3	**ICONBLK** structure
R_BITBLK	4	**BITBLK** structure
R_STRING	5	Free String data

R_IMAGEDATA	6	Free Image data
R_OBSPEC	7	*ob_spec* field within **OBJECT**s
R_TEPTEXT	8	*te_ptext* within **TEDINFO**s
R_TEPTMPLT	9	*te_ptmplt* within **TEDINFO**s
R_TEPVALID	10	*te_pvalid* within **TEDINFO**s
R_IBPMASK	11	*ib_pmask* within **ICONBLK**s
R_IBPDATA	12	*ib_pdata* within **ICONBLK**s
R_IBPTEXT	13	*ib_ptext* within **ICONBLK**s
R_BIPDATA	14	*bi_pdata* within **BITBLK**s
R_FRSTR	15	Free string
R_FRIMG	16	Free image

BINDING

```
intin[0] = type;
intin[1] = index;

crys_if(0x70);

*addr = addrout[0];

return intout[0];
```

RETURN VALUE **rsrc_gaddr()** returns a 0 if the address in *addr* is valid or non-zero if the object did not exist.

COMMENTS This function is most often used to obtain the address of **OBJECT** trees, 'free' strings, and 'free' images after loading a resource file.

SEE ALSO **rsrc_saddr()**

rsrc_load()

WORD rsrc_load(*fname*)
char *_fname_;

rsrc_load() loads and allocates memory for the named resource file.

OPCODE 110 (0x6E)

AVAILABILITY All **AES** versions.

PARAMETERS *fname* is a character pointer to a **NULL**-terminated **GEMDOS** file specification of the resource to load.

BINDING

```
addrin[0] = fname;
```

```
return crys_if(0x6E);
```

RETURN VALUE **rsrc_load()** returns 0 if successful or non-zero if an error occurred.

COMMENTS In addition to loading the resource, all **OBJECT** coordinates are converted from character based coordinates to screen coordinates.

SEE ALSO **rsrc_free()**

rsrc_obfix()

WORD rsrc_obfix(***tree, obj*** **)**
OBJECT * ***tree*****;**
WORD ***obj*****;**

rsrc_obfix() converts an object's coordinates from character-based to pixel-based.

OPCODE 114 (0x72)

AVAILABILITY All **AES** versions.

PARAMETERS *tree* specifies the **OBJECT** tree containing the object *obj* to convert.

BINDING

```
intin[0] = obj;
addrin[0] = tree;
return crys_if(0x72);
```

RETURN VALUE **rsrc_obfix()** returns a 0 if successful or non-zero otherwise.

COMMENTS All objects in '.RSC' files have their coordinates based on character positions rather than screen coordinates to allow an object tree to be shown in any resolution. This function converts those character coordinates to pixel coordinates based on the current screen resolution.

SEE ALSO **rsrc_load(), rsrc_rcfix()**

rsrc_rcfix()

WORD rsrc_rcfix(*rc_header*)
VOID **rc_header*;

rsrc_rcfix() fixes up coordinates and memory pointers of raw resource data in memory.

OPCODE 115 (0x73)

AVAILABILITY Available only in **AES** versions 4.0 and greater. The presence of this call should also be checked for using **appl_getinfo()**.

PARAMETERS *rc_header* is a pointer to an Atari Resource Construction Set (or compatible) resource file header in memory.

BINDING

```
addrin[0] = rc_header;
return crys_if(0x73);
```

RETURN VALUE **rsrc_rcfix()** returns a 0 if successful or non-zero otherwise.

COMMENTS If a resource has already been loaded with **rsrc_load()** it must be freed by **rsrc_free()** prior to this call. In addition, resources identified with this call must likewise be freed before program termination or another resource file is needed.

SEE ALSO **rsrc_obfix()**

rsrc_saddr()

WORD rsrc_saddr(*type, index, addr*)
WORD *type, index*;
VOID **addr*;

rsrc_saddr() sets the address of a resource element.

OPCODE 113 (0x71)

AVAILABILITY All **AES** versions.

PARAMETERS *type* specifies the type of resource element to set as defined under **rsrc_gaddr()**. *index* specifies the index of the element to modify (0 based). *addr* specifies the actual address that will be placed in the appropriate data structure.

BINDING

```
intin[0] = type;
intin[1] = index;

addrin[0] = addr;

return crys_if(0x71);
```

RETURN VALUE

rsrc_saddr() returns 0 if an error occurred or non-zero otherwise.

COMMENTS

In most cases, direct manipulation of the structures involved is quicker and easier than using this call.

SEE ALSO

rsrc_gaddr(), rsrc_load()

Scrap Library

The *Scrap Library* is used to maintain the location of the clipboard directory used for interprocess data exchange. The members of the *Scrap Library* are:

- **scrp_read()**
- **scrp_write()**

scrp_read()

WORD scrp_read(***cpath*** **)**
char ****cpath*;**

scrp_read() returns the location of the current clipboard directory.

OPCODE 80 (0x50)

AVAILABILITY All **AES** versions.

PARAMETERS *cpath* is a pointer to a character buffer of at least 128 bytes into which the clipboard path will be placed.

BINDING

```
addrin[0] = cpath;

return crys_if(0x50);
```

RETURN VALUE **scrp_read()** returns 0 if the clipboard path had not been set or non-zero if *cpath* was properly updated.

CAVEATS The system scrap directory is a global resource. Some programs incorrectly call **scrp_write()** with a path *and* filename when only a pathname should be used. The following is an example of a correctly formatted *cpath* argument:

```
C:\CLIPBRD\
```

Unfortunately, not all programs adhere exactly to this standard. For this reason, programs reading this information from **scrp_read()** should be especially careful that the information returned is parsed correctly. In addition, don't count on a trailing backslash or the existence of a drive specification.

COMMENTS If a value of 0 is returned and the application wishes to write a scrap to the clipboard you should follow these steps:

- Create a folder '\CLIPBRD\' on the root directory of the user's boot drive ('C:' or 'A:').
- Write your scrap to the directory as 'SCRAP.???' where '???' signifies the type of information contained in the file.
- Allow other applications to access this information by calling **scrp_write()** with the new clipboard path. For example "C:\CLIPBRD\".

A detailed discussion of the proper clipboard data exchange protocol, including information about a scrap directory semaphore useful with **MultiTOS**, is given earlier in this chapter.

SEE ALSO **scrp_write()**

scrp_write()

WORD scrp_write(***cpath*** **)**
char ****cpath*;**

scrp_write() sets the location of the clipboard directory.

OPCODE 81 (0x51)

AVAILABILITY All **AES** versions.

PARAMETERS *cpath* points to a **NULL**-terminated path string containing a valid drive and path specification with a closing backslash. The following is an example of a correctly formatted *cpath* argument:

```
C:\CLIPBRD\
```

BINDING

```
addrin[0] = cpath;

return crys_if(0x51);
```

RETURN VALUE **scrp_write()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS The scrap directory is a global resource. This call should only be used in two circumstances as follows:

- when used to set the default location of the scrap directory using a CPX or accessory at bootup or by the user's request.
- when **scrp_read()** returns an error value and you need to create the clipboard to write information to it.

The clipboard data exchange protocol is discussed in greater detail earlier in this chapter.

SEE ALSO **scrp_read()**

Shell Library

The *Shell Library* contains several miscellaneous functions most often used by the **GEM Desktop** and other 'Desktop-like' applications. Other applications may, however, need specific functions of the *Shell Library* for various tasks. The members of the *Shell Library* are:

- **shel_envrn()**
- **shel_find()**
- **shel_get()**
- **shel_put()**
- **shel_read()**
- **shel_write()**

shel_envrn()

WORD shel_envrn(*value, name*)
char *****value*;**
char ****name*;**

shel_envrn() searches the current environment string for a specific variable.

OPCODE 125 (0x7D)

AVAILABILITY All **AES** versions.

PARAMETERS *value* points to a character pointer which will be filled in with the address of the first character in the environment string following the string given by *name*. If the string given by *name* is not found, *value* will be filled in with **NULL**. For instance, suppose the current environment looked like this:

```
PATH=C:\;D:\;E:\
```

A call made to **shel_envrn()** with *name* pointing to the string 'PATH=' would set the pointer pointed to by *value* to the string 'C:\;D:\;E:\' above.

BINDING

```
addrin[0] = value;
addrin[1] = name;

return crys_if(0x7D);
```

RETURN VALUE **shel_envrn()** currently always returns 1.

VERSION NOTES **AES** versions prior to 1.4 only accepted semi-colons as separators between multiple 'PATH='arguments. Newer versions accept commas as well.

COMMENTS The character string pointed to by name should include the name of the variable *and* the equals sign.

shel_find()

WORD shel_find(*buf*)
char ****buf*;**

shel_find() searches for a file along the **AES**'s current path, any paths specified by the 'PATH' environmental variable, and the calling application's path.

OPCODE 124 (0x7C)

AVAILABILITY All **AES** versions.

PARAMETERS *buf* should point to a character buffer of at least 128 characters and contain the filename of the file to search for on entry. If the function was able to find the file, the buffer pointed to by *buf* will be filled in with the full pathname of the file upon return.

BINDING

```
addrin[0] = buf;
return crys_if(0x7C);
```

RETURN VALUE **shel_find()** returns 0 if the file was not found or non-zero otherwise.

SEE ALSO **shel_write()**

shel_get()

WORD shel_get(*buf, length*)
char **buf*;
WORD *length*;

shel_get() copies the contents of the **AES**'s shell buffer (normally the 'DESKTOP.INF' or 'NEWDESK.INF' file) into the specified buffer.

OPCODE 122 (0x7A)

AVAILABILITY All **AES** versions.

PARAMETERS *buf* points to a buffer at least *length* bytes long into which the **AES** should copy the shell buffer into.

BINDING

```
intin[0] = length;
addrin[0] = buf;
return crys_if(0x7A);
```

RETURN VALUE **shel_get()** returns 0 if an error occurred or non-zero otherwise.

VERSION NOTES **AES** versions prior to version 1.4 had a shell buffer size of 1024 bytes. Versions 1.4 to 3.0 had a shell buffer size of 4192 bytes.

In **AES** versions 4.0 or greater the shell buffer is no longer of a fixed size. When **appl_getinfo()** indicates that this feature is supported, *length* can be specified as **SHEL_BUFSIZE** (-1) to return the size of the current shell buffer.

SEE ALSO **shel_put()**

shel_put()

WORD shel_put(***buf, length*** **)**
char * ***buf*****;**
WORD ***length*****;**

shel_put() copies information into the **AES**'s shell buffer.

OPCODE 123 (0x7B)

AVAILABILITY All **AES** versions.

PARAMETERS *buf* points to a user memory buffer from which *length* bytes are to be copied into the shell buffer.

BINDING

```
intin[0] = length;

addrin[0] = buf;

return crys_if(0x7B);
```

RETURN VALUE **shel_put()** returns 0 if an error occurred or non-zero otherwise.

VERSION NOTES Prior to **AES** version 4.0 this function would only copy as many bytes as would fit into the current buffer. As of version 4.0, the **AES** will dynamically allocate more memory as needed (up to 32767 bytes) for the shell buffer.

COMMENTS The **Desktop** uses the information in the shell buffer for several purposes. Applications should not use the shell buffer for their own purposes.

SEE ALSO **shel_get()**

shel_read()

WORD shel_read(***name, tail*** **)**
char * ***name, *tail*****;**

shel_read() is used to determine the current application's parent and the command tail used to call it.

OPCODE 120 (0x78)

AVAILABILITY All **AES** versions.

PARAMETERS *name* points to a buffer which upon exit will be filled in with the complete file specification of the application which launched the current process.

tail will likewise be filled in with the initial command line. The first BYTE of the command line indicates the length of the string which actually begins at &*tail[1]*.

BINDING

```
addrin[0] = name;
addrin[1] = tail;

return crys_if(0x78);
```

RETURN VALUE **shel_read()** returns 0 if an error occurred or non-zero otherwise.

CAVEATS **shel_read()** actually returns the arguments to the last **shel_write()** so if a process was **Pexec()**'ed, the information returned will be incorrect.

shel_write()

WORD shel_write(*mode, wisgr, wiscr, cmd, tail*)
WORD *mode, wisgr, wiscr*;
char **cmd, *tail*;

shel_write() is a multi-purpose function which handles the manipulation and launching of processes.

OPCODE 121 (0x79)

AVAILABILITY All **AES** versions. In **AES** versions 4.0 and above, **appl_getinfo()** can be used to determine the highest legal value for *mode* as well as the functionality of extended *mode* bits.

PARAMETERS *mode* specifies the meaning of the rest of the parameters as follows:

Name	*mode*	Meaning
SWM_LAUNCH	0	Launch a **GEM** or **TOS** application or **GEM** desk accessory depending on the extension of the file. This mode is only available as of **AES** version 4.0. *wisgr* is not used in *mode* **SWM_LAUNCH** (0). When the lower eight bits of *mode* are **SWM_LAUNCH** (0), **SWM_LAUNCHNOW** (1), or **SWM_LAUNCHACC** (3), appropriate bits in the upper byte may be set to enter 'extended' mode. The bits in the upper byte are assigned as follows:

Name	Mask	Meaning
SW_PSETLIMIT	0x100	Initial **Psetlimit()**
SW_PRENICE	0x200	Initial **Prenice()**
SW_DEFDIR	0x400	Default Directory
SW_ENVIRON	0x800	Environment

If the upper byte is empty, extended mode is not entered and *cmd* specifies the filename (to search for the file with **shel_find()**) or the complete file specification. Otherwise, if any extended bits are set, *cmd* points to a structure as shown below.

```
typedef struct _shelw
{
     char *newcmd;
     LONG psetlimit;
     LONG prenice;
     char *defdir;
     char *env;
} SHELW;
```

_shelw.newcmd points to the filename formatted in the manner indicated above.

If bit 8 (**SW_PSETLIMIT**) of *mode* is set, *_shelw.psetlimit* contains the maximum memory size available to the process.

If bit 9 of *mode* is (**SW_PRENICE**) set, *_shelw.prenice* contains the process priority of the process to launch.

If bit 10 of *mode* (**SW_DEFDIR**) is set, *_shelw.defdir* points to a character string containing the default directory for the application begin launched.

If bit 11 of *mode* (**SW_ENVIRON**) is set, *_shelw.env* points to a valid environment string for the process.

tail points to a buffer containing the command tail to pass to the process. If *wiscr* is set to **CL_NORMAL** (0), *tail* is passed normally, otherwise, if *wiscr* is set to **CL_PARSE** (1), the **AES** will parse *tail* and set up an **ARGV** environment string.

modes **SWM_LAUNCH** (0), **SWM_LAUNCHNOW** (1), and **SWM_LAUNCHACC** (3) return the **AES** id of the started process. If a 0 is returned, then the process was not launched.

Under **MultiTOS**, processes are launched concurrently with their parent. An exit code is returned in a **CH_EXIT** message when the child terminates. See **evnt_mesag()**.

In **AES** versions 4.0 and above, **appl_getinfo()** should be used to determine the exact result of this call.

SWM_LAUNCHNOW	1	Launch a **GEM** or **TOS** application based on the value of *wisgr*. If *wisgr* is **TOSAPP** (0), the application will be launched as a **TOS** application, otherwise if *wisgr* is **GEMAPP** (1), the application will be launched as a **GEM** application. For the meaning of other parameters, see mode **SWM_LAUNCH** (0). The extended bits in mode are only supported by **AES** versions of at least 4.0. Parent applications which launch children using this mode are suspended under **MultiTOS**. In **AES** versions 4.0 and above, **appl_getinfo()** should be used to determine the exact result of this call.
SWM_LAUNCHACC	3	Launch a **GEM** desk accessory. For the meaning of other parameters, see mode **SWM_LAUNCH** (0). This mode is only supported by **AES** versions of at least 4.0.
SWM_SHUTDOWN	4	Manipulate 'Shutdown' mode. Shutdown mode is usually used prior to a resolution change to cause system processes to terminate. *wisgr*, *cmd*, and *tail* are ignored by this call. The value of *wiscr* determines the action this call takes as follows: **Name** / ***wiscr*** / **Meaning** **SD_ABORT** 0 Abort shutdown mode **SD_PARTIAL** 1 Partial shutdown mode **SD_COMPLETE** 2 Complete shutdown mode During a shutdown, processes which have registered themselves as accepting **AP_TERM** messages will be sent them and all accessories will be sent **AC_CLOSE** messages. In addition, in complete shutdown mode, **AP_TERM** messages will also be sent to accessories. Shutdown mode may be aborted but only by the original caller. The status of the shutdown is sent to the calling processes by **AES** messages. See **evnt_mesag()**. This mode is only supported by **AES** versions greater than or equal to 4.0.
SWM_REZCHANGE	5	Change screen resolution. *wisgr* is the work station ID (same as in **AES** *global[13]*) of the new resolution. No other parameters are utilized. This mode is only recognized as of **AES** version 4.0.
SWM_BROADCAST	7	Broadcast an **AES** message to all processes. *cmd* should point to an 8 **WORD** message buffer containing the message to send. All other parameters are ignored. This mode is only recognized as of **AES** version 4.0.

SWM_ENVIRON	8	Manipulate the **AES** environment. If *wisgr* is **ENVIRON_SIZE** (0), the current size of the environment string is returned. If *wisgr* is **ENVIRON_CHANGE** (1), *cmd* should point to a environment variable to modify. If *cmd* points to "TOSEXT=TOS,TTP", that string will be added. Likewise, "TOSEXT=" will remove that environment variable. If *wisgr* is **ENVIRON_COPY** (2), the **AES** will copy as many as *wiscr* bytes of the current environment string into a buffer pointer to by *cmd.* The function will return the number of bytes *not* copied. This mode is only recognized as of **AES** version 4.0.
SWM_NEWMSG	9	Inform the **AES** of a new message the current application understands. *wisgr* is a bit mask which specifies which new messages the application understands. Currently only bit 0 (**B_UNTOPPABLE**) has a meaning. Setting this bit when calling this function will inform the **AES** that the application understands **AP_TERM** messages. No other parameters are used. This mode is only recognized as of **AES** version 4.0.
SWM_AESMSG	10	Send a message to the **AES**. *cmd* points to an 8 **WORD** message buffer containing the message to send. No other parameters are needed. This mode is only recognized as of **AES** version 4.0.

BINDING

```
intin[0] = mode;
intin[1] = wisgr;
intin[2] = wiscr;

addrin[0] = cmd;
addrin[1] = tail;

return crys_if(0x79);
```

RETURN VALUE

The value **shel_write()** differs depending on the mode which was invoked. See above for details.

VERSION NOTES

Many new features were added as of **AES** version 4.0. For details of each, see above.

Window Library

The *Window Library* is responsible for the displaying and maintenance of **AES** windows. The members of the *Window Library* are:

- **wind_calc()**
- **wind_close()**
- **wind_create()**
- **wind_delete()**
- **wind_find()**
- **wind_get()**
- **wind_new()**
- **wind_open()**
- **wind_set()**
- **wind_update()**

wind_calc()

WORD wind_calc(***request, kind, x1, y1, w1, h1, x2, y2, w2, h2*** **)**
WORD ***request, kind, x1, y1, w1, h1*****;**
WORD ****x2, *y2, *w2, *h2*****;**

wind_calc() returns size information for a specific window.

OPCODE 108 (0x6C)

AVAILABILITY All **AES** versions.

PARAMETERS *request* specifies the mode of this call.

If *request* is **WC_BORDER** (0), *x1*, *y1*, *w1*, and *h1* specify the work area of a window of type *kind*. The call then fills in the **WORD**s pointed to by *x2*, *y2*, *w2*, and *h2* with the full extent of the window.

If request is **WC_WORK** (1), *x1*, *y1*, *w1*, and *h1* specify the full extent of a window of type *kind*. The call fills in the **WORD**s pointed to by *x2*, *y2*, *w2*, and *h2* with the work area of the window.

kind is a bit mask of window 'widgets' present with the window. For a detailed listing of these elements see **wind_create()**.

BINDING

```
intin[0] = request;
intin[1] = kind;
intin[2] = x1;
intin[3] = y1;
intin[4] = w1;
intin[5] = h1;

crys_if(0x6C);

*x2 = intout[1];
*y2 = intout[2];
*w2 = intout[3];
*h2 = intout[4];

return intout[0];
```

RETURN VALUE **wind_calc()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS **wind_calc()** is unable to calculate correct values when a toolbar is attached to a window. This can be corrected, though, by adjusting the values output by this function with the height of the toolbar.

SEE ALSO **wind_create()**

wind_close()

WORD wind_close(*handle*)
WORD *handle*;

wind_close() removes a window from the display screen.

OPCODE 102 (0x66)

AVAILABILITY All **AES** versions.

PARAMETERS *handle* specifies the window handle of the window to close.

BINDING

```
intin[0] = handle;
return crys_if(0x66);
```

RETURN VALUE **wind_close()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS Upon calling **wind_close()** a redraw message for the portion of the screen changed will be sent to all applications.

Calling **wind_close()** does not release the memory allocated to the window structure. **wind_delete()** must be called to permanently destroy the window and free any memory allocated by the **AES** for the window. Until **wind_delete()** is called, the window may be re-opened at any time with **wind_open()**.

SEE ALSO **wind_create(), wind_open(), wind_delete()**

wind_create()

WORD wind_create(*kind, x, y, w, h*)
WORD *kind, x, y, w, h*;

wind_create() initializes a new window structure and allocates any necessary memory.

OPCODE 100 (0x64)

AVAILABILITY All **AES** versions.

PARAMETERS *kind* is a bit array whose elements determine the presence of any ‘widgets’ on the

window as follows:

Name	Mask	Meaning
NAME	0x01	Window has a title bar.
CLOSER	0x02	Window has a close box.
FULLER	0x04	Window has a fuller box.
MOVER	0x08	Window may be moved by the user.
INFO	0x10	Window has an information line.
SIZER	0x20	Window has a sizer box.
UPARROW	0x40	Window has an up arrow.
DNARROW	0x80	Window has a down arrow.
VSLIDE	0x100	Window has a vertical slider.
LFARROW	0x200	Window has a left arrow.
RTARROW	0x400	Window has a right arrow.
HSLIDE	0x800	Window has a horizontal slider.
SMALLER	0x4000	Window has an iconifier.

The parameter kind is created by OR'ing together any desired elements.

x, *y*, *w*, and *h*, specify the maximum extents of the window. Normally this is the entire screen area minus the menu bar (to find this area use **wind_get()** with a parameter of **WF_WORKXYWH**). The area may be smaller to bound the window to a particular size and location.

BINDING

```
intin[0] = kind;
intin[1] = x;
intin[2] = y;
intin[3] = w;
intin[4] = h;

return crys_if(0x64);
```

RETURN VALUE

wind_create() returns a window handle if successful or a negative number if it was unable to create the window.

VERSION NOTES

The **SMALLER** gadget is only available as of **AES** version 4.1.

COMMENTS

A window is not actually displayed on screen with this call, you need to call **wind_open()** to do that.

TOS version 1.00 and 1.02 limited applications to four windows. In **TOS** version 1.04 that limit was raised to seven. As of **MultiTOS** the number of open windows is limited only by memory and the capabilities of an application.

You should ensure that your application calls a **wind_delete()** for each **wind_create()**, otherwise memory may not be deallocated when your application

exits.

SEE ALSO **wind_open(), wind_close(), wind_delete()**

wind_delete()

WORD wind_delete(*handle*)
WORD *handle*;

wind_delete() destroys the specified window and releases any memory allocated for it.

OPCODE 103 (0x67)

AVAILABILITY All **AES** versions.

PARAMETERS *handle* specifies the window handle of the window to destroy.

BINDING

```
intin[0] = handle;
return crys_if(0x67);
```

RETURN VALUE **wind_delete()** returns 0 if an error occurred or non-zero otherwise.

COMMENTS A window should by closed with **wind_close()** before deleting it.

SEE ALSO **wind_create(), wind_open(), wind_close(), wind_new()**

wind_find()

WORD wind_find(*x, y*)
WORD *x, y*;

wind_find() returns the handle of the window found at the given coordinates.

OPCODE 106 (0x6A)

AVAILABILITY All **AES** versions.

PARAMETERS *x* and *y* specify the coordinates to search for a window at.

BINDING

```
intin[0] = x;
intin[1] = y;
```

```
return crys_if(0x6A);
```

RETURN VALUE **wind_find()** returns the handle of the uppermost window found at location *x*, *y*. If no window is found, the function returns 0 meaning the **Desktop** window.

COMMENTS This function is useful for tracking the mouse pointer and changing its shape depending upon what window it falls over.

wind_get()

WORD wind_get(*handle, mode, parm1, parm2, parm3, parm4*)
WORD *handle, mode*;
WORD *parm1, *parm2, *parm3, *parm4*;

wind_get() returns various information about a window.

OPCODE 104 (0x68)

AVAILABILITY All **AES** versions.

PARAMETERS *handle* specifies the handle of the window to return information about (0 is the desktop window). *mode* specifies the information to return and the values placed into the **WORD**s pointed to by *parm1*, *parm2*, *parm3*, and *parm4* as follows:

Name	*mode*	Meaning
WF_WORKXYWH	4	*parm1*, *parm2*, *parm3*, and *parm4* are filled in with the x, y, w, and h of the current coordinates of the window's work area.
WF_CURRXYWH	5	*parm1*, *parm2*, *parm3*, and *parm4* are filled in with the x, y, w, and h of the current coordinates of the full extent of the window.
WF_PREVXYWH	6	*parm1*, *parm2*, *parm3*, and *parm4* are filled in with the x, y, w, and h of the previous coordinates of the full extent of the window prior to the last **wind_set()** call.
WF_FULLXYWH	7	*parm1*, *parm2*, *parm3*, and *parm4* are filled in with the x, y, w, and h values specified in the **wind_create()** call.
WF_HSLIDE	8	*parm1* is filled in with the current position of the horizontal slider between 1 and 1000. A value of one indicates that the slider is in its leftmost position.
WF_VSLIDE	9	*parm1* is filled in with the current position of the vertical slider between 1 and 1000. A value of one indicates that the slider is in its uppermost position.
WF_TOP	10	*parm1* is filled in with the window handle of the window currently on top. As of **AES** version 4.0 (and when appl_getinfo() indicates), *parm2* is filled in with the owners **AES** id, and *parm3* is filled in with the handle of the window directly below it.

WF_FIRSTXYWH	11	*parm1*, *parm2*, *parm3*, and *parm4* are filled in with the x, y, w, and h of the first **AES** rectangle in the window's rectangle list. If *parm3* and *parm4* are both 0, the window is completely covered.
WF_NEXTXYWH	12	*parm1*, *parm2*, *parm3*, and *parm4* are filled in with subsequent **AES** rectangles for each time this function is called until *parm3* and *parm4* are 0 to signify the end of the list.
WF_NEWDESK	14	As of **AES** versions 4.0 (and when **appl_getinfo()** indicates), this *mode* returns a pointer to the current desktop background **OBJECT** tree. *parm1* contains the high **WORD** of the address and *parm2* contains the low **WORD**.
WF_HSLSIZE	15	*parm1* contains the size of the current slider relative to the size of the scroll bar as a value from 1 to 1000. A value of 1000 indicates that the slider is at its maximum size.
WF_VSLSIZE	16	*parm1* contains the size of the current slider relative to the size of the scroll bar as a value from 1 to 1000. A value of 1000 indicates that the slider is at its maximum size.
WF_SCREEN	17	This *mode* returns a pointer to the current **AES** menu/alert buffer and its size. The pointer's high **WORD** is returned in *parm1* and the pointer's low **WORD** is returned in *parm2*. The length of the buffer is returned as a **LONG** with the upper **WORD** being in *parm3* and the lower **WORD** being in *parm4*. Note that **TOS** 1.02 returns 0 in *w*and *h* by mistake. The menu/alert buffer is used by the **AES** to save the screen area hidden by menus and alert boxes. It is not recommended that applications use this area as its usage is not guaranteed in future versions of the OS.

<table>
<tr>
<td>WF_COLOR</td>
<td>18</td>
<td>This mode gets the current color of the window widget specified on entry to the function in the WORD pointed to by parm1. Valid window widget indexes are as follows (W_SMALLER is only valid as of AES 4.1):

<table>
<tr><th>parm1</th><th>Value</th><th>ob_type</th></tr>
<tr><td>W_BOX</td><td>0</td><td>IBOX</td></tr>
<tr><td>W_TITLE</td><td>1</td><td>BOX</td></tr>
<tr><td>W_CLOSER</td><td>2</td><td>BOXCHAR</td></tr>
<tr><td>W_NAME</td><td>3</td><td>BOXTEXT</td></tr>
<tr><td>W_FULLER</td><td>4</td><td>BOXCHAR</td></tr>
<tr><td>W_INFO</td><td>5</td><td>BOXTEXT</td></tr>
<tr><td>W_DATA</td><td>6</td><td>IBOX</td></tr>
<tr><td>W_WORK</td><td>7</td><td>IBOX</td></tr>
<tr><td>W_SIZER</td><td>8</td><td>BOXCHAR</td></tr>
<tr><td>W_VBAR</td><td>9</td><td>BOX</td></tr>
<tr><td>W_UPARROW</td><td>10</td><td>BOXCHAR</td></tr>
<tr><td>W_DNARROW</td><td>11</td><td>BOXCHAR</td></tr>
<tr><td>W_VSLIDE</td><td>12</td><td>BOX</td></tr>
<tr><td>W_VELEV</td><td>13</td><td>BOX</td></tr>
<tr><td>W_HBAR</td><td>14</td><td>BOX</td></tr>
<tr><td>W_LFARROW</td><td>15</td><td>BOXCHAR</td></tr>
<tr><td>W_RTARROW</td><td>16</td><td>BOXCHAR</td></tr>
<tr><td>W_HSLIDE</td><td>17</td><td>BOX</td></tr>
<tr><td>W_HELEV</td><td>18</td><td>BOX</td></tr>
<tr><td>W_SMALLER</td><td>19</td><td>BOXCHAR</td></tr>
</table>

The ob_spec field (containing the color information) used for the object when not selected is returned in the WORD pointed to by parm2. The ob_spec field used for the object when selected is returned in parm3.

This mode under wind_get() is only valid as of AES version 3.30. From AES versions 4.0 and above, appl_getinfo() should be used to determine if this mode is supported.</td>
</tr>
<tr>
<td>WF_DCOLOR</td>
<td>19</td>
<td>This mode gets the default color of newly created windows as with WF_COLOR above. As above, this mode under wind_get() only works as of AES version 3.30.

As of AES version 4.1, WF_DCOLOR changes the color of open windows unless they have had their colors explicitly set with WF_COLOR.</td>
</tr>
<tr>
<td>WF_OWNER</td>
<td>20</td>
<td>parm1 is filled in with the AES id of the owner of the specified window. parm2 is filled in with its open status (0 = closed, 1 = open). parm3 is filled in with the handle of the window directly above it (in the window order list) and parm4 is filled in with the handle of the window below it (likewise, in the window order list).

This mode is only available as of AES version 4.0 (and when indicated by appl_getinfo()).</td>
</tr>
</table>

WF_BEVENT	24	*parm1*, *parm2*, *parm3*, *parm4* are each interpreted as bit arrays whose bits indicate supported window features. Currently only one bit is supported. If bit 0 of the value returned in *parm1* is 1, that window has been set to be 'un-toppable' and it will never receive **WM_TOPPED** messages, only button clicks. This mode is only available as of **AES** version 4.0 (and when indicated by appl_getinfo()).
WF_BOTTOM	25	*parm1* will be filled in with the handle of the window currently on the bottom of the window list (it may actually be on top if there is only one window). Note also that this does not include the desktop window. This *mode* is only available as of **AES** version 4.0 (and when indicated by **appl_getinfo()**).
WF_ICONIFY	26	*parm1* will be filled in with 0 if the window is not iconified or non-zero if it is. *parm2* and *parm3* contain the width and height of the icon. *parm4* is unused. This *mode* is only available as of **AES** version 4.1 (and when indicated by appl_getinfo()).
WF_UNICONIFY	27	*parm1, parm2, parm3,* and *parm4,* are filled in with the x, y, w, and h of the original coordinates of the iconified window. This *mode* is only available as of **AES** version 4.1 (and when indicated by **appl_getinfo()**).
WF_TOOLBAR	30	*parm1* and *parm2* contain the high and low **WORD** respectively of the pointer to the current toolbar object tree (or **NULL** if none). This *mode* is only available as of **AES** version 4.1.
WF_FTOOLBAR	31	*parm1, parm2, parm3,* are *parm4,* are filled in with the x, y, w, and h, respectively of the first uncovered rectangle of the toolbar region of the window. If *parm3* and *parm4* are 0, the toolbar is completely covered. This *mode* is only available as of **AES** version 4.1.
WF_NTOOLBAR	32	*parm1, parm2, parm3,* and *parm4,* are filled in with the x, y, w, and h, respectively of subsequent uncovered rectangles of the toolbar region. This mode should be repeated to reveal subsequent rectangles until *parm3* and *parm4* are found to be 0. This *mode* is only available as of **AES** version 4.1.

BINDING

```
/* This binding must be different to */
/* accomodate reading WF_COLOR and   */
/* WF_DCOLOR                         */

contrl[0] = 0x68;
contrl[1] = 2;
contrl[2] = 1;
contrl[3] = 0;
contrl[4] = 0;
```

```
intin[0] = handle;
intin[1] = mode;

if(mode == WF_DCOLOR || mode == WF_COLOR)
{
       intin[2] = *x;
       contrl[1] = 3;
}

aes();

*x = intout[1];
*y = intout[2];
*w = intout[3];
*h = intout[4];

return intout[0];
```

RETURN VALUE **wind_get()** returns a 0 if an error occurred or non-zero otherwise.

SEE ALSO **wind_set()**

wind_new()

WORD wind_new(VOID)

wind_new() closes and deletes all of the application's windows. In addition, the state of **wind_update()**, and the mouse pointer hide count is reset.

OPCODE 109 (0x6D)

AVAILABILITY Available as of **AES** version 0x0140.

BINDING

```
return crys_if(0x6D);
```

RETURN VALUE The return value is reserved and currently unused

COMMENTS This function should not be relied upon to clean up after an application. It was designed for parent processes that wish to ensure that a poorly written child process has properly cleaned up after itself.

SEE ALSO **wind_delete(), graf_mouse(), wind_update()**

wind_open()

WORD wind_open(*handle, x, y, w, h*)
WORD *handle*;
WORD x, y, w, h;

wind_open() opens the window specified.

OPCODE 101 (0x65)

AVAILABILITY All **AES** versions.

PARAMETERS *handle* specifies the handle of the window to open as returned by **wind_create()**. *x*, *y*, *w*, and *h* specify the rectangle into which the rectangle should be displayed.

BINDING

```
intin[0] = handle;
return crys_if(0x65);
```

RETURN VALUE **wind_open()** returns a 0 if an error occurred or non-zero otherwise.

COMMENTS This call will also trigger a **WM_REDRAW** message which encompasses the work area of the window so applications should not initially render the work area, rather, wait for the message.

SEE ALSO **wind_close(), wind_create(), wind_delete()**

wind_set()

WORD wind_set(*handle, mode, parm1, parm2, parm3, parm4*)
WORD *handle, mode, parm1, parm2, parm3, parm4*;

wind_set() sets various window attributes.

OPCODE 105 (0x69)

AVAILABILITY All **AES** versions.

PARAMETERS *handle* specifies the window handle of the window to modify. *mode* specifies the attribute to change and the meanings of *parm1*, *parm2*, *parm3*, and *parm4* as follows:

Name	*mode*	Meaning
WF_NAME	2	This *mode* passes a pointer to a character string containing the new title of the window. *parm1* contains the high **WORD** of the pointer and *parm2* contains the low **WORD**.
WF_INFO	3	This *mode* passes a pointer to a character string containing the new information line of the window. *parm1* contains the high **WORD** of the pointer, *parm2* contains the low **WORD**.
WF_CURRXYWH	5	*parm1*, *parm2*, *parm3*, and *parm4* specify the x, y, w, and h of the new coordinates of the full extent of the window.
WF_HSLIDE	8	*parm1* specifies the new position of the horizontal slider between 1 and 1000. A value of 1 indicates that the slider is in its leftmost position.
WF_VSLIDE	9	*parm1* specifies the new position of the vertical slider between 1 and 1000. A value of 1 indicates that the slider is in its uppermost position.
WF_TOP	10	*parm1* specifies the window handle of the window to top. Note that if multiple calls of **wind_set(WF_TOP**, ... **)** are made without releasing control to the **AES** (which allows the window to actually be topped), only the most recent window specified will actually change position.
WF_NEWDESK	14	This *mode* specifies a pointer to an **OBJECT** tree which is redrawn automatically by the desktop as the background. *parm1* contains the high **WORD** of the pointer and *parm2* contains the low **WORD**. To reset the desktop background to the default, specify *parm1* and *parm2* as 0.
WF_HSLSIZE	15	*parm1* defines the size of the current slider relative to the size of the scroll bar as a value from 1 to 1000. A value of 1000 indicates that the slider is at its maximum size.
WF_VSLSIZE	16	*parm1* defines the size of the current slider relative to the size of the scroll bar as a value from 1 to 1000. A value of 1000 indicates that the slider is at its maximum size.

<table>
<tr><td>WF_COLOR</td><td>18</td><td>This mode sets the current color of the window widget specified on entry in parm1. Valid window widget indexes are as follows (W_SMALLER is only valid as of AES 4.1):

<table>
<tr><th>parm1</th><th>Value</th><th>ob_type</th></tr>
<tr><td>W_BOX</td><td>0</td><td>IBOX</td></tr>
<tr><td>W_TITLE</td><td>1</td><td>BOX</td></tr>
<tr><td>W_CLOSER</td><td>2</td><td>BOXCHAR</td></tr>
<tr><td>W_NAME</td><td>3</td><td>BOXTEXT</td></tr>
<tr><td>W_FULLER</td><td>4</td><td>BOXCHAR</td></tr>
<tr><td>W_INFO</td><td>5</td><td>BOXTEXT</td></tr>
<tr><td>W_DATA</td><td>6</td><td>IBOX</td></tr>
<tr><td>W_WORK</td><td>7</td><td>IBOX</td></tr>
<tr><td>W_SIZER</td><td>8</td><td>BOXCHAR</td></tr>
<tr><td>W_VBAR</td><td>9</td><td>BOX</td></tr>
<tr><td>W_UPARROW</td><td>10</td><td>BOXCHAR</td></tr>
<tr><td>W_DNARROW</td><td>11</td><td>BOXCHAR</td></tr>
<tr><td>W_VSLIDE</td><td>12</td><td>BOX</td></tr>
<tr><td>W_VELEV</td><td>13</td><td>BOX</td></tr>
<tr><td>W_HBAR</td><td>14</td><td>BOX</td></tr>
<tr><td>W_LFARROW</td><td>15</td><td>BOXCHAR</td></tr>
<tr><td>W_RTARROW</td><td>16</td><td>BOXCHAR</td></tr>
<tr><td>W_HSLIDE</td><td>17</td><td>BOX</td></tr>
<tr><td>W_HELEV</td><td>18</td><td>BOX</td></tr>
<tr><td>W_SMALLER</td><td>19</td><td>BOXCHAR</td></tr>
</table>

The ob_spec field of the object (containing the color information) while the window is on top is defined in parm2. The ob_spec field for the object while the window is not on top is defined in parm3.

This mode is only valid as of AES version 0x0300.</td></tr>
<tr><td>WF_DCOLOR</td><td>19</td><td>This mode sets the default color of newly created windows as with WF_COLOR above. This mode only works as of AES version 0x0300. As of AES version 4.1, this mode causes all currently displayed windows which have not had their color explicitly set with WF_COLOR to be changed.</td></tr>
<tr><td>WF_BEVENT</td><td>24</td><td>parm1, parm2, parm3, and parm4 are each interpreted as bit arrays whose bits indicate supported window features. Currently only one bit is supported. If bit 0 (B_UNTOPPABLE) of parm1 is set, the window will be set to be ‘un-toppable’ and it will never receive WM_TOPPED messages, only button clicks.

This mode is only available as of AES versions 4.0.</td></tr>
<tr><td>WF_BOTTOM</td><td>25</td><td>This mode will place the specified window at the bottom of the window list (if there is more than one window) and top the new window on the top of the list.

This mode is only available as of AES version 4.0.</td></tr>
</table>

WF_ICONIFY	26	This *mode* iconifies the specified window to the X, Y, width, and height coordinates given in *parm1*, *parm2*, *parm3,* and *parm4* respectively. Normally, this happens as the result of receiving a **WM_ICONIFY** message. This *mode* is only available as of **AES** version 4.1.
WF_UNICONIFY	27	This *mode* uniconifies the window specified, returning it to its original X, Y, width, and height as specified in *parm1*, *parm2*, *parm3*, and *parm4* respectively. Normally, this happens as the result of receiving a **WM_UNICONIFY** message. This *mode* is only available as of **AES** version 4.1.
WF_UNICONIFYXYWH	28	This mode sets the X, Y, width, and height that will be transmitted to the window with the next **WM_UNICONIFY** message that targets it. This call is used when a window is opened in an iconified state to give the OS a method of positioning it when it is uniconified. This *mode* is only available as of **AES** version 4.1.
WF_TOOLBAR	30	This *mode* attaches a toolbar to the specified window. *parm1* and *parm2* contain the high and low **WORD** of the address of the toolbar **OBJECT** tree respectively. *parm3* and *parm4* are unused. Set *parm1* and *parm2* to 0 to remove a toolbar.

BINDING

```
intin[0] = handle;
intin[1] = mode;
intin[2] = x;
intin[3] = y;
intin[4] = w;
intin[5] = h;

return crys_if(0x69);
```

RETURN VALUE **wind_set()** returns 0 if an error occurred or non-zero otherwise.

SEE ALSO **wind_get()**

wind_update()

WORD wind_update(*mode*)
WORD *mode*;

wind_update() manages the screen drawing semaphore.

OPCODE 107 (0x6B)

AVAILABILITY All **AES** versions.

PARAMETERS *mode* specifies an action as follows:

Name	*mode*	Meaning
END_UPDATE	0	This mode resets the flag set by **BEG_UPDATE** and should be called as soon as redrawing is complete. This will allow windows to be moved and menus to be dropped down again.
BEG_UPDATE	1	Calling this mode will suspend the process until no drop-down menus are showing and no other process is updating the screen. This will then set a flag which guarantees that the screen will not be updated and windows will not be moved until you reset it with **END_UPDATE**. Generally this call is made whenever a **WM_REDRAW** message is received to lock the screen semaphore while redrawing.
END_MCTRL	2	This mode releases control of the mouse to the **AES** and resumes mouse click message services.
BEG_MCTRL	3	This mode prevents mouse button messages from being sent to applications other than your own. **form_do()** makes this call to lock out screen functions. Desk accessories which display a dialog outside of a window must use this function to prevent button clicks from falling through to the desktop.

BINDING

```
intin[0] = mode;

return crys_if(0x6B);
```

RETURN VALUE **wind_update()** returns 0 if an error occurred or non-zero otherwise.

VERSION NOTES As of **AES** version 4.0, you may logically OR a mask of **NO_BLOCK** (0x0100) to either **BEG_UPDATE** or **BEG_MCTRL**. This mask will prevent the application from blocking if another application currently has control of the screen semaphore. Instead, if another application has control, the function will immediately return with an error value of 0.

This method should only be used by timing-sensitive applications such as terminal programs in which a long redraw by another application could cause a timeout.

COMMENTS All **wind_update()** modes nest. For instance, to release the screen semaphore, the same number of **END_UPDATE** calls must be received as were **BEG_UPDATE** calls. It it recommended that you design your application in a manner that avoids nesting these calls.

Both the **BEG_UPDATE** and **BEG_MCTRL** modes should be used prior to displaying a form or popup to prevent them from being overwritten or clicks to them being sent to other applications.

Always wait until *after* the **BEG_UPDATE** call to turn off the mouse cursor when updating the screen to be sure you have gained control of the screen.

Applications such as slide-show viewers which require the whole screen area (and may need to change screen modes) may call **wind_update()** with parameters of both **BEG_UPDATE** and **BEG_MCTRL** to completely lock out the screen from other applications. The application would still be responsible for saving the screen area, manipulating video modes as necessary, restoring the screen when done, and returning control of the screen to other applications with **END_UPDATE** and **END_MCTRL**.

SEE ALSO **wind_new()**

– CHAPTER 7 –

VDI

Overview

The Virtual Device Interface (**VDI**) is a collection of drivers designed to provide applications with a device-independent method of accessing graphically based devices such as monitors, printers, and plotters. Applications which are written to use the **VDI** rather than directly accessing hardware will be compatible with all currently available devices including those which have not yet been developed.

All Atari systems with **TOS** in ROM include a **VDI** screen driver adaptable to each display resolution the system can support. Soft-loaded screen drivers and drivers for other devices are loaded through a **VDI** sub-system called the Graphics Device Operating System (**GDOS**).

The **GDOS** system is disk-loaded as a TSR utility at bootup. It loads device drivers based upon the contents of its configuration file(s).

Applications wishing to use the **GDOS** extensions must verify its presence using the method described later in this chapter. If an application's output will be limited to the screen and no font other than the system font is needed, then the presence of **GDOS** is not mandatory.

VDI Workstations

Every system call made to the **VDI** must include a workstation handle. This handle is a unique integer which identifies the device and current attribute array. Workstation handles are returned by the **VDI** calls **v_opnwk()** or **v_opnvwk()**.

Workstations provide a lookup array of attributes such as line width, text color, clipping state, etc. that are unique to it.

Physical Workstations

Each device must be initialized by opening its physical workstation. Opening a physical workstation causes all drawing and clipping attributes to be reset and the current page (display) to be reset to the default background color. Only one physical workstation may be opened to a single device at any given time.

The screen device's physical workstation is automatically initialized by the **AES** upon bootup. Its physical workstation handle may be obtained from the **AES** call **graf_handle()**.

Devices such as printers and plotters must have their physical workstation opened by the application wishing to utilize them. When opening a physical workstation the application must specify a device ID which identifies the device to open. Device identification codes are assigned as follows:

VDI Device Identification Numbers	
Screen	1–10
Plotters	11–20
Printers	21–30
Metafiles	31–40
Cameras	41–50
Tablets	51–60
Memory	61–70
Other	71–

These values correspond to the value listed in the leftmost column of the user's 'ASSIGN.SYS' file. The following code segment demonstrates opening a physical workstation to the printer device with ID #21. It is important to note that the function assumes that the presence of **GDOS** has been tested for and was verified.

work_in[0] is set to the desired device ID and *work_in[1-9]* are filled in with common defaults for workstation attributes. *work_in[10]* is set to 2 to indicate raster coordinates as explained later in this chapter. The function returns a non-zero value if an error occurred.

```
WORD work_in[11],work_out[57];
WORD handle;

WORD
printer_open( VOID )
{
        WORD i;

        work_in[0] = 21;
        for(i = 1;i < 10; work_in[i++] = 1);
        work_in[10] = 2;

        v_opnwk(work_in,&handle,work_out);

        return (handle == 0);
}
```

Virtual Workstations

Each physical workstation may have multiple virtual workstations opened which allow individual applications to maintain separate workstation attributes. In fact, a single application may open multiple virtual workstations to the same device to manage workstation attributes more efficiently. Opening a virtual workstation does not affect the current contents of the display.

Most **GEM** applications will open a virtual workstation to the current screen device upon initialization. The following code segment illustrates opening a virtual workstation to the display device.

The device identification code for the display device must be specified as **Getrez()** + 2 for all **VDI** features to work correctly. All other parameters are passed the same as the example for

opening a physical workstation except that *handle* must contain the physical workstation handle of the device for which you wish to obtain a virtual workstation handle.

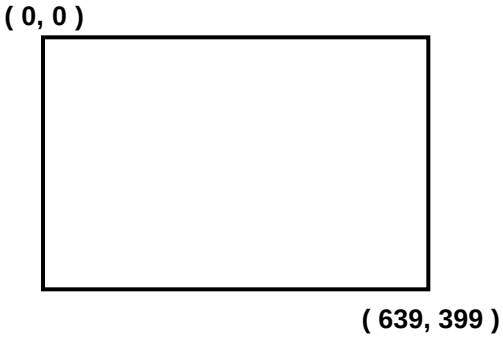
A more programmer-friendly method of opening workstations involves the use of the **VDI_Workstation** structure which is discussed in the reference entry for **V_Opnvwk()**

```
WORD work_in[11],work_out[57];
WORD handle;
WORD wcell, hcell, wbox, hbox;

WORD
screen_open( VOID )
{
        WORD i;

        handle = graf_handle( &wcell, &hcell, &wbox, &hbox);

        work_in[0] = Getrez() + 2;
        for(i = 1;i < 10;work_in[i++] = 1);
        work_in[10] = 2;

        v_opnvwk(work_in, &handle, work_out);

        return (handle == 0);
}
```

Workstation Specifics

Coordinate Systems

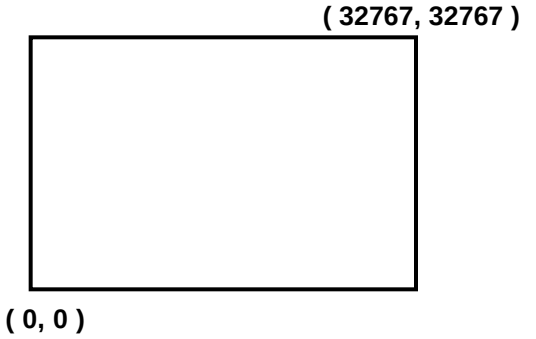
The **VDI** defaults to the usage of Raster Coordinates (RC) which places the origin at the upper-left of the page or display. As an example, the coordinate range for the 1040ST's monochrome graphics mode is shown here:



RC coordinate ranges vary with the device. It is up to the application to interpret and scale the size and position of its output appropriately.

With the addition of **GDOS**, the **VDI** gains the ability to utilize Normalized Device Coordinates (NDC). When using NDC, **GDOS** translates and scales all coordinates to the device as

appropriate. All devices using NDC will have their origin at the lower-left hand corner of the display or page as follows:



Using NDC provides an excellent manner of reducing the overhead of having to internally scale every coordinate, however, applications which depend on the proper aspect ratio for their output should consider managing coordinates internally.

Rendering Graphics

Each **VDI** output function uses attributes set by other related **VDI** functions to determine characteristics such as line width, text face, and color. The following table lists **VDI** attribute calls and the functions they affect.

To output a **VDI** object, set each attribute as desired and then make the appropriate call. For example, to output a line of text in the System font at 9 point colored red, make the following sequence of calls.

```
vst_font( handle, 1 );              /* Select the System Font */
vst_point( handle, 9 );
vst_color( handle, 2 );
v_ftext( handle, 10, 10, “The Atari Compendium” );
```

Generalized Device Primitives

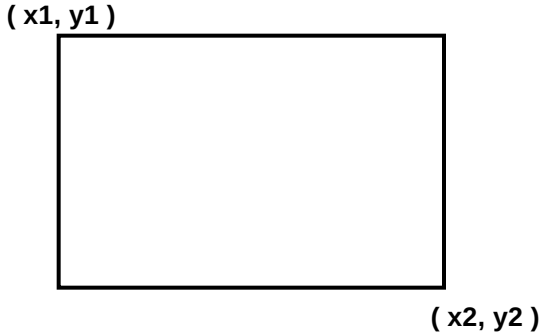
GDP’s (Generalized Device Primitives) are basic drawing components available through the **VDI**. All current device drivers support all GDP’s though specialized drivers may not be able to. *intout[14-24]* may be used to determine the presence of GDP’s. Currently there are 10 supported GDP’s as follows:

#	GDP
1	Bar (Rectangle)
2	Arc
3	Pie Slice
4	Circle
5	Ellipse
6	Elliptical Arc
7	Elliptical Pie
8	Rounded Rectangle
9	Filled Rounded Rectangle
10	Justified Graphics Text

VDI Rectangles

Several **VDI** functions require that a rectangle in **VDI** format be passed to them. **VDI** rectangles are different from **AES** rectangles in the manner in which they are specified.

To correctly define a **VDI** rectangle you must specify two coordinate pairs one representing the upper-left point of the rectangle and the other specifying the lower-right as follows:



The following two functions provide simple conversion between **AES GRECT**s and **VDI** rectangles in an array.

```
VOID
Grect2xy( GRECT *g, short *pxy)
{
       pxy[0] = g.g_x;
       pxy[1] = g.g_y;
       pxy[2] = g.g_x + g.g_w - 1;
       pxy[3] = g.g_y + g.g_h - 1;
}

VOID
Xy2Grect( short *pxy, GRECT *g )
{
       g.g_x = pxy[0];
       g.g_y = pxy[1];
       g.g_w = pxy[2] - pxy[0] + 1;
       g.g_h = pxy[3] - pxy[1] + 1;
}
```

Device Types vs. Required Functions

Not all **VDI** functions are supported by all drivers. The presence of GDP functions may be checked using the information returned in the *intout* array after a **v_opnwk()** call. Other calls may be checked for by entering a test call and comparing returned information with what would be expected.

In addition, each type of driver has a certain number of required functions which must be supported by the device. Each entry in the ***VDI** Function Reference* specifies the support required for a function.

Write Modes

All **VDI** graphics primitives are subject to one of four writing modes set by **vswr_mode()**, with the exception of **vro_cpyfm()** which is passed one of sixteen writing modes.

The following logic tables illustrate the effects of each of the four primary modes. Graphic examples can be found under the reference entry for **vswr_mode()**.

Mode	Logic
Replace	Destination = Source
Transparent	Destination = Source **OR** Destination
XOR	Destination = Source **XOR** Destination
Reverse Transparent	Destination = (**NOT** Source) **AND** Destination

Using Color

The color capabilities of **VDI** devices can be placed into three categories as follows. Determining which category a device falls into is accomplished by examining the return values from **v_opnvwk()**, **v_opnwk()**, and **vq_extnd()**.

Categories	v_opn/v/wk() *work_out[13] { colors }*	vq_extnd() *work_out[5] { lut }*
Monochrome Device[1]	2	0
Palette-Based Device	>= 2	1
True Color Device	> 2	0

[1] Sometimes monochrome devices appear as palette-based devices with two available colors.

Monochrome Devices

Monochrome devices are only capable of displaying one color. Often, monochrome devices are instead represented by palette-based devices with two fixed colors.

Palette-Based Devices

Palette-based devices have a fixed number of colors that may be rendered on screen simultaneously. Each pixel value is used to index into the palette to decide what color to display. For instance, if you change **VDI** color #2 to green, draw a box with that color index, and then change **VDI** color #2 to red, the box will appear first in green and then turn red.

The first 16 **VDI** color registers are used by the operating system and should be avoided. If your application must change them, they should be restored when no longer needed.

True Color Devices

True-color devices allow each pixel to have a unique color value. Rather than palette entries, *colors* (*work_out[13]*) corresponds to the number of available virtual pens. Drawing is accomplished by using these pens, however, unlike using a palette, changing the color of a pen does not change any pixel's color drawn with that pen on the screen.

Whatever color is stored in virtual pen #0 is considered the background color for the purpose of computing write modes.

It is possible for external devices, printers, plotters, etc. to behave as if they were a true-color device.

Color Mapping

Color values are defined in the **VDI** by specifying a red, green, and blue value from 0–1000. The **VDI** will scale the value to the closest color possible. **vq_color()** can be used to determine the actual color that was set.

VDI Raster Forms

The **VDI** handles raster forms using three commands, **vro_cpyfm()**, **vrt_cpyfm()**, and **vr_trnfm()**. **vro_cpyfm()** and **vrt_cpyfm()** are responsible for 'blitting' raster images between memory and a workstation. These functions may also be used to copy images from one location on a workstation to another. 'Blitting' is the process of copying memory from one location to another. Atari computers use the BLiTTER chip (when one is installed) or a software bit blit algorithm to quickly move memory. While these calls are designed to transfer screen memory, if carefully used, they may also be used to transfer other types of memory as well.

vr_trnfm() is responsible for the transformation of images between device-specific and **VDI** standard format, the two raster image formats recognized by the **VDI**. Device-specific format is limited to images in the format of the source device whereas the second is a generic format recommended for transporting images to non-standard displays.

VDI Device-Specific Format

Device-specific format simply mimics the layout of pixels and planes on the source device. When using **vro_cpyfm()** and **vrt_cpyfm()** the source form will be transferred to the destination form in device-specific format[2].

If you intend to save images to disk you should first utilize **vr_trnfm()** to transform the image into a **VDI** standard format so that the image can be successfully ported to any display.

VDI Standard Format

VDI standard format is designed to provide a portable method of specifying raster images which may be displayed on any device. Images stored in **VDI** standard format must be transformed with **vr_trnfm()** before copying them to a workstation.

Images in **VDI** standard format appear in memory in a plane-by-plane fashion. All of the bits for plane #0 appear first followed by the bits for plane #1, and so on for as many planes as exist in the image.

Images may be easily transferred to devices with a higher number of planes by simply inserting empty bytes to account for planes not present in the source image. This method will only work, however, with palette based devices.

Vector Handling

The **VDI** screen driver is also responsible for managing some hardware vectors responsible for keyboard and mouse input. The functions available for altering these vectors are **vex_motv()**, **vex_timv()**, **vex_curv()**, and **vex_butv()**. For further explanation of these calls please see the ***VDI** Function Reference*.

Use of these functions is not recommended with **MultiTOS** as these vectors are global and affect all applications. In addition, results are undefined if two or more non-resident applications utilized these calls at once.

Existing applications which use these calls must have their program flags set to either supervisor or global memory protection. See the ***GEMDOS** Overview* for a discussion of the program flags.

[2]The definitions of **vro_cpyfm()** and **vrt_cpyfm()** allow for the specification of the format of the source and destination form, however, this feature is not currently supported by any version of the operating system. Any call which specifies either the source or destination form to be in device-independent format will fail.

GDOS

The Graphics Device Operating System (**GDOS**) is a disk-based component of the operating system which allows disk-loadable device drivers and additional fonts to be accessible through standard **VDI** calls.

Several versions of Atari **GDOS** have been released in addition to several third-party **GDOS** 'clones'. All of these forms have stayed backward-compatible with **GDOS** 1.0, however it is recommended that programs be written to support newer **GDOS** calls when it can be determined that a more recent release of **GDOS** is present.

Each **VDI** call documented in the ***VDI** Function Reference* specifies if **GDOS** is required, and if so, what type.

Determining the Version of GDOS Present

A non-standard **VDI** call is available to check for the presence of **GDOS**. The following machine-code subroutine will return a longword result in d0 which can be used to determine the variety of **GDOS** present. Beware of older bindings which looked only for the original **GDOS** and returned a 1 or 0 as a result.

```
                .text
_vq_gdos:
                move.l   #-2,d0
                trap     #2
                rts

                .end
```

The longword return value in d0 can be interpreted as follows:

Name	Value	Meaning
GDOS_NONE	-2	No **GDOS** is installed.
—	Any other value.	Original **GDOS** 1.x is installed.
GDOS_FNT	0x5F464E54 '**_FNT**'	**FONTGDOS** is installed.
GDOS_FSM	0x5F46534D '**_FSM**'	**FSM GDOS** or **SpeedoGDOS** is installed. For information on determining the specific variety of outline **GDOS** available, see the description of the 'FSMC' cookie in *Chapter 3:* **BIOS**

FSM GDOS vs. SpeedoGDOS

Since **FSMGDOS** (a QMS/Imagen outline font-based **GDOS**) was never officially released from Atari (though shipped in limited quantity with third-party products), some changes have been made to calls in **SpeedoGDOS** that were never exploited by developers. For that reason, these calls will only be documented in the Speedo-compatible way in the ***VDI** Function Reference*. This does mean, however, that use of these calls will cause your application to fail under the original **FSMGDOS**.

The calls which were affected are **v_getoutline()**, **v_getbitmap_info()**, **v_killoutline()**, and **vqt_get_table()**. In addition, use of the new **SpeedoGDOS** calls **vst_charmap()**, **vqt_trackkern()**, **vqt_pairkern()**, **vqt_fontheader()**, **vst_kern()**, or any of the older calls when used with the **fix31** data type will fail with the older **FSM**.

To determine the type of outline-font **GDOS** installed, look for the '**FSMC**' cookie. The cookie value is a pointer to a longword which contains the character string '**_FSM**' for Imagen-based **FSMGDOS** or '**_SPD**' for Speedo-based **FSMGDOS**.

GDOS 1.x

GDOS 1.0 and the other 1.x versions which followed it was the original **GDOS** developed by Digital Research for Atari. It handled only bitmap fonts and was slow compared to the newer **FONTGDOS** which now replaces it.

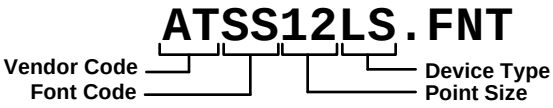
When a **v_opnwk()** call is made with **GDOS** installed, a check is done to see if a driver was assigned to the device ID specified in the 'ASSIGN.SYS' file, and if so, loaded.

All **VDI** calls which specify the returned handle will subsequently be redirected to the driver.

Not all **VDI** functions are available with every driver. Check the 'Availability' heading for each specific function in the ***VDI** Function Reference* for specific availability.

Bitmap Fonts

Bitmap fonts have the ability to be quickly rendered and highly accurate. They do generally require more disk space and a font file must be available for each point size and aspect ratio required. Bitmap fonts follow a special naming convention as follows:



The vendor code is a unique two-letter identifier which specifies the creator of the font. The font code is a two-letter code which abbreviates the font's name. The point size field specifies the point size of the font. The device type is a two-letter abbreviation which should match the aspect ratio of the device as follows:

Device Type	Destination Ratio
None or HI	91x91 (Screen Devices)
CG	91x45 (Screen Devices)
LS	300x300 (Laser Printers, Inkjets)
EP	120x144 (Lo-Res Dot-Matrix Printers)
LB	160x72 (Lo-Res Dot-Matrix Printers)
SP	180x180 (Med-Res Dot-Matrix Printers)
QD	240x216 (Med-Res Dot-Matrix Printers)
NP	360x360 (High-Res Dot-Matrix Printers)

For a driver to recognize a bitmap font it must be listed in the user's 'ASSIGN.SYS' file and be of the correct aspect ratio. No extra fonts are made available to applications until a **vst_load_fonts()** call is made.

FONTGDOS

FONTGDOS is the successor to **GDOS** 1.x. As with the original **GDOS**, **FONTGDOS** supports only bitmap fonts. Its differences are improved driver support, support for bezier curves, improved error handling, and a much quicker response time.

Bezier Curves

FONTGDOS conforms to the **PC-GEM/3** file standard with the inclusion of bezier curve rendering capability with the **v_bez()** and **v_bez_fill()** calls. **v_bez_on()** must be used to allow **FONTGDOS** to allocate the memory necessary for bezier rendering. Likewise **v_bez_off()** should be used before an application exits to free any memory used for bezier calls.

Error Support

When **GDOS** 1.x encountered an error condition, it simply wrote an error message at the top of the display overwriting a portion of the menu bar and display screen. **FONTGDOS** allows an application to disengage this behavior and instead return error codes in a global variable. It is then the applications responsibility to check this variable after calls which may cause an error condition. See the ***VDI** Function Reference* call **vst_error()** for more information.

FSMGDOS

FSMGDOS was developed by Atari in conjunction with QMS/Imagen Corp. to provide Imagen outline fonts which could be displayed at any point size, aspect ratio, or device. It provided all of the improved features of **FONTGDOS** with outline fonts and caching capability. This version of **GDOS** was, however, never officially released. Third-party manufacturers did ship many copies of this **GDOS** to the public. In addition, many developers did update their products to utilize the special features of **FSMGDOS**.

Most **VDI** function calls added with this version of **GDOS** have remained compatible with **SpeedoGDOS**, however, some calls which were never used by developers were changed. This

means that applications written to support **SpeedoGDOS** may not be backwardly compatible. For specific compatibility information, consult the ***VDI** Function Reference*.

SpeedoGDOS

SpeedoGDOS is a new variety of **FSM** which employs outline font technology from Bitstream using Speedo-format outline fonts. In addition, several new calls were added to gain access to internal font information and provide true WYSIWYG (What-You-See-Is-What-You-Get) output.

The fix31 Data Type

SpeedoGDOS optionally allows the use of the **fix31** data type in some calls for parameters and return values. Old bindings designed for the Imagen-based **FSM** will still function properly. Newer bindings may be written to take advantage of this data type.

The **fix31** data type allows for the internal representation and manipulation of floating-point values without the use of a floating-point library. It is a 32-bit value with a 1-bit sign and a 31-bit magnitude. Each value specifies a number in 1/65536 pixels. Examples of this data type follow:

fix31	Floating Point
0x00010000	1.0
0xFFFF0000	-1.0
0x00018000	1.5

Character advances can be simply be added or subtracted to each other using integer arithmetic. To convert a **fix31** unit to an integer (rounding to 0) use the following code:

```
x_integer = (WORD)(x_fix31 >> 16);
```

To convert a **fix31** to an integer and round it to the closest integer use the following code:

```
x_integer = (WORD)((x_fix31 + 32768) >> 16);
```

Use of **fix31** values provides higher character placement accuracy and access to non-integer point sizes. For specific implementation notes, see the ***VDI** Function Reference* entries for **vqt_advance32()**, **v_getbitmap_info()**, **vst_arbpt32()**, and **vst_setsize32()**.

Kerning

SpeedoGDOS outline fonts have the ability to be kerned using two methods. Track kerning is global for an entire font and has three settings, normal, tight, and extra tight. Pair kerning works for individual pair groups of characters. In addition, new pairs may be defined as necessary to produce the desired output.

Kerning is taken into account with **v_ftext()** and **vqt_advance()** only when enabled. Use the calls **vst_kern()**, **vqt_pairkern()**, and **vqt_trackkern()** to access kerning features.

Caching

All **SpeedoGDOS** extent and outline rendering calls are cached for improved performance. Cache files may be loaded or saved to disk as desired to preserve the current state of the cache. In addition, an application might want to flush the cache before doing an output job to a device such as a printer to improve performance with new fonts.

The call **vqt_cachesize()** can be used to estimate the ability of the cache to store data for an unusually large character and prevent memory overflow errors.

Special Effects

The call **vst_scratch()** determines the method used when calculating the size of the special effects buffer. In general an application should not allow the user to use algorithmically generated effects on Speedo fonts. In most cases, special effects are available by simply choosing another font.

The problem is that Speedo fonts may be scaled to any size and **SpeedoGDOS** has no way of predicting the upper-limit on the size of a character to allocate special effects memory. Currently, **SpeedoGDOS** allocates a buffer large enough to hold the largest character possible from the point sizes in the 'ASSIGN.SYS' file and those listed in the 'EXTEND.SYS' file. If your application limits special effects to these sizes then no problems will occur.

If you intend to restrict users to using special effects only with bitmap fonts you may call **vst_scratch()** with a *mode* parameter of 1, memory allocation will be relaxed to only take bitmap fonts into account. You may also specify a *mode* parameter of 2 if you plan to allow no special effects at all. The **vst_scratch()** call must be made prior to calling **vst_load_fonts()**.

Speedo Character Indexes

Speedo fonts contain more characters than the Atari ASCII set can define. Fonts may be re-mapped with a CPX using the **vqt_get_table()** call (this method is not recommended on an application basis as this call affects all applications in the system).

Another method involves the use of a new call, **vst_charmap()**. Calling this function with a *mode* parameter of 0 causes all functions which take character indexes (like **v_ftext()**, **vqt_width()**, etc.) to interpret characters as **WORD**s rather than **BYTE**s and utilize Speedo International Character Encoding rather than ASCII.

The ***Function Reference*** provides two alternate bindings for **v_ftext()** and **v_ftext_offset()** called **v_ftext16()** and **v_ftext_offset16()** which correctly output 16-bit Speedo character text rather than 8-bit ASCII text.

A complete listing of the Bitstream International Character Set is listed in *Appendix G:* ***Speedo Fonts***.

Speedo Font IDs

The function **vqt_name()** is used with all versions of **GDOS** to return a unique integer identifier for each font. Because some bitmap font ID's conflicted with Bitstream outline font ID's, **SpeedoGDOS** versions 4.20 and higher add 5000 to each of the outline font ID's to differentiate them from bitmap fonts.

Device Drivers

Printer and Plotter Drivers

Printer drivers are the most common form of **GDOS** driver available, though some plotter drivers do exist. The ***VDI** Function Reference* can be used to determine if a particular function call is required to be available on a particular device. This does not, however, prohibit the addition of supplementary functions.

Some special printer driver features are available with drivers designed to support them as follows:

Dot-Matrix Printers

Dot-matrix printers with wide carriages can have their print region expanded by passing a custom X and Y resolution for the driver in *ptsin[0]* and *ptsin[1]* respectively prior to the **v_opnwk()** call. In addition, *contrl[1]* should be set to 1 to indicate the presence of the parameters.

SLM804

After a **v_opnwk()** call to an SLM804 driver *contrl[0]* will contain the MSB and *contrl[1]* will contain the LSB of the allocated printer buffer address.

After a **v_updwk()** call, *intout[0]* will contain a printer status code as follows:

Name	Error Code	Meaning
SLM_OK	0x00	No Error
SLM_ERROR	0x02	General Printer Error
SLM_NOTONER	0x03	Toner Empty
SLM_NOPAPER	0x05	Paper Empty

All Printer Drivers

A user-defined printer buffer may be passed to the **v_updwk()** call by specifying the address of the buffer in *intin[0]* and *intin[1]*. In addition, *contrl[3]* must be set to 2 to indicate the new parameters and *contrl[1]* must be set to 1 to instruct the **VDI** to not clear the buffer first.

Camera and Tablet Drivers

As of this writing, no camera or tablet drivers existed for Atari **GEM**. Several functions are reserved to support them which were developed under **PC-GEM**, however, many remain undocumented. Where documentation was available, those calls are included for completeness in the ***VDI** Function Reference*.

The Metafile Driver

'META.SYS' drivers are specially designed drivers which create '.GEM' disk files rather than produce output on a device. When a metafile device is opened, the file 'GEMFILE.GEM' is created in the current **GEMDOS** path. The function **vm_filename()** may be used to change the filename to which the metafile is written to, however, the file 'GEMFILE.GEM' must be deleted by the application.

When a metafile is opened, several defaults relating to the coordinate space and pixel size are set. Each pixel is assigned a default width and height of 85 microns (1 micron = 1/25400 inch). This equates to a default resolution of 300dpi.

The device size is specified where Normalized Device Coordinates (NDC) = Raster Coordinates (RC). The coordinate space of the metafile has (0, 0) in the lower-left corner and (32767, 32767) in the upper-right. This coordinate system may be modified with **vm_coords()**. The size of the actual object space being written to the metafile should also be specified with **vm_pagesize()** so that an application may correctly clip the objects when reading.

After changing coordinate space, values returned by **vq_extnd()** related to pixel width, height and page size will *not* change. Also, font metrics returned by functions such as **vqt_fontinfo()** and **vqt_advance()** will remain based on the default metafile size information. In most cases, text metric information should be embedded based on the workstation metrics of the destination device (such as a screen or printer) anyway.

The metafile is closed when a **v_clswk()** call is issued. Other applications which read metafiles will play back the file by issuing commands in the same order as recorded by the driver. For more information on the metafile format see *Appendix C: **Native File Formats***.

The Memory Driver

'MEMORY.SYS' includes all of the standard **VDI** calls yet works only in memory and is not designed to be output to a device. Normally, the memory driver should be assigned in the user's 'ASSIGN.SYS' file as device number 61. Upon calling **v_opnwk()** to the memory driver, *contrl[1]* should be set to 1 and *ptsin[0]* and *ptsin[1]* should contain the X and Y extent of the memory area. Upon return from the call, *contrl[0]* and *contrl[1]* will contain the high and low **WORD** respectively of the address of the memory device raster. **v_updwk()** clears the raster.

VDI Function Calling Procedure

The **GEM VDI** is accessed through a 68x00 TRAP #2 statement. Prior to the TRAP, register d0 should contain the magic number 0x73 and register d1 should contain a pointer to **VDI** parameter block. An example binding is as follows:

```
        .text
_vdi:
        move.l      #_VDIpb,d1
        move.l      #$73,d0
        trap        #2
        rts
```

The **VDI** parameter block is an array of 5 pointers which each point to a specialized array of **WORD** values which contain input parameters and function return values. Different versions of the **VDI** support different size arrays. The following code contains the 'worst case' sizes for these arrays. Many newer versions of the **VDI** support larger array sizes. You can inquire what the maximum array size that **VDI** supports by examining the *work_out* array after a **v_opnvwk()** or **v_opnwk()**. Larger array sizes allow more points to be passed at a time for drawing functions and longer strings to be passed for text functions. The definition of the **VDI** parameter block follows:

```
            .data

_contrl:    ds.w    12
_intin:     ds.w    128
_ptsin:     ds.w    256
_intout:    ds.w    128
_ptsout:    ds.w    256

_VDIpb:     dc.l    _contrl, _intin, _ptsin
            dc.l    _intout, _ptsout

            .end
```

The *contrl* array contains the opcode and number of parameters being passed the function as follows:

contrl[x]	Contents
0	Function Opcode
1	Number of Input Vertices in *ptsin*
2	Number of Output Vertices in *ptsout*

3	Number of Parameters in *intin*
4	Number of Output Values in *intout*
5	Function Sub-Opcode
6	Workstation Handle
7–11	Function Specific

contrl[0], *contrl[1]*, *contrl[3]*, *contrl[5]* (when necessary), and *contrl[6]* must be filled in by the application. *contrl[2]* and *contrl[4]* are filled in by the **VDI** on exit. *contrl[7-11]* are rarely used, however some functions do rely on them for function-specific parameters.

For specific information on bindings, see the ***VDI*** *Function Reference*.

VDI/GDOS Function Reference

v_alpha_text()

VOID v_alpha_text(***handle, str*** **)**
WORD *handle*;
char ****str***;**

v_alpha_text() outputs a line of alpha text.

OPCODE 5

SUB-OPCODE 25

AVAILABILITY Supported by all printer and metafile drivers.

PARAMETERS *handle* is a valid workstation handle. *str* is a pointer to a null-terminated text string which will be printed. Two special **BYTE** codes may be embedded in the text. ASCII 12 will cause a printer form-feed. ASCII 18 'DC2' will initiate an escape sequence followed by a command descriptor **BYTE** (in ASCII) indicating which action to take as follows.

Command BYTE	Meaning
'0'	Enable bold print.
'1'	Disable bold print.
'2'	Enable italic print.
'3'	Disable italic print.
'4'	Enable underlining.
'5'	Disable underlining.
'6'	Enable superscript.
'7'	Disable superscript.
'8'	Enable subscript.
'9'	Disable subscript.
'A'	Enable NLQ mode.
'B'	Disable NLQ mode.
'C'	Enable wide printing.
'D'	Disable wide printing.
'E'	Enable light printing.
'F'	Disable light printing.
'W'	Switch to 10-cpi printing.
'X'	Switch to 12-cpi printing.
'Y'	Toggle compressed printing.
'Z'	Toggle proportional printing.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*str++);

contrl[0] = 5;
contrl[1] = 0;
contrl[3] = --i;
contrl[5] = 25;
contrl[6] = handle;

vdi();
```

CAVEATS The line of text must not exceed the maximum allowable length of the *intin* array as returned by **vq_extnd()** or the maximum length of your compilers' array.

COMMENTS Only commands '0', '1', '2', '3', '4', and '5' are available with most printer drivers.

SEE ALSO **v_gtext(), v_ftext()**

v_arc()

VOID v_arc(***handle, x, y, radius, startangle, endangle*** **)**
WORD ***handle, x, y, radius, startangle, endangle*****;**

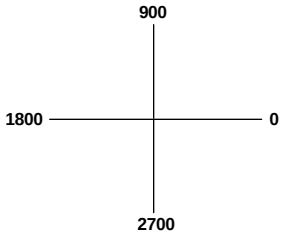
v_arc() outputs an arc to the specified workstation.

OPCODE 11

SUB-OPCODE 2

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* is a valid workstation handle. *x* and *y* specify the center of an arc with a radius of *radius* and starting and ending angles of *startangle* and *endangle* specified in tenths of degrees as follows:



BINDING

```
contrl[0] = 11;
contrl[1] = 4;
contrl[3] = contrl[5] = 2;
contrl[6] = handle;

intin[0] = startangle;
intin[1] = endangle;

ptsin[0] = x;
ptsin[1] = y;
ptsin[2] = ptsin[3] = ptsin[4] = ptsin[5] = 0;
ptsin[6] = radius;
ptsin[7] = 0;

vdi();
```

SEE ALSO **vsl_color()**

v_bar()

VOID v_bar(*handle, pxy*)
WORD *handle*;
WORD *pxy*;

v_bar() outputs a filled rectangle to the specified workstation.

OPCODE 11

SUB-OPCODE 1

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* is a valid workstation handle. *pxy* points to an array of four **WORD**s specifying a **VDI** format rectangle to output.

BINDING

```
contrl[0] = 11;
contrl[1] = 2;
contrl[3] = 0;
contrl[5] = 1;
contrl[6] = handle;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];

vdi();
```

COMMENTS This function, as opposed to **vr_recfl()**, *does* take the setting of **vsf_perimeter()** into consideration.

SEE ALSO **vsf_interior(), vsf_style(), vsf_color(), vsf_perimeter(), vsf_udpat()**

v_bez()

VOID v_bez(*handle, count, pxy, bezarr, extent, totpts, totmoves*)
WORD *handle, count*;
WORD **pxy, *extent*;
char **bezarr*;
WORD **totpts, *totmoves*;

v_bez() outputs a bezier curve path.

OPCODE 6

SUB-OPCODE 13

AVAILABILITY Available only with **FONTGDOS**, **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* is a valid workstation handle. *count* specifies the number of vertices in the path. *pxy* is a pointer to a **WORD** array (*count* * 2) **WORD**s long containing the vertices where *pxy[0]* is the X coordinate of the first point, *pxy[1]* is the Y coordinate of the first point and so on. *bezarr* is a pointer to a character array *count* **BYTE**s long where each byte is a bit mask with two flags that dictate the interpretation of each vertice as follows:

Name	Bit	Meaning
BEZ_BEZIER (0x01) **BEZ_POLYLINE** (0x00)	0	If set, begin a 4-point bezier segment (two anchor points followed by two control points), otherwise, begin a polyline segment.
BEZ_NODRAW (0x02)	1	If set, jump to this point without drawing.
—	2-7	Currently unused (set to 0).

Upon exit, a 4 **WORD** array pointed to by *extent* is filled in with a **VDI** format rectangle defining a bounding box of the path drawn. The **WORD** pointed to by *totpts* is filled in with the number of points in the resulting path whereas the total number of moves is stored in the **WORD** pointed to by *totmoves*.

BINDING

```
WORD i;

contrl[0] = 6;
contrl[1] = count;
contrl[3] = (count + 1)/2;
contrl[5] = 13;
contrl[6] = handle;

for(i = 0;i < count; i++)
{
       intin[i] = (WORD)bezarr[i];
       ptsin[ i*2 ] = pxy[ i*2 ];
       ptsin[ (i*2) + 1 ] = pxy[ (i*2) + 1];
}

vdi();

*totpts = intin[0];
*totmoves = intin[1];

for(i = 0; i < 4; i++)
       extent[i] = ptsout[i];
```

SEE ALSO **v_bez_fill(), v_bez_on(), v_bez_off(), v_bez_qual(), v_set_app_buff()**

v_bez_fill()

VOID v_bez_fill(***handle, count, pxy, bezarr, extent, totpts, totmoves*** **)**
WORD ***handle, count*****;**
WORD ****pxy, *extent***;**
char ****bezarr***;**
WORD ****totpts, *totmoves***;**

v_bez_fill() outputs a filled bezier path.

OPCODE 9

SUB-OPCODE 13

AVAILABILITY Available only with **FONTGDOS**, **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS Same as **v_bez()**.

BINDING

```
WORD i;

contrl[0] = 9;
contrl[1] = count;
contrl[3] = (count + 1)/2;
contrl[5] = 13;
contrl[6] = handle;

for(i = 0;i < count * 2; i++)
       ptsin[i] = pxy[i];
for(i = 0;i < count; i++)
       intin[i] = (WORD)bezarr[i];

vdi();

*totpts = intin[0];
*totmoves = intin[1];

for(i = 0; i < 4; i++)
       extent[i] = ptsout[i];
```

SEE ALSO **v_bez(), v_bez_on(), v_bez_off(), v_bez_qual(), v_set_app_buff()**

v_bez_off()

VOID v_bez_off(***handle*** **)**
WORD *handle*;

v_bez_off() disables bezier capabilities and frees associated memory.

OPCODE 11

SUB-OPCODE 13

AVAILABILITY Available only with **FONTGDOS, FSM,** or **SpeedoGDOS**.

PARAMETERS *handle* is a valid workstation handle.

BINDING

```
contrl[0] = 11;
contrl[1] = 0;
contrl[3] = 0;
contrl[5] = 13;
```

```
contrl[6] = handle;

vdi();
```

COMMENTS This function should be called to free any memory reserved by the bezier functions.

SEE ALSO **v_bez_on()**

---

v_bez_on()

WORD v_bez_on(***handle*** **)**
WORD ***handle*****;**

v_bez_on() enables bezier capabilities.

OPCODE 11

SUB-OPCODE 13

AVAILABILITY Available only with **FONTGDOS**, **FSM,** or **SpeedoGDOS**.

PARAMETERS *handle* is a valid workstation handle.

BINDING

```
contrl[0] = 11;
contrl[1] = 1;
contrl[3] = 0;
contrl[5] = 13;
contrl[6] = handle;

vdi();

return intout[0];
```

RETURN VALUE **v_bez_on()** returns a **WORD** value indicating the number of line segments each curve is composed of (smoothness). The value returned (0-7) is a power of 2 meaning that a return value of 7 indicates 128 line segments per curve.

SEE ALSO **v_bez_off()**

---

v_bez_qual()

VOID v_bez_qual(***handle, percent, actual*** **)**
WORD ***handle, percent*****;**
WORD ****actual***;**

v_bez_qual() sets the speed/quality ratio of the bezier curve rendering engine.

OPCODE 5

SUB-OPCODE 99

AVAILABILITY Available only with **FONTGDOS**, **FSM,** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *percent* is a value (0–100) specifying the tradeoff between bezier quality and speed. A value of 0 renders a bezier fastest with the lowest quality while a value of 100 renders a bezier slowest with the highest possible quality. On return, the **WORD** pointed to by *actual* will contain the actual value used.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 3;
contrl[5] = 99;
contrl[6] = handle;

intin[0] = 32;
intin[1] = 1;
intin[2] = percent;

vdi();

*actual = intout[0];
```

COMMENTS *actual* may not be an exact percentage as the rendering engine may not actually support every value possible between 1–99.

SEE ALSO **v_bez(), v_bez_fill(), v_bez_on()**

v_bit_image()

VOID v_bit_image(***handle, fname, ratio, xscale, yscale, halign, valign, pxy*** **)**
WORD ***handle*****;**
char ****fname*****;**
WORD ***aspect, xscale, yscale, halign, valign*****;**
WORD ****pxy*****;**

v_bit_image() outputs a disk-based **GEM** '.IMG' file.

OPCODE 5

SUB-OPCODE 23

AVAILABILITY Supported by all printer, metafile, and memory drivers.

PARAMETERS *handle* is a valid workstation handle. *fname* specifies the **GEMDOS** file specification for the **GEM** bit-image file to print. *ratio* should be 0 to ignore the aspect ratio of the image and 1 to adhere to it.

xscale and *yscale* specify the method of scaling to apply to the image. Fractional scaling is specified by a value of 0 whereas a value of 1 represents integer scaling.

If fractional scaling is used, the image will be displayed at the coordinates given by the **VDI** format rectangle pointed to by *pxy*. If integer scaling is applied, the image will be displayed as large as possible within the given coordinates using *halign* and *valign* to specify the image justification as follows:

Value	*halign*	*valign*
0	Left **IMAGE_LEFT**	Top **IMAGE_TOP**
1	Center **IMAGE_CENTER**	Center **IMAGE_CENTER**
2	Right **IMAGE_RIGHT**	Bottom **IMAGE_BOTTOM**

BINDING

```
WORD tmp = 5;

intin[0] = ratio;
intin[1] = xscale;
intin[2] = yscale;
intin[3] = halign;
intin[4] = valign;
while(intin[tmp++] = (WORD)*fname++);

contrl[0] = 5;
```

```
contrl[1] = 2;
contrl[3] = --tmp;
contrl[5] = 23;
contrl[6] = handle;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];

vdi();
```

COMMENTS A flag indicating whether the device supports scaling can be found in **vq_extnd()**. This call used with the memory driver can provide image scaling for transfer to the screen with **vrt_cpyfm()**.

SEE ALSO **vq_scan()**

v_cellarray()

VOID v_cellarray(***handle, pxy, rowlen, elements, num_rows, wrmode, colarray*** **)**
WORD ***handle*****;**
WORD ****pxy*;**
WORD ***rowlen, elements, num_rows, wrmode*****;**
WORD ****colarray*;**

v_cellarray() outputs an array of colored cells.

OPCODE 10

AVAILABILITY Not supported by any current drivers.

PARAMETERS *handle* specifies a valid workstation handle. *pxy* points to a **WORD** array with 4 entries specifying a **VDI** format rectangle giving the extent of the array to output.

rowlen specifies the length of each color array row. *elements* specifies the total number of color array elements. *num_rows* specifies the number of rows in the color array. *wrmode* specifies a valid writing mode (1–4) and *colarray* points to an array of **WORD**s (*num_rows* * *elements*) long.

BINDING

```
WORD i;

contrl[0] = 10;
contrl[1] = 2;
contrl[3] = num_rows * elements;
contrl[6] = handle;
contrl[7] = rowlen;
contrl[8] = elements;
contrl[9] = num_rows;
```

```
contrl[10] = wrt_mode;

for(i = 0;i < (num_rows * elements);i++)
       intin[i] = colarray;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];

vdi();
```

CAVEATS This function is not guaranteed available in any driver and should therefore be avoided unless you are sure the driver you are utilizing understands it.

SEE ALSO **vq_cellarray()**

v_circle()

VOID v_circle(***handle, x, y, radius*** **)**
WORD ***handle, x, y, radius*****;**

v_circle() outputs a filled circle.

OPCODE 11

SUB-OPCODE 4

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* specifies a valid workstation. *x* and *y* specify the center of a circle with a radius of *radius*.

BINDING

```
contrl[0] = 11;
contrl[1] = 3;
contrl[3] = 0;
contrl[5] = 4;
contrl[6] = handle;

ptsin[0] = x;
ptsin[1] = y;
ptsin[2] = ptsin[3] = 0;

vdi();
```

SEE ALSO **vsf_color(), vsf_interior(), vsf_style(), vsf_udpat()**

v_clear_disp_list()

VOID v_clear_disp_list(*handle*)
WORD *handle*;

v_clear_disp_list() clears the display list of a workstation.

OPCODE 5

SUB-OPCODE 22

AVAILABILITY Supported by printer, plotter, metafile, and camera drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 22;
contrl[6] = handle;

vdi();
```

COMMENTS **v_clear_disp_list()** is essentially the same as **v_clrwk()** except that no form feed is issued.

SEE ALSO **v_clrwk()**

v_clrwk()

VOID v_clrwk(*handle*)
WORD *handle*;

v_clrwk() clears a physical workstation.

OPCODE 3

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation.

BINDING

```
contrl[0] = 3;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;
```

```
vdi();
```

COMMENTS Physical workstations are cleared automatically when they are opened.

This call will generate a form feed on page-oriented devices.

Using this command on a virtual workstation will clear the underlying physical workstation. This is generally not recommended because it will effect all virtual workstations not simply your own.

SEE ALSO **v_clear_disp_list(), v_updwk()**

v_clsvwk()

VOID v_clsvwk(*handle*)
WORD *handle*;

v_clsvwk() closes a virtual workstation.

OPCODE 101

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid virtual workstation to close.

BINDING

```
contrl[0] = 101;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();
```

SEE ALSO **v_opnvwk()**

v_clswk()

VOID v_clswk(*handle*)
WORD *handle*;

v_clswk() closes a physical workstation.

OPCODE 2

AVAILABILITY Available only with some form of **GDOS**.

PARAMETERS *handle* specifies a valid physical workstation to close.

BINDING

```
contrl[0] = 2;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();
```

SEE ALSO **v_opnvwk()**

v_contourfill()

VOID v_contourfill(*handle, x, y, color*)
WORD *handle, x, y, color*;

v_countourfill() outputs a 'seed' fill.

OPCODE 103

AVAILABILITY Supported by all *current* screen, printer and metafile drivers. The availability of this call can be checked for using **vq_extnd()**.

PARAMETERS *handle* specifies a valid workstation handle. x and y specify the starting point for the fill. If *color* is **OTHER_COLOR** (-1) then the fill continues in all directions until a color other than that found in *x* and *y* is found. If *color* is positive then the fill continues in all directions until color *color* is found.

BINDING

```
contrl[0] = 103;
contrl[1] = contrl[3] =  0;
contrl[6] = handle;

intin[0] = color;

ptsin[0] = x;
ptsin[1] = y;

vdi();
```

COMMENTS In true-color mode if a positive value for *color* is used, the fill spreads until a pixel is found with the same color as 'virtual pen' *color*.

SEE ALSO **vsf_color(), vsf_interior(), vsf_style(), vsf_udpat()**

v_curdown()

VOID v_curdown(***handle*** **)**
WORD *handle*;

v_curdown() moves the text cursor down one line.

OPCODE 5

SUB-OPCODE 5

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 5;
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-B VT-52 code.

SEE ALSO **v_curup()**

v_curhome()

VOID v_curdown(***handle*** **)**
WORD *handle*;

v_curhome() moves the text cursor to the upper-left of the screen.

OPCODE 5

SUB-OPCODE 8

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 8;
```

```
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-H VT-52 code.

v_curleft()

VOID v_curleft(*handle*)
WORD *handle*;

v_curleft() moves the text cursor left one character position.

OPCODE 5

SUB-OPCODE 7

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* is a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 7;
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-D VT-52 code.

SEE ALSO **v_curright()**

v_curright()

VOID v_curright(*handle*)
WORD *handle*;

v_curright() moves the text cursor one position to the right.

OPCODE 5

SUB-OPCODE 6

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 6;
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-C VT-52 code.

SEE ALSO **v_curleft()**

v_curtext()

VOID v_curtext(*handle, str*)
WORD *handle*;
char **str*;

v_curtext() outputs a line of text to the screen in text mode.

OPCODE 5

SUB-OPCODE 12

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* is a valid workstation handle. *str* is a character pointer to a string no more than 127 characters long.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*str++);

intin[i] = 0;
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = --i;
contrl[5] = 12;
contrl[6] = handle;

vdi();
```

COMMENTS The line of text must not exceed the maximum length of the intin array as returned by **vq_extnd()** or the maximum length of your compilers' array.

SEE ALSO **vs_curaddress(), v_rvon(), v_rvoff()**

v_curup()

VOID v_curup(*handle*)
WORD *handle*;

v_curup() moves the text cursor up one line.

OPCODE 5

SUB-OPCODE 4

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 4;
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-A VT-52 code.

SEE ALSO **v_curdown()**

v_dspcur()

VOID v_dspcur(*handle, x, y*)
WORD *handle, x, y*;

v_dspcur() displays the mouse pointer on screen at the specified position.

OPCODE 5

SUB-OPCODE 18

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the screen coordinates of where to display the mouse pointer.

BINDING

```
contrl[0] = 5;
contrl[1] = 1
contrl[3] = 0;
contrl[5] = 18;
contrl[6] = handle;

ptsin[0] = x;
ptsin[1] = y;

vdi();
```

COMMENTS This call will render a mouse cursor on screen regardless of its current 'show' status. Normally a function will use either **graf_mouse()** if using the **AES** or **v_show_c()** if using the **VDI**.

SEE ALSO **v_rmcur(), graf_mouse(), v_show_c()**

v_eeol()

VOID v_eeol(*handle*)
WORD *handle*;

v_eeol() erases the text line from the current cursor position rightwards.

OPCODE 5

SUB-OPCODE 10

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 10;
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-K VT-52 code.

SEE ALSO **v_eeos()**

v_eeos()

WORD v_eeos(***handle*** **)**
WORD *handle*;

v_eeos() erases the current screen of text from the cursor position.

OPCODE 5

SUB-OPCODE 9

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 9;
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-J VT-52 code.

SEE ALSO **v_eeol()**

v_ellarc()

VOID v_ellarc(***handle, x, y, xradius, yradius, startangle, endangle*****)**
WORD *handle, x, y, xradius, yradius, startangle, endangle*;

v_ellarc() outputs an elliptical arc segment.

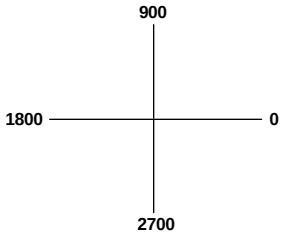
OPCODE 11

SUB-OPCODE 6

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the coordinates of the

center of an arc with an X radius of *xradius* and a Y radius of *yradius*. Only the portion of the arc which falls between the angles specified in *startangle* and *endangle* will be drawn. Angles are specified in tenths of degrees as follows:



BINDING

```
contrl[0] = 11;
contrl[1] = contrl[3] = 2;
contrl[5] = 6;
contrl[6] = handle;

intin[0] = startangle;
intin[1] = endangle;

ptsin[0] = x;
ptsin[1] = y;
ptsin[2] = xradius;
ptsin[3] = yradius;

vdi();
```

SEE ALSO **v_ellipse(), v_ellpie(), vsl_color(), vsl_type(), vsl_width(), vsl_udsty()**

v_ellipse()

VOID v_ellipse(***handle, x, y, xradius, yradius*****)**
WORD ***handle, x, y, xradius, yradius*****;**

v_ellipse() outputs a filled ellipse.

OPCODE 11

SUB-OPCODE 5

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the center point of an arc with an X radius of *xradius* and a Y radius of *yradius*.

BINDING

```
contrl[0] = 11;
contrl[1] = 2;
contrl[3] = 0;
contrl[5] = 5;
contrl[6] = handle;

ptsin[0] = x;
ptsin[1] = y;
ptsin[2] = xradius;
ptsin[3] = yradius;

vdi();
```

SEE ALSO **v_ellpie(), v_ellarc(), vsf_color(), vsf_interior(), vsf_style(), vsf_udpat(), vs_perimeter()**

v_ellpie()

VOID v_ellpie(***handle, x, y, xradius, yradius, startangle, endangle*****)**
WORD ***handle, x, y, xradius, yradius, startangle, endangle*****;**

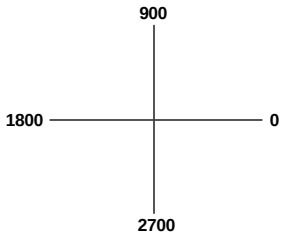
v_ellpie() outputs a filled elliptical pie segment.

OPCODE 11

SUB-OPCODE 7

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the center coordinates of an elliptical pie segment to draw with an X radius of *xradius* and a Y radius of *yradius*. Only the portion of the arc will be drawn falling between the angles specified in *startangle* and *endangle* (as shown below). The ends of this arc is connected to the center point with lines forming the pie segment.



BINDING

```
contrl[0] = 11;
contrl[1] = contrl[3] = 2;
contrl[5] = 7;
contrl[6] = handle;

intin[0] = startangle;
intin[1] = endangle;

ptsin[0] = x;
ptsin[1] = y;
ptsin[2] = xradius;
ptsin[3] = yradius;

vdi();
```

SEE ALSO **v_ellarc(), v_ellipse(), vsf_color(), vsf_style(), vsf_interior(), vsf_udpat(), vs_perimeter()**

v_enter_cur()

VOID v_enter_cur(*handle*)
WORD *handle*;

v_enter_cur() clears the screen to color 0, removes the mouse cursor and enters text mode.

OPCODE 5

SUB-OPCODE 3

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 3;
contrl[6] = handle;

vdi();
```

CAVEATS You should check that the left mouse button has been released with **vq_mouse()** prior to calling this function. If the button is depressed when you call this function the **VDI** will lock waiting for it to be released after **v_exit_cur()**.

COMMENTS This call is used by a **GEM** application to prepare for executing a **TOS** application when not running under **MultiTOS**.

SEE ALSO **v_exit_cur()**

v_exit_cur()

VOID v_exit_cur(*handle*)
WORD *handle*;

v_exit_cur() exits text mode and restores the mouse pointer.

OPCODE 5

SUB-OPCODE 2

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 2;
contrl[6] = handle;

vdi();
```

CAVEATS See **v_enter_cur()**.

COMMENTS To completely restore the screen you should call **form_dial(FMD_FINISH**, *sx*, *sy*, *sw*, *sh*) where *sx*, *sy*, *sw*, and *sh* are the coordinates of the screen.

SEE ALSO **v_enter_cur()**

v_fillarea()

VOID v_fillarea(*handle, count, pxy*)
WORD *handle, count*;
WORD **pxy*;

v_fillarea() outputs a filled polygon.

OPCODE 9

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *count* specifies the number of vertices in the polygon to output. *pxy* should point to an array of coordinate pairs with the first **WORD** being the first X point, the second **WORD** being the first Y point and so on.

BINDING

```
WORD i;

contrl[0] = 9;
contrl[1] = count;
contrl[3] = 0;
contrl[6] = handle;

for(i = 0;i < count*2;i++)
       ptsin[i] = pxy[i];

vdi();
```

COMMENTS This function will automatically connect the first point with the last point.

SEE ALSO **v_pline(), v_contourfill()**

v_flushcache()

VOID v_flushcache(*handle*)
WORD *handle*;

v_flushcache() flushes the character bitmap portion of the cache.

OPCODE 251

AVAILABILITY Available only with **FSMGDOS** and **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 251;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();
```

SEE ALSO **v_loadcache(), v_savecache()**

v_fontinit()

VOID v_fontinit(***fptr_high, fptr_low*** **)**
WORD ***fptr_high, fptr_low*****;**

v_fontinit() allows replacement of the built-in system font.

OPCODE 5

SUB-OPCODE 102

AVAILABILITY All **TOS** versions.

PARAMETERS *fptr_high* and *fptr_low* are the high and low **WORD**s of a pointer to a Line-A compatible font header structure in Motorola (Big-Endian) format which contains information about the font to be used as a replacement for the system font.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 2;
contrl[5] = 102;
contrl[6] = handle;

intin[0] = fptr_high;
intin[1] = fptr_low;

vdi();
```

COMMENTS This function has never been officially documented though it exists in all current versions of **TOS**.

v_form_adv()

VOID v_form_adv(***handle*** **)**
WORD ***handle*****;**

v_form_adv() outputs the current page without clearing the display list.

OPCODE 5

SUB-OPCODE 20

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 20;
contrl[6] = handle;

vdi();
```

COMMENTS This function is useful if you wish to print a new page containing the same objects as on the previous page.

SEE ALSO **v_updwk()**

v_ftext()

VOID v_ftext(***handle, x, y, str*****)**
WORD ***handle, x, y*****;**
char ****str*;**

v_ftext() outputs outline text taking spacing remainders into consideration.

OPCODE 241

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the starting coordinate of the **NULL**-terminated text string (see **vst_alignment()**) pointed to by *str* to print.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*str++);

contrl[0] = 241;
contrl[1] = 1;
contrl[3] = --i;
contrl[6] = handle;

ptsin[0] = x;
ptsin[1] = y;

vdi();
```

COMMENTS The text contained in *str* (including its **NULL** byte) should not exceed the maximum allowable size of the *intin* array (as indicated in the *work_out* array) or the size of the *intin* array allocated by your compiler.

To output 16-bit Speedo character indexes, use **v_ftext16()**.

This function produces output more properly spaced than with **v_gtext()** because it takes the remainder amounts from **vqt_f_extent()** into consideration.

SEE ALSO **v_ftext(), v_ftext_offset(), v_ftext_offset16(), v_gtext(), vst_alignment(), vst_color(), vst_effects(), vst_arbpt(), vst_height(), vst_font(), vqt_f_extent(), vst_point()**

v_ftext16()

VOID v_ftext16(***handle, x, y, wstr, wstrlen*****)**
WORD ***handle, x, y*****;**
WORD ****wstr*;**
WORD ***wstrlen*****;**

v_ftext16() is a variant binding of **v_ftext()** that outputs 16-bit Speedo character text rather than 8-bit ASCII text.

OPCODE 241

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the starting coordinate of the location to output text. *wstr* points to a **NULL**-terminated text string composed of **WORD**-sized Speedo characters. *wstrlen* specifies the length of the text string.

BINDING

```
WORD i;

for( i = 0; i < wstrlen; i++)
       intin[i] = wstr[i];

contrl[0] = 241;
contrl[1] = 1;
contrl[3] = wstrlen;
contrl[6] = handle;

ptsin[0] = x;
ptsin[1] = y;

vdi();
```

COMMENTS This function should only be used when **vst_charmap()** has been used to indicate that **WORD**-sized Speedo character indexes should be recognized rather than 8-bit ASCII.

The text contained in *wstr* (including its **NULL** byte) should not exceed the maximum allowable size of the *intin* array (as indicated in the *work_out* array) or

the size of the *intin* array allocated by your compiler.

CAVEATS Current versions of **SpeedoGDOS** become confused when the space character (index 0) is encountered in the string. It is suggested that one of the three space characters (of varying widths) at indexes 560-562 be used instead.

SEE ALSO **v_ftext(), v_ftext_offset(), v_ftext_offset16(), v_gtext(), vst_alignment(), vst_color(), vst_effects(), vst_arbpt(), vst_height(), vst_font(), vqt_f_extent(), vst_point()**

v_ftext_offset()

VOID v_ftext_offset(***handle, x, y, str, offset*** **)**
WORD ***handle, x, y*****;**
char *****str***;**
WORD *****offset***;**

v_ftext_offset() is a variant binding of **v_ftext()** available under **SpeedoGDOS** which allows an offset vector for each character to be specified.

OPCODE 241

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* give the point where the string will be rendered. *offset* points to an array of **WORD**s which contains one x and y offset value for each character in *str*.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*str++);
--i;

ptsin[0] = x;
ptsin[1] = y;

for(j = 0; j < i * 2;j++)
       ptsin[j + 2] = offset[j];

contrl[0] = 241;
contrl[1] = i + 1;
contrl[3] = i;
contrl[6] = handle;

vdi();
```

COMMENTS The text contained in *str* (including its **NULL** byte) should not exceed the maximum allowable size of the *intin* array (as indicated in the *work_out* array) or

the size of the *intin* array allocated by your compiler.

To output 16-bit Speedo character indexes, use **v_ftext_offset16()**.

SEE ALSO **v_ftext_offset16(), v_ftext(), v_gtext()**

v_ftext_offset16()

VOID v_ftext_offset(***handle, x, y, wstr, wstrlen, offset*** **)**
WORD ***handle, x, y*****;**
WORD ****wstr*;**
WORD ***wstrlen***;**
WORD ****offset*;**

v_ftext_offset16() is a variant binding of **v_ftext_offset()** which allows 16-bit Speedo character strings to be output rather than 8-bit ASCII codes.

OPCODE 241

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* give the point where the string will be rendered. *offset* points to an array of **WORD**s which contains one x and y offset value for each character in *wstr*.

BINDING

```
WORD i;

for( i = 0;i < wstrlen; i++)
       intin[i] = wstr[i];

ptsin[0] = x;
ptsin[1] = y;

for(j = 0; j < i * 2;j++)
       ptsin[j + 2] = offset[j];

contrl[0] = 241;
contrl[1] = wstrlen + 1;
contrl[3] = wstrlen;
contrl[6] = handle;

vdi();
```

COMMENTS This function should only be used when **vst_charmap()** has been used to indicate that **WORD** sized Speedo character indexes should be recognized rather than 8-bit ASCII.

The text contained in *wstr* (including its **NULL** byte) should not exceed the

maximum allowable size of the *intin* array (as indicated in the *work_out* array) or the size of the *intin* array allocated by your compiler.

CAVEATS Current versions of **SpeedoGDOS** become confused when the space character (index 0) is encountered in the string. It is suggested that one of the three space characters (of varying widths) at indexes 560-562 be used instead.

SEE ALSO **v_ftext16(), v_ftext_offset()**

v_getbitmap_info()

VOID v_getbitmap_info(***handle, ch, advx, advy, xoff, yoff, width, height, bitmap*****)**
WORD ***handle, ch*****;**
fix31 *advx, *advy, *xoff, *yoff;
WORD *width, *height;
VOID *bitmap;

v_getbitmap_info() returns placement information for the bitmap of a character based on the current character font, size, and alignment.

OPCODE 239

AVAILABILITY Available only with **SpeedoGDOS**[1].

PARAMETERS *handle* specifies a valid workstation handle. *ch* is the character to return information about.

The **fix31** variables pointed to by *advx*, *advy*, *xoff*, and *yoff* will be filled in with the x and y advance and offset vectors respectively. The **WORD**s pointed to by *width* and *height* will be filled in with the width and height of the bitmap pointed to by the value returned in *bitmap*.

BINDING

```
contrl[0] = 239;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = ch;

vdi();

*width = intout[0];
*height = intout[1];
*advx = *(fix31 *)&intout[2];
```

[1]This call did exist in **FSMGDOS**, however the call had a completely different calling format. Atari changed the existing call as no **FSMGDOS** program had yet been written to utilize it.

```
*advy = *(fix31 *)&intout[4];
*xoff = *(fix31 *)&intout[6];
*yoff = *(fix31 *)&intout[8];
*bitmap = *(void *)&intout[10];
```

COMMENTS The advance vector represents the amount to add to the current point to properly place the character. The offset vector, when added to the current point, give the location of the upper-left corner of the bitmap.

v_getoutline()

VOID v_getoutline(***handle, ch, xyarray, bezarray, maxverts, numverts*** **)**
WORD *handle, ch*;
WORD *xyarray;
char *bezarray;
WORD maxverts;
WORD *numverts;

v_getoutline() returns information about an **SpeedoGDOS** character required to generate the character with bezier curves.

OPCODE 243

AVAILABILITY Available only with **SpeedoGDOS**[2].

PARAMETERS *handle* specifies a valid workstation handle. *ch* specifies the character to return information about. The arrays pointed to by *xyarray* and *bezarray* are filled in with the bezier information for the character. The definition of *xyarray* and *bezarray* is given in the binding for **v_bez()**.

maxverts should indicate the maximum number of vertices the buffer can hold. The **WORD** pointed to by *numverts* will be filled in with the actual number of vertices for the character.

BINDING

```
contrl[0] = 243;
contrl[1] = 0;
contrl[3] = 6;
contrl[6] = handle;

intin[0] = ch;
intin[1] = maxverts;
*(WORD *)&intin[2] = xyarray;
*(WORD *)&intin[4] = bezarray;

vdi();
```

[2]This call was present under **FSMGDOS**, however it's binding has dramatically changed. Applications using this binding will not operate under the older **FSMGDOS**.

```
*numverts = intout[0];
```

v_get_pixel()

VOID v_get_pixel(***handle, x, y, pindex, vindex*** **)**
WORD ***handle, x, y*****;**
WORD ****pindex, *vindex*****;**

v_get_pixel() returns the color value for a specified coordinate on the screen.

OPCODE 105

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle. *x* any *y* specify the coordinate to return color information for.

In a palette-based mode the **WORD** pointed to by *pindex* will contain the hardware register index of the color and the **WORD** pointer to by *vindex* will contain the **VDI** index of the color.

In 16-bit true-color modes, *pindex* will be 0 and *vindex* will return the 16-bit RGB pixel value in the format {RRRR RGGG GGGB BBBB}.

In 32-bit color modes, the lower byte of *vindex* will contain the 8 bits of red data, the upper byte of *pindex* will contain the 8 bits of green data, and the lower byte of *pindex* will contain the 8 bits of blue data. The upper byte of *vindex* is reserved for non-color data.

BINDING

```
contrl[0] = 105;
contrl[1] = 1;
contrl[3] = 0;
contrl[6] = handle;

ptsin[0] = x;
ptsin[1] = y;

vdi();

*pindex = intout[0];
*vindex = intout[1];
```

v_gtext()

VOID v_gtext(***handle, x, y, str*****)**
WORD ***handle, x, y*****;**
char ***str*****;**

v_gtext() outputs graphic text.

OPCODE 8

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the starting coordinates of the text (see **vst_alignment()**). *str* is a pointer to a **NULL**-terminated character string to print.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*str++);

contrl[0] = 8;
contrl[1] = 1;
contrl[3] = --i;
contrl[6] = handle;

ptsin[0] = x;
ptsin[1] = y;

vdi();
```

COMMENTS The text contained in *str* (including its **NULL** byte) should not exceed the maximum allowable size of the *intin* array (as indicated in the *work_out* array) or the size of the *intin* array allocated by your compiler.

Using this function to output outline text with **FSMGDOS** is possible to remain backward-compatible but not recommended as it will introduce small errors as spacing remainders are lost.

SEE ALSO **v_ftext(), v_ftext_offset(), vst_color(), vst_effects(), vst_alignment(), vst_height(), vst_point()**

v_hardcopy()

VOID v_hardcopy(*handle*)
WORD *handle*;

v_hardcopy() invokes the ALT-HELP screen dump.

OPCODE 5

SUB-OPCODE 17

AVAILABILITY Supported by screen drivers running under ST compatible resolutions.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 17;
contrl[6] = handle;

vdi();
```

CAVEATS This function works in only ST compatible screen modes and should thus be avoided.

SEE ALSO **Scrdmp()**

v_hide_c()

VOID v_hide_c(*handle*)
WORD *handle*;

v_hide_c() hides the mouse cursor.

OPCODE 123

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 123;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();
```

COMMENTS This call is nested. For each time you call this function you must call **v_show_c()** an equal number of times to show the mouse.

SEE ALSO **v_show_c(), graf_mouse()**

v_justified()

VOID v_justified(***handle, x, y, str, length, wflag, cflag*****)**
WORD ***handle, x, y*****;**
char ****str*****;**
WORD ***length, wflag, cflag*****;**

v_justified() outputs justified graphics text.

OPCODE 11

SUB-OPCODE 10

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the starting coordinates at which to draw the **NULL**-terminated text string (see **vst_alignment()**) pointed to by *str*. *length* specifies the pixel length of the area to justify on.

wflag and *cflag* specify the type of justification to perform between words and characters respectively. A value of **NOJUSTIFY** (0) indicates no justification whereas a value of **JUSTIFY** (1) indicates to perform justification.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*str++);

contrl[0] = 11;
contrl[1] = 2;
contrl[3] = --i;
contrl[5] = 10;
contrl[6] = handle;

intin[0] = wflag;
intin[1] = cflag;

ptsin[0] = x;
```

```
ptsin[1] = y;
ptsin[2] = length;
ptsin[3] = 0;

vdi();
```

COMMENTS This call does not take into account remainder information from outline fonts.

SEE ALSO **v_gtext(), v_ftext(), vst_color(), vst_font(), vst_effects(), vst_alignment(), vst_point(), vst_height()**

v_killoutline()

VOID v_killoutline(***handle, outline*****)**
WORD ***handle*****;**
FSMOUTLINE ***outline*****;**

v_killoutline() releases an outline from memory.

OPCODE 242

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

COMMENTS Under **FSMGDOS** this call was required to release memory allocated for an outline returned from **v_getoutline()**. With **SpeedoGDOS**, this call is no longer required and is thus not documented further.

SEE ALSO **v_getoutline()**

v_loadcache()

WORD v_loadcache(***handle, fname, mode*****)**
WORD ***handle*****;**
char ****fname***;**
WORD ***mode*****;**

v_loadcache() loads a previously saved cache file from disk.

OPCODE 250

AVAILABILITY Supported only by **FSMGDOS** and **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *fname* specifies the **GEMDOS** file

specification of the cache file to load. *mode* specifies whether current data will be flushed first. A value of 0 will append the loaded cache to the current cache whereas a value of 1 will flush the cache prior to loading.

BINDING

```
WORD i = 1;

intin[0] = mode;
while(intin[i++] = (WORD)*fname++);

contrl[0] = 250;
contrl[1] = 0;
contrl[3] = --i;
contrl[6] = handle;

vdi();

return intout[0];
```

RETURN VALUE **v_loadcache()** returns 0 if successful or -1 if an error occurred.

COMMENTS This command only affects the cache responsible for storing bitmaps created from outline characters.

SEE ALSO **v_savecache(), v_flushcache()**

v_meta_extents()

VOID v_meta_extents(***handle, xmin, ymin, xmax, ymax*****)**
WORD ***handle, xmin, ymin, xmax, ymax*****;**

v_meta_extents() embeds placement information for a metafile.

OPCODE 5

SUB-OPCODE 98

AVAILABILITY Supported by all metafile drivers.

PARAMETERS *handle* specifies a valid workstation handle. *xmin* and *ymin* specify the upper left corner of the bounding box of the metafile. *xmax* and *ymax* specify the lower left corner.

BINDING

```
contrl[0] = 5;
contrl[1] = 2;
contrl[3] = 0;
contrl[5] = 98;
contrl[6] = handle;

ptsin[0] = xmin;
```

```
ptsin[1] = ymin;
ptsin[2] = xmax;
ptsin[3] = ymax;

vdi();
```

COMMENTS Parameters sent to this call should be specified in whatever coordinate system the metafile is currently using.

SEE ALSO **vm_pagesize()**

v_opnvwk()

VOID v_opnvwk(***work_in, handle, work_out*** **)**
WORD *****work_in, *handle, *work_out;

v_opnvwk() opens a virtual **VDI** workstation.

OPCODE 100

AVAILABILITY Supported by all drivers.

PARAMETERS *work_in* is a pointer to an array of 11 **WORD**s which define the inital defaults for the workstation as follows:

work_in[x]	Meaning
0	Device identification number. This indicates the physical device ID of the device (the line number of the driver in ASSIGN.SYS when using **GDOS**). For screen devices you should normally use the value **Getrez()** + 2, however, a value of 1 is acceptable if not using any loaded fonts.
1	Default line type (same as **vsl_type()**).
2	Default line color (same as **vsl_color()**).
3	Default marker type (same as **vsm_type()**).
4	Default marker color (same as **vsm_color()**).
5	Default font (same as **vst_font()**).
6	Default text color (same as **vst_color()**).
7	Default fill interior.
8	Default fill style.
9	Default fill color.

10	Coordinate type flag. A value of 0 specifies NDC 'Normalized Device Coordinates' coordinates whereas a value of 2 specifies RC 'Raster Coordinates'. All other values are reserved. NDC coordinates are only available when using external drivers with **GDOS**.

handle should be set to the current handle (not the device ID) of the physical workstation for this device. For screen devices this is the value returned by **graf_handle()**. On exit *handle* will be filled in the **VDI** workstation handle allocated, if successful, or 0 if the workstation could not be opened.

work_out points to an array of 57 **WORD**s which on exit will be filled in by the **VDI** with information regarding the allocated workstation as follows (a structure name is listed beside its array member for those using the 'C' style **VDI_Workstation** structure instead of the array):

work_out[x]	VDI Structure Member	Meaning
0	*xres*	Width of device in pixels - 1.
1	*yres*	Height of device in pixels - 1.
2	*noscale*	Device coordinate units flag: 0 = Device capable of producing a precisely scaled image (screen, printer, etc...) 1 = Device not capable of producing a precisely scaled image (film recorder, etc...)
3	*wpixel*	WIdth of pixel in microns (1/25400 inch).
4	*hpixel*	Height of pixel in microns (1/25400 inch).
5	*cheights*	Number of character heights (0 = continuous scaling).
6	*linetypes*	Number of line types.
7	*linewidths*	Number of line widths (0 = continous scaling).
8	*markertypes*	Number of marker types.
9	*markersizes*	Number of marker sizes (0 = continuous scaling).
10	*faces*	Number of faces supported by the device.
11	*patterns*	Number of available patterns.
12	*hatches*	Number of available hatches.
13	*colors*	Number of predefined colors/pens (ST High = 2, ST Medium = 4, TT Low = 256, True Color = 256).
14	*ngdps*	Number of supported GDP's

15-24	*cangdps[10]*	*cangdps*[0 – (*ngdps* - 1)] contains a list of the GDP's the device supports as follows: 1 = Bar 2 = Arc 3 = Pie Slice 4 = Circle 5 = Ellipse 6 = Elliptical Arc 7 = Elliptical Pie 8 = Rounded Rectangle 9 = Filled Rounded Rectangle 10 = Justified Graphics Text
25-34	*gdpattr[10]*	For each GDP as listed above, *gdpattr*[0 – (*ngdps* - 1)] indicates the attributes which are applied to that GDP as follows: 1 = Polyline (vsl_...) 2 = Polymarker (vsm_...) 3 = Text (vst_...) 4 = Fill Area (vsf_...) 5 = None
35	*cancolor*	Color capability flag. 0 = No 1 = Yes
36	*cantextrot*	Text rotation flag. 0 = No 1 = Yes
37	*canfillarea*	Fill area capability flag. 0 = No 1 = Yes
38	*cancellarray*	Cell array capability flag. 0 = No 1 = Yes
39	*palette*	Number of available colors in palette. 0 = > 32767 colors 2 = Monochrome >2 = Color
40	*locators*	Number of locator devices. 1 = Keyboard only. 2 = Keyboard and other.
41	*valuators*	Number of valuator devices. 1 = Keyboard only. 2 = Keyboard and other.
42	*choicedevs*	Number of choice devices. 1 = Function keys. 2 = Function keys + keypad.
43	*stringdevs*	Number of string devices. 1 = Keyboard.
44	*wstype*	Workstation type. 0 = Output only 1 = Input only 2 = Input/Output 3 = Metafile
45	*minwchar*	Minimum character width in pixels.
46	*minhchar*	Minimum character height in pixels.
47	*maxwchar*	Maximum character width in pixels.

48	*maxhchar*	Maximum character height in pixels.
49	*minwline*	Minimum line width.
50	*zero5*	Reserved (0).
51	*maxwline*	Maximum line width.
52	*zero7*	Reserved (0).
53	*minwmark*	Minimum marker width.
54	*minhmark*	Minimum marker height.
55	*maxwmark*	Maximum marker width.
56	*maxhmark*	Maximum marker height.

BINDING

```
WORD i;

contrl[0] = 100;
contrl[1] = 0;
contrl[3] = 11;
contrl[6] = *handle;

for(i = 0;i < 11;i++)
       intin[i] = work_in[i];

vdi();

*handle = contrl[6];

for(i = 0;i < 45;i++)
       work_out[i] = intout[i];

for(i = 0;i < 13;i++)
       work_out[45+i] = intout[i];
```

CAVEATS

The **VDI** included with **TOS** versions less than 2.06 sometimes returned the same handle for consecutive calls using the same physical handle.

COMMENTS

Using multiple virtual workstations provides the benefit of being able to define multiple sets of default line types, text faces, etc... without having to constantly set them.

The **VDI_Workstation** structure method is the recommended method of using this function. See the **VDI** entry for **V_Opnwk()** and **V_Opnvwk()**.

Desk accessories running under **TOS** versions below 1.4 should not leave a workstation open across any call which might surrender control to **GEM** (**evnt_button()**, **evnt_multi()**, etc...). This could give **GEM** time to change screen resolutions and **TOS** versions below 1.4 did not release memory allocated by a desk accessory (including workstations) when a resolution change occurred.

SEE ALSO

v_opnwk(), vq_extend(), v_clsvwk(), V_Opnvwk()

V_Opnvwk()

WORD V_Opnvwk(***dev*** **)**
VDI_Workstation ***dev*****;**

V_Opnvwk() is not a component of the **VDI**, rather an interface binding designed to simplify working with virtual screen workstations. It will open a virtual screen workstation with a **VDI_Workstation** structure as a parameter rather than *work_in* and *work_out* arrays.

OPCODE N/A

AVAILABILITY User-defined.

PARAMETERS *ws* is a pointer to a **VDI_Workstation** structure defined as follows (for the meaning of each structure member, refer to **v_opnvwk()**):

```
typedef struct
{
        WORD handle, dev_id;
        WORD wchar, hchar, wbox, hbox;
        WORD xres, yres;
        WORD noscale;
        WORD wpixel, hpixel;
        WORD cheights;
        WORD linetypes, linewidths;
        WORD markertypes, markersizes;
        WORD faces, patterns, hatches, colors;
        WORD ngdps;
        WORD cangdps[10];
        WORD gdpattr[10];
        WORD cancolor, cantextrot;
        WORD canfillarea, cancellarray;
        WORD palette;
        WORD locators, valuators;
        WORD choicedevs, stringdevs;
        WORD wstype;
        WORD minwchar, minhchar;
        WORD maxwchar, maxwchar;
        WORD minwline;
        WORD zero5;
        WORD maxwline;
        WORD zero7;
        WORD minwmark, minhmark;
        WORD maxwmark, maxhmark;
        WORD screentype;
        WORD bgcolors, textfx;
        WORD canscale;
        WORD planes, lut;
        WORD rops;
        WORD cancontourfill, textrot;
        WORD writemodes;
        WORD inputmodes;
```

```
        WORD textalign, inking, rubberbanding;
        WORD maxvertices, maxintin;
        WORD mousebuttons;
        WORD widestyles, widemodes;
        WORD reserved[38];
 } VDI_Workstation;
```

BINDING

```
WORD
V_Opnvwk( dev )
VDI_Workstation dev;
{
       WORD i, in[11];

       in[0] = Getrez() + 2;
       dev->dev_id = in[0];
       for(i = 1;i < 10; in[i++] = 1);
       in[10] = 2;
       i = graf_handle( &dev->wchar,
            &dev->hchar, &dev->wbox,
            &dev->hbox );

       v_opnvwk( in, &i, &dev->xres );
       dev->handle = i;

       if(i)
        vq_extnd( i, 1, &dev->screentype );

       return (i);
}
```

RETURN VALUE **V_Opnvwk()** returns 0 if non-successful or the workstation handle otherwise.

COMMENTS This function definition is adapted from an article which appeared in the 'Atari .RSC' developers newsletter (Nov '90 - Jan '91).

SEE ALSO **v_opnvwk(), V_Opnwk(), vq_extnd()**

v_opnwk()

VOID v_opnwk(***work_in, handle, work_out*** **)**
WORD * ***work_in, *handle, *work_out*****;**

v_opnwk() opens a physical workstation.

OPCODE 1

AVAILABILITY Available only with some form of **GDOS**.

PARAMETERS All parmeters for this function are consistent with **v_opnvwk()** except as follows:

On entry, *handle* does not need to contain any specific value. On return, however,

it will contain a workstation handle if successful or 0 if the call failed.

BINDING

```
WORD i;

contrl[0] = 1;
contrl[1] = 0;
contrl[3] = 11;

for(i = 0;i < 11;i++)
       intin[i] = work_in[i];

vdi();

*handle = contrl[6];

for(i = 0;i < 45;i++)
       work_out[i] = intout[i];

for(i = 0;i < 13;I++)
       work_out[45+i] = ptsout[i];
```

COMMENTS Physical workstations should be opened when needed and closed immediately afterwards. For example, a word processor should *not* open the printer workstation when the application starts and close it when it ends. If this is done, the user will be unable to change printers with the Printer Setup CPX(s).

SEE ALSO **V_Opnwk(), v_opnvwk(), vq_extnd()**

V_Opnwk()

WORD V_Opnwk(***devno*****,** ***dev*** **)**
WORD ***devno*****;**
VDI_Workstation ***dev*****;**

V_Opnwk() is not a component of the **VDI**, rather an interface binding designed to simplify working with **VDI** workstations. It will open a physical workstation using a **VDI_Workstation** structure rather than *work_in* and *work_out*.

OPCODE N/A

AVAILABILITY User-defined.

PARAMETERS *devno* specifies the device ID of the device to open. Valid values for *devno* follow:

1-10	=	Screen (loaded device drivers only)
11-20	=	Plotters
21-30	=	Printers
31-40	=	Metafile Drivers

41-50 = Camera Drivers
51-60 = Tablet Drivers
61-70 = Memory Drivers

ws is a **VDI_Workstation** structure as defined in **V_Opnvwk()**.

BINDING

```
WORD
V_Opnvwk( devno, dev )
WORD devno;
VDI_Workstation dev;
{
        WORD i, in[11];

        in[0] = dev->dev_id = devno;
        for(i = 1;i < 10; in[i++] = 1);
        in[10] = 2;
        i = devno;

        v_opnvwk( in, &i, &dev->xres );
        dev->handle = i;

        if(i)
          vq_extnd( i, 1, &dev->screentype );

        return (i);
}
```

RETURN VALUE **V_Opnwk()** returns a workstation handle if successful or 0 if the call failed.

COMMENTS This function definition is adapted from an article which appeared in the 'Atari .RSC' developers newsletter (Nov '90 - Jan '91).

SEE ALSO **v_opnwk(), vq_extnd(), v_opnvwk(), V_Opnvwk()**

v_output_window()

VOID v_output_window(*handle*, *pxy*)
WORD *handle*;
WORD **pxy*;

v_output_window() outputs a specified portion of the current page.

OPCODE 5

SUB-OPCODE 22

AVAILABILITY Supported by all printer and metafile drivers under any type of **GDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *pxy* is a pointer to an array of four

WORDs in **VDI** rectangle format which specifies the bounding extents of the current page to output.

BINDING

```
contrl[0] = 5;
contrl[1] = 2;
contrl[3] = 0;
contrl[5] = 21;
contrl[6] = handle;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];

vdi();
```

CAVEATS Some printer drivers ignore the sides of the bounding box specified and print the entire width of the page.

COMMENTS This call is similar to **v_updwk()** except that only a portion of the page is output.

SEE ALSO **v_updwk()**

v_pgcount()

VOID v_pgcount(***handle, numcopies*****)**
WORD ***handle, numcopies*****;**

v_pgcount() is used to cause the laser printer to output multiple copies of the current page.

OPCODE 5

SUB-OPCODE 2000

AVAILABILITY Supported only with some laser printer drivers (for instance the Atari laser printer driver) under some form of **GDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *numcopies* specifies the number of copies to print minus one. A value of 0 means print one copy, a value of 1, two copies, and so on.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 1;
contrl[5] = 2000;
contrl[6] = handle;

intin[0] = numcopies;
```

```
vdi();
```

COMMENTS This call is preferred over repeatedly calling **v_updwk()** and **v_form_adv()** as this method forces the printer data to be resent for each page.

v_pieslice()

VOID v_pieslice(***handle, x, y, radius, startangle, endangle*** **)**
WORD ***handle, x, y, radius, startangle, endangle*****;**

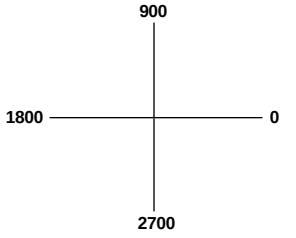
v_pieslice() outputs a filled pie segment.

OPCODE 11

SUB-OPCODE 3

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* specify the center of a circlular segment of radius *radius* which is drawn between the angles of *startangle* and *endangle* (specified in tenths of degrees - legal values illustrated below) and connected to the center point.



BINDING

```
contrl[0] = 11;
contrl[1] = 4;
contrl[3] = 2;
contrl[5] = 3;
contrl[6] = handle;

ptsin[0] = x;
ptsin[1] = y;
ptsin[2] = ptsin[3] = ptsin[4] = ptsin[5] = 0
ptsin[6] = radius;

intin[0] = startangle;
```

```
intin[1] = endangle;

vdi();
```

SEE ALSO **v_ellpie(), vsf_color(), vsf_style(), vsf_interior(), vsf_udpat(), vsf_perimeter()**

v_pline()

VOID v_pline(***handle, count, pxy*** **)**
WORD ***handle, count*****;**
WORD *****pxy***;**

v_pline() outputs a polyline (group of one or more lines).

OPCODE 6

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *count* specifies the number of vertices in the line path (2 to plot a single line). *pxy* points to a **WORD** array with *count* * 2 elements containing the vertices to plot as in (X1, Y1), (X2, Y2), etc...

BINDING

```
WORD i;

contrl[0] = 6;
contrl[1] = count;
contrl[3] = 0;
contrl[6] = handle;

for(i = 0;i < (count*2);i++)
       ptsin[i] = count[i];

vdi();
```

COMMENTS To draw a single point with this function, *pxy[2]* should equal *pxy[0]*, *pxy[3]* should equal *pxy[1]*, and *count* should be 2.

SEE ALSO **v_fillarea(), vsl_color(), vsl_type(), vsl_udsty(), vsl_ends()**

v_pmarker()

VOID v_pmarker(***handle, count, pxy*** **)**
WORD ***handle, count*****;**
WORD *****pxy***;**

v_pmarker() outputs one or several markers.

OPCODE 7

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation. *count* specifies the number of markers to plot. *pxy* points to a **WORD** array with (*count* * 2) elements containing the vertices of the markers to plot as in (X1, Y1), (X2, Y2), etc...

BINDING

```
WORD i;

contrl[0] = 7;
contrl[1] = count;
contrl[3] = 0;
contrl[6] = handle;

for(i = 0;i < (count * 2); i++)
       ptsin[i] = pxy[i];

vdi();
```

COMMENTS Single points may be plotted quickly with this function when the proper marker type is selected with **vsm_type()**.

SEE ALSO **vsm_type(), vsm_height(), vsm_color()**

v_rbox()

VOID v_rbox(***handle, pxy*** **)**
WORD ***handle*****;**
WORD *****pxy***;**

v_rbox() outputs a rounded box (not filled).

OPCODE 11

SUB-OPCODE 8

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* specifies a valid workstation handle. *pxy* points to an array of 4 **WORD**s containing the **VDI** format rectangle of the rounded box to output.

BINDING

```
contrl[0] = 11;
contrl[1] = 2;
contrl[3] = 0;
contrl[5] = 8;
contrl[6] = handle;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];

vdi();
```

CAVEATS There is no way to define to size of the 'roundness' of the corners.

SEE ALSO **v_rfbox(), v_bar(), vsl_type(), vsl_color(), vsl_udsty(), vsl_ends()**

v_rfbox()

VOID v_rfbox(*handle, pxy*)
WORD *handle*;
WORD **pxy*;

v_rfbox() outputs a filled rounded-rectangle.

OPCODE 11

SUB-OPCODE 9

AVAILABILITY Supported by all drivers. This function composes one of the 10 **VDI** GDP's (Generalized Drawing Primitives). Although all current drivers support all GDP's, their availability is not guaranteed and may vary. To check for a particular GDP refer to the table returned by **v_opnvwk()** or **v_opnwk()**.

PARAMETERS *handle* specifies a valid workstation handle. *pxy* points to an array of four **WORD**s which specify the **VDI** format rectangle of the rounded-rectangle to output.

BINDING

```
contrl[0] = 11;
```

```
contrl[1] = 2;
contrl[3] = 0;
contrl[5] = 9;
contrl[6] = handle;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];

vdi();
```

CAVEATS There is no way to specify the 'roundness' of the rectangle.

SEE ALSO **v_rbox(), v_bar(), vsf_color(), vsf_style(), vsf_interior(), vsf_udpat()**

v_rmcur()

VOID v_rmcur(***handle*** **)**
WORD *handle*;

v_rmcur() removes the last mouse cursor displayed.

OPCODE 5

SUB-OPCODE 19

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 19;
contrl[6] = handle;

vdi();
```

COMMENTS **v_rmcur()** should only be used in conjunction with **v_dspcur()** when the mouse is moved manually. **graf_mouse()** or **v_hide_c()** should be used unless this is your intention.

SEE ALSO **v_hide_c(), graf_mouse()**

v_rvoff()

VOID v_rvoff(*handle*)
WORD *handle*;

v_rvoff() causes alpha screen text to be displayed in normal video (as opposed to inverse).

OPCODE 5

SUB-OPCODE 14

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 14;
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-Q VT-52 code.

SEE ALSO **v_rvon(), v_curtext()**

v_rvon()

VOID v_rvon(*handle*)
WORD *handle*;

v_rvon() causes alpha screen text to be displayed in inverse mode.

OPCODE 5

SUB-OPCODE 13

AVAILABILITY Supported by all screen devices.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
```

```
contrl[5] = 13;
contrl[6] = handle;

vdi();
```

COMMENTS This call is equivalent to the ESC-P VT-52 code.

SEE ALSO **v_rvoff(), v_curtext()**

v_savecache()

WORD v_savecache(***handle, fname*** **)**
WORD *handle*;
char ****fname***;**

v_savecache() saves the current outline cache.

OPCODE 249

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *fname* specifies the **GEMDOS** file specification of the cache file to save.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*fname++);

contrl[0] = 249;
contrl[1] = 0;
contrl[3] = --i;
contrl[6] = handle;

vdi();

return intout[0];
```

RETURN VALUE **v_savecache()** returns 0 if successful or -1 if an error occurred.

COMMENTS This call only saves the portion of the cache responsible for storing bitmaps created from outlines.

SEE ALSO **v_loadcache(), v_flushcache()**

v_set_app_buff()

VOID v_set_app_buff(***but, nparagraphs*** **)**
VOID ****buf*;**
WORD ***nparagraphs***;

v_set_app_buff() designates memory for use by the bezier generation routines.

OPCODE -1

SUB-OPCODE 6

AVAILABILITY Available only with **FONTGDOS**, **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *buf* specifies the address of a buffer which the bezier generator routines may safely use. *nparagraphs* specifies the size of the buffer in 'paragraphs' (16 bytes).

BINDING

```
contrl[0] = -1;
contrl[1] = 0;
contrl[3] = 2;
contrl[5] = 6;

*(VOID *)&intin[0] = buf;
intin[2] = nparagraphs;

vdi();
```

COMMENTS Before the application exits, it should call **v_set_app_buff(NULL, 0)** to 'unmark' memory. The application is then responsible for deallocating the memory.

In the absence of this call the first **v_bez()** or **v_bezfill()** call will allocate its own buffer of 8K. Atari documentation recommends a size of about 9K depending on the extents of the bezier you wish to generate.

SEE ALSO **v_bez()**

v_show_c()

VOID v_show_c(***handle, reset*** **)**
WORD ***handle, reset***;

v_show_c() 'unhides' the mouse cursor.

OPCODE 122

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle. If *reset* is 0 the mouse will be displayed regardless of the number of times it was 'hidden'. Otherwise, the call will only display the cursor if the function has been called an equal number of times compared to **v_hide_c()**.

BINDING

```
contrl[0] = 122;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = reset;

vdi();
```

CAVEATS While it may be tempting to always use a *reset* value of 0, it is not recommended. Doing so may confuse the system so that when the critical error handler is called, the mouse is not displayed.

SEE ALSO **v_hide_c(), graf_mouse()**

v_updwk()

VOID v_updwk(*handle*)
WORD *handle*;

v_updwk() outputs the current page to the specified device.

OPCODE 4

AVAILABILITY Supported by all printer, metafile, plotter, and camera devices when using any form of **GDOS**.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 4;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();
```

COMMENTS This call does not cause the 'page' to be ejected. You must use either **v_clrwk()** or **v_form_adv()** to accomplish that.

SEE ALSO **v_clrwk(), v_form_adv()**

v_write_meta()

VOID v_write_meta(***handle, intin_len, intin, ptsin_len, ptsin*** **)**
WORD ***handle, intin_len*****;**
WORD ****intin*****;**
WORD ***ptsin_len*****;**
WORD ****ptsin*****;**

v_write_meta() writes a customized metafile sub-opcode.

OPCODE 5

SUB-OPCODE 99

AVAILABILITY Supported by all metafile drivers.

PARAMETERS *handle* specifies a valid workstation handle. *intin* points to an array of **WORD**s with *intin_len* (0-127) elements. *ptsin* points to an array of **WORD**s with *ptsin_len* (0-127) elements. *ptsin* is not required to be of any length, however, *intin* should be at least one word long to specify the sub-opcode in *intin[0]*. Sub-opcodes 0-100 are reserved for use by Atari. Several pre-defined sub-opcodes in this range already exist as follows:

Sub-Opcode: intin[0]	Meaning
10	Start group.
11	End group.
49	Set no line style.
50	Set attribute shadow on.
51	Set attribute shadow off.
80	Start draw area type primitive.
81	End draw area type primitive.

BINDING

```
WORD i;

contrl[0] = 5;
contrl[1] = ptsin_len;
contrl[3] = intin_len;
contrl[5] = 99;
contrl[6] = handle;

for(i = 0;i < intin_len; i++)
       intin[i] = m_intin[i];
for(i = 0;i < ptsin_len; i++)
       ptsin[i] = m_ptsin[i];
```

```
vdi();
```

COMMENTS Metafile readers should ignore and safely skip any opcodes not understood.

vex_butv()

VOID vex_butv(*handle, butv, old_butv*)
WORD *handle*;
WORD (butv*)((WORD) *bstate*);**
WORD (*old_butv*)((WORD) *bstate*);**

vex_butv() installs a routine which is called by the **VDI** every time a mouse button is pressed.

OPCODE 125

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid physical workstation handle. *butv* points to a user-defined button-click handler routine. The address pointed to by *old_butv* will be filled in with the address of the old button-click handler.

BINDING

```
contrl[0] = 125;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;
contrl[7] = (WORD)((LONG)butv >> 16);
contrl[8] = (WORD)((LONG)butv);

vdi();

*(LONG *)old_butv = (LONG)(((LONG)contrl[9] << 16) |
       (LONG)contrl[10]);
```

COMMENTS Upon entry to *butv*, the mouse status is contained in 68x00 register D0 (in the same format as the button return value in **vq_mouse()**). A 'C' handler should, therefore, be sure to specify register calling parameters for this function. Any registers which will be modifed should be saved and restored upon function exit. The routine may call the **BIOS** and/or **XBIOS** sparingly but should not call the **AES**, **VDI**, or **GEMDOS**.

SEE ALSO **vex_curv(), vex_motv()**

vex_curv()

VOID vex_curv(***handle, curv, old_curv*** **)**
WORD ***handle*****;**
WORD (***curv*****)((WORD)** ***mx*****, (WORD)** ***my*** **);**
WORD (****old_curv*****)((WORD)** ***mx*****, (WORD)** ***my*** **);**

vex_curv() installs a routine which is called every time the mouse cursor is drawn allowing a customized mouse rendering routine to replace that of the system.

OPCODE 126

AVAILABILITY Supported by all screen devices.

PARAMETERS *handle* specifies a valid physical workstation handle. *curv* points to a user defined function which will be called every time the mouse is to be refreshed. *old_curv* is the address of a pointer to the old rendering routine which will be filled in by the function on exit.

BINDING

```
contrl[0] = 126;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;
contrl[7] = (WORD)((LONG)curv >> 16);
contrl[8] = (WORD)((LONG)curv);

vdi();

*(LONG *)old_curv = (LONG)(((LONG)contrl[9] << 16) |
       (LONG)contrl[10]);
```

COMMENTS Upon entry to *curv*, the mouse's X and Y location on screen is contained in 68x00 registers D0 and D1 respectively. A 'C' handler should, therefore, be sure to specify register calling parameters for this function. Any registers which will be modifed should be saved and restored upon function exit. The routine may call the **BIOS** and/or **XBIOS** sparingly but should not call the **AES**, **VDI**, or **GEMDOS**.

SEE ALSO **vex_butv(), vex_motv()**

vex_motv()

VOID vex_motv(*handle, motv, old_motv*)
WORD *handle*;
WORD (motv*)((WORD) *mx*, (WORD) *my*);**
WORD (*old_motv*)((WORD) *mx*, (WORD) *my*);**

vex_motv() installs a user routine which is called every time the mouse pointer is moved.

OPCODE 126

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid physical workstation handle. *motv* points to a user-defined routine which is called every time the mouse is moved. *old_motv* is an address to a pointer which will be filled in containing the address of the old function.

BINDING

```
contrl[0] = 126;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;
contrl[7] = (WORD)((LONG)motv >> 16);
contrl[8] = (WORD)((LONG)motv);

vdi();

*(LONG *)old_motv = (LONG)(((LONG)contrl[9] << 16) |
       (LONG)contrl[10]);
```

COMMENTS Upon entry to *motv*, the mouse's new X and Y location is contained in 68x00 registers D0 and D1 respectively. A 'C' handler should, therefore, be sure to specify register calling parameters for this function. Any registers which will be modifed should be saved and restored upon function exit. The routine may call the **BIOS** and/or **XBIOS** sparingly but should not call the **AES**, **VDI**, or **GEMDOS**. The routine may modify the contents of D0 and D1 as necessary to affect the movement of the mouse (one way of implementing a mouse accelerator).

SEE ALSO **vex_curv(), vex_butv()**

vex_timv()

VOID vex_timv(*handle, timv, old_timv, mpt*)
WORD *handle*;
VOID (timv*)(VOID);**
VOID (*old_timv*)(VOID);**
WORD **mpt*;

vex_timv() installs a user-defined routine that will be called at each timer tick (currently once every 50 milliseconds).

OPCODE 118

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid physical workstation handle. *timv* should point to a user-defined timer tick routine. *old_timv* is an address to a pointer which will be filled in with the old timer tick routine. *mpt* is a pointer to a **WORD** which will be filled in with the value representing the current number of milliseconds per timer tick.

BINDING

```
contrl[0] = 118;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;
contrl[7] = (WORD)((LONG)timv >> 16);
contrl[8] = (WORD)((LONG)timv);

vdi();

*(LONG *)old_timv = (LONG)(((LONG)contrl[9] << 16) |
       (LONG)contrl[10]);
```

COMMENTS Any registers which will be modifed should be saved and restored upon function exit. The routine may call the **BIOS** and/or **XBIOS** sparingly but should not call the **AES**, **VDI**, or **GEMDOS**. The routine should fall through to the old routine. As this vector is jumped through quite often, the routine should be very simple to avoid system performance slowdowns.

vm_coords()

VOID vm_coords(*handle, xmin, ymin, xmax, ymax*)
WORD *handle, xmin, ymin, xmax, ymax*;

vm_coords() allows the use of variable coordinate systems with metafiles.

OPCODE 5

SUB-OPCODES 99, 1

AVAILABILITY Supported by all metafile drivers.

PARAMETERS *handle* specifies a valid workstation handle. *xmin* and *ymin* specify the coordinate pair which provides an anchor for the upper-left point of the coordinate system. *xmax* and *ymax* specify the coordinate pair which provides an anchor for the lower-right point of the coordinate system.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 5;
contrl[5] = 99;
contrl[6] = handle;

intin[0] = 1;
intin[1] = xmin;
intin[2] = ymin;
intin[3] = xmax;
intin[4] = ymax;

vdi();
```

COMMENTS Use of this function allows the use of practically any coordinate system with a limit of (-32768, -32768), (32767, 32767).

Metafiles default to a coordinate space of (0, 32767), (32767, 0).

SEE ALSO **vm_pagesize(), v_meta_extents()**

vm_filename()

VOID vm_filename(*handle, fname*)
WORD *handle*;
char **fname*;

vm_filename() allows specfying a user-defined filename for metafile output.

OPCODE 5

SUB-OPCODE 100

AVAILABILITY Supported by all metafile drivers.

PARAMETERS *handle* specifys a valid workstation handle. *fname* points to a **NULL**-terminated **GEMDOS** filename which all metafile output should be redirected to.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*fname++);

contrl[0] = 5;
contrl[1] = 0;
contrl[3] = --i;
contrl[5] = 100;
contrl[6] = handle;

vdi();
```

CAVEATS When a metafile is opened, the default file 'GEMFILE.GEM' is created in the current **GEMDOS** path on the current drive and is not deleted as a result of this call. You will need to manually delete it yourself.

COMMENTS This call should be made immediately after a **v_opnwk()** to a metafile handle if you wish to use an alternate filename to prevent data from being lost.

vm_pagesize()

VOID vm_pagesize(***handle, pwidth, pheight*** **)**
WORD ***handle, pwidth, pheight*****;**

vm_pagesize() specifys a metafile's source page size.

OPCODE 5

SUB-OPCODES 99, 0

AVAILABILITY Supported by all metafile drivers.

PARAMETERS *handle* specifies a valid workstation handle. *pwidth* specifies the width of the page which the metafile was originally placed on in tenths of a millimeter. *pheight* specifies the height of the page which the metafile was originally placed on in tenths of a millimeter.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 2;
contrl[5] = 99;
contrl[6] = handle;

intin[0] = 0;
intin[1] = pwidth;
intin[2] = pheight;

vdi();
```

COMMENTS A metafile originally designed on an 8.5” x 11” page would have a *pwidth* value of 2159 and a *pheight* value of 2794.

SEE ALSO **v_meta_extents()**

vq_cellarray()

VOID vq_cellarray(*handle, pxy, rowlen, num_rows, elements, rows_used, status, colarray*)
WORD *handle*;
WORD **pxy*;
WORD *rowlen, num_rows*;
WORD **elements, *rows_used, *status, *colarray*;

vq_cellarray() returns the cell array definitions of specified pixels.

OPCODE 27

AVAILABILITY Not supported by any known drivers.

PARAMETERS *handle* specifies a valid workstation handle. *pxy* points to an array of 4 **WORD**s which specify a **VDI** format rectangle. *row_length* specifies the length of each row in the color array. *num_rows* specifies the number of total rows in the color array.

Upon return, the **WORD** pointed to by *elements* will indicate the number of array elements used per row. In addition, *rows_used* will be filled in with actual number of rows used by the color array and the **WORD** pointed to by *status* will be filled in with 0 if the operation was successful or 1 if at least one element could not be determined. Finally, the **WORD** array (with (*num_rows* * *row_length*) elements) pointed to by *colarray* will be filled in with the color index array stored one row at a time. On return *colarray* will actually contain (*elements* * *rows_used*) valid elements.

BINDING

```
WORD i;

contrl[0] = 27;
contrl[1] = 2;
contrl[3] = 0;
contrl[6] = handle;
contrl[7] = row_length;
contrl[8] = num_rows;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];
```

```
vdi();

*el_used = contrl[9];
*rows_used = contrl[10];
*status = contrl[11];

for(i = 0;i < contrl[4];i++)
       colarray[i] = intout[i];
```

CAVEATS No driver types are required to utilize this function. It is therefore recommended that it be avoided unless your application is aware of the capabilities of the driver.

SEE ALSO **v_cellarray()**

vq_chcells()

VOID vq_chcells(*handle, rows, columns*)
WORD *handle*;
WORD **rows, *columns*;

vq_chcells() returns the current number of columns and rows on the alpha text mode of the device.

OPCODE 5

SUB-OPCODE 1

AVAILABILITY Supported by all screen and printer drivers.

PARAMETERS *handle* specifies a valid workstation handle. *rows* and *columns* each point to a **WORD** which will be filled in with the current number of rows and columns of the device (in text mode).

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 1;
contrl[6] = handle;

vdi();

*rows = intout[0];
*columns = intout[1];
```

SEE ALSO **v_curtext()**

vq_color()

WORD vq_color(***handle, index, flag, rgb*****)**
WORD ***handle, index, flag*****;**
WORD ****rgb***;**

vq_color() returns RGB information for a particular **VDI** color index.

OPCODE 26

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *index* specifies the **VDI** color index of which you wish to inquire. *rgb* points to an array of 3 **WORD**s which will be filled in with the red, green, and blue values (0-1000) of the color index. The values returned in the RGB array are affected by the value of *flag* as follows:

Name	*flag*	Values returned in *rgb*
COLOR_REQUESTED	0	Return the values as last requested by the user (ie: not mapped to the actual color value displayed).
COLOR_ACTUAL	1	Return the values as the actual color being displayed.

BINDING

```
contrl[0] = 26;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = index;
intin[1] = flag;

vdi();

rgb[0] = intout[1];
rgb[1] = intout[2];
rgb[2] = intout[3];

return intout[0];
```

RETURN VALUE **vq_color()** returns -1 if the specified index is out of range for the device.

COMMENTS Some drivers for color printers do not allow you to modify the color of each register. A simple test will allow you to determine if the driver will allow you to change index colors as follows:

- Call **vq_color()** with a *flag* value of 0 and save the return.
- Call **vs_color()** to modify that color index by a signifigant value.
- Call **vq_color()** with a *flag* value of 0 and compare with what you set.
- Restore the old value.

- If equivalent values are returned, you may modify each color index.

SEE ALSO **vs_color()**

vq_curaddress()

VOID vq_curaddress(*handle, row, column*)
WORD *handle*;
WORD **row, *column*;

vq_curaddress() returns the current position of the alpha text cursor.

OPCODE 5

SUB-OPCODE 15

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle. The **WORD**s pointed to by *row* and *column* will be filled in with the current row and column respectively of the text cursor in alpha mode.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 15;
contrl[6] = handle;

vdi();

*row = intout[0];
*column = intout[1];
```

SEE ALSO **v_curtext(), vq_chcells()**

vq_extnd()

VOID vq_extnd(*handle, mode, work_out*)
WORD *handle, mode*;
WORD **work_out*;

vq_extnd() returns extra information about a particular workstation.

OPCODE 102

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. If *mode* is set to 0 then this call fills in the array pointed to by *work_out* with the same 57 **WORD**s which are returned by either **v_opnwk()** or **v_opnvwk()**. If *mode* is 1 then the 57 **WORD**s of *work_out* are filled in with other information as follows:

work_out[x]	VDI Structure Member	Meaning
0	*screentype*	Type of display screen: 0 = Not screen. 1 = Separate alpha/ graphic controllers and displays. 2 = Separate alpha/ graphic controllers with common screen. 3 = Common alpha/ graphic controllers with separate image memory. 4 = Common alpha/ graphic controllers and image memory. (All known devices either return 0 or 4.)
1	*bgcolors*	Number of background colors available.
2	*textfx*	Text effects supported. (Same bitmask as with **vst_effects()**).
3	*canscale*	Scaling of rasters: 0 = Can't scale. 1 = Can scale.
4	*planes*	Number of planes.
5	*lut*	Lookup table supported: 0 = Table not supported. 1 = Table supported. (True color modes return a value of 0 for *lut* and >2 for *colors* in **v_opnvwk()**). See the caveat listed below.
6	*rops*	Performance factor. Number of 16x16 raster operations per second.
7	*cancontourfill*	**v_contourfill()** availability: 0 = Not available. 1 = Available.
8	*textrot*	Character rotation capability: 0 = None. 1 = 90 degree increments. 2 = Any angle of rotation.
9	*writemodes*	Number of writing modes available.
10	*inputmodes*	Highest level of input modes available: 0 = None. 1 = Request. 2 = Sample.
11	*textalign*	Text alignment capability flag: 0 = Not available. 1 = Available.
12	*inking*	Inking capability flag. 0 = Device can't ink. 1 = Device can ink.

13	*rubberbanding*	Rubberbanding capability flag: 0 = No rubberbanding. 1 = Rubberbanded lines. 2 = Rubberbanded lines and rectangles.
14	*maxvertices*	Maximum vertices for polyline, polymarker, or filled area (-1 = no maximum).
15	*maxintin*	Maximum length of intin array (-1 = no maximum).
16	*mousebuttons*	Number of mouse buttons.
17	*widestyles*	Styles available for wide lines? 0 = No 1 = Yes
18	*widemodes*	Writing modes available for wide lines? 0 = No 1 = Yes
19-56	*reserved1*	Reserved for future use.

BINDING

```
WORD i;

contrl[0] = 102;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = mode;

vdi();

for(i = 0;i < 45;i++)
       work_out[i] = intout[i];

for(i = 0;i < 13;i++)
       work_out[45+i] = ptsout[i];
```

COMMENTS

See the entry for **V_Opnwk()** and **V_Opnvwk()** to see how the **vq_extnd()** information and **v_opn/v/wk()** calls are integrated into a 'C' style structure.

CAVEATS

The *lut* member of the **VDIWORK** structure was originally misdocumented by Atari with the values reversed. The Falcon030 as well as some third-party true-color boards return the correct values. Some older boards may not, however.

One alternative method of determining if the current screen is not using a software color lookup table (i.e. true color) is to compare the value for 2 ^ *planes* with the number of colors in the palette found in *colors*. If this number is different, the **VDI** is not using a software color lookup table.

SEE ALSO

v_opnwk(), v_opnvwk(), V_Opnwk(), V_Opnvwk()

vq_gdos()

ULONG vq_gdos(VOID)

vq_gdos() determines the availability and type of **GDOS** present.

OPCODE N/A

AVAILABILITY Supported in ROM by all Atari computers.

BINDING

```
; Correct binding for vq_gdos. Some compilers
; use the name vq_vgdos for the new version
; and vq_gdos for the old version which
; looked like:
;                move.w       #-2,d0
;                trap         #2
;                cmp.w        #-2,d0
;                sne          d0
;                ext.w        d0

_vq_gdos:

move.w       #-2,d0
trap         #2
rts
```

RETURN VALUE Currently one of the following values are returned:

Name	Value	GDOS Type
GDOS_NONE	-2	**GDOS** not installed.
—	Any other value.	**GDOS** 1.0, 1.1, or 1.2 installed.
GDOS_FNT	0x5F464E54 ('**_FNT**')	**FONTGDOS** installed.
GDOS_FSM	0x5F46534D ('**_FSM**')	**FSMGDOS** installed.

COMMENTS Calling a **GDOS** function without **GDOS** loaded is fatal and will cause a system crash.

To determine whether **FSMGDOS** or **SpeedoGDOS** is loaded look for the '**FSMC**' cookie in the cookie jar. The cookie value points to a longword which will contain either '**_FSM**' or '**_SPD**'.

vq_key_s()

VOID vq_key_s(***handle, status*** **)**
WORD ***handle*****;**
WORD ****status*****;**

vq_key_s() returns the current shift-key status.

OPCODE 128

AVAILABILITY Supported by all Atari computers.

PARAMETERS *handle* specifies a valid workstation handle. *status* points to a **WORD** which is filled in on function exit with a bit mask containing the current shift key status as follows:

Name	Bit	Meaning
K_RSHIFT	0	Right shift key depressed
K_LSHIFT	1	Left shift key depressed
K_CTRL	2	Control key depressed
K_ALT	3	Alternate key depressed

BINDING

```
contrl[0] = 128;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

*status = intout[0];
```

SEE ALSO **graf_mkstate()**

vq_mouse()

VOID vq_mouse(***handle, mb, mx, my*** **)**
WORD ***handle*****;**
WORD ****mb, *mx, *my*****;**

vq_mouse() returns information regarding the current state of the mouse.

OPCODE 124

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle. *mb* points to a **WORD** which will be filled in upon function exit with a bit mask indicating the current status of the mouse buttons as follows:

Name	Mask	Meaning
LEFT_BUTTON	0x01	Left mouse button
RIGHT_BUTTON	0x02	Right mouse button
MIDDLE_BUTTON	0x04	Middle button (this button would be the first button to the left of the rightmost button on the device).
—	0x08 . .	Other buttons (0x08 is the mask for the button to the immediate left of the middle button. Masks continue leftwards).

mx and *my* both point to **WORD**s which will be filled in upon function exit with the current position of the mouse pointer.

BINDING

```
contrl[0] = 124;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

*mb = intout[0];
*mx = ptsout[0];
*my = ptsout[1];
```

SEE ALSO **graf_mkstate(), v_key_s()**

vq_scan()

VOID vq_scan(*handle, grh, passes, alh, apage, div*)
WORD *handle*;
WORD *grh, *passes, *alh, *apage, *div;

vq_scan() returns information regarding printer banding.

OPCODE 5

SUB-OPCODE 24

AVAILABILITY Supported by all printer drivers.

PARAMETERS *handle* specifies a valid workstation handle. *passes* specifies the number of graphic passes per printer page.

The value obtained through the formula *grh*/*div* specifies the number of graphics scan lines per pass. The value obtained by the formula *alh*/*div* specifies the number of graphic scan lines per alpha text line. *apage* specifies the number of alpha lines per page.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 24;
contrl[6] = handle;

vdi();

*grh = intout[0];
*passes = intout[1];
*alh = intout[2];
*apage = intout[3];
*div = intout[4];
```

COMMENTS This call has been previously mis-documented.

vq_tabstatus()

WORD vq_tabstatus(*handle*)
WORD *handle*;

vq_tabstatus() determines the availability of a tablet device.

OPCODE 5

SUB-OPCODE 16

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 16;
contrl[6] = handle;

vdi();

return intout[0];
```

RETURN VALUE **vq_tabstatus()** returns 0 if no tablet is available or 1 if a tablet device is present.

SEE ALSO **vq_tdimensions(), vt_origin(), vt_axis(), vt_resolution(), vt_alignment()**

vq_tdimensions()

VOID vq_tdimensions(*handle, xdim, ydim*)
WORD *handle*;
WORD **xdim, *ydim*;

vq_tdimensions() returns the scanning dimensions of the attached graphics tablet.

OPCODE 5

SUB-OPCODE 84

AVAILABILITY Supported by all tablet drivers.

PARAMETERS *handle* specifies a valid workstation handle. *xdim* and *ydim* point to **WORD**s which upon function exit will contain the X and Y dimensions of the tablet scanning area specified in tenths of an inch.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 84;
contrl[6] = handle;

vdi();

*xdim = intout[0];
*ydim = intout[1];
```

SEE ALSO **vq_tabstatus()**

vqf_attributes()

VOID vqf_attributes(*handle, attr*)
WORD *handle*;
WORD **attr*;

vqf_attributes() returns information regarding the current fill attributes.

OPCODE 37

AVAILABILITY Supported by all devices.

PARAMETERS *handle* specifies a valid workstation handle. *attr* points to an array of five **WORD**s which upon exit will be filled in as follows:

attr[x]	Meaning
0	Current fill area interior type (see **vsf_interior()**).
1	Current fill area color (see **vsf_color()**).
2	Current fill area style (see **vsf_style()**).
3	Current writing mode (see **vswr_mode()**).
4	Current perimeter status (see **vsf_perimeter()**).

BINDING

```
contrl[0] = 37;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

attr[0] = intout[0];
attr[1] = intout[1];
attr[2] = intout[2];
attr[3] = intout[3];
attr[4] = intout[4];
```

SEE ALSO **vqt_attributes(), vql_attributes(), vqm_attributes()**

vqin_mode()

VOID vqin_mode(***handle, dev, mode*** **)**
WORD ***handle, dev*****;**
WORD ****mode***;**

vqin_mode() returns the input status of the specified **VDI** device.

OPCODE 115

AVAILABILITY Supported by all Atari computers.

PARAMETERS *handle* specifies a valid workstation handle. *mode* points to a **WORD** which upon exit will be filled in with 1 if the specified device is in request mode or 2 if in sample mode. *dev* specifies the device to inquire as follows:

Name	*dev*	Device
LOCATOR	1	Locator (Mouse, Mouse Buttons, and Keyboard)
VALUATOR	2	Valuator (not currently defined)
CHOICE	3	Choice (not currently defined)
STRING	4	String (Keyboard)

BINDING

```
contrl[0] = 115;
```

```
contrl[1] = 0
contrl[3] = 1;
contrl[6] = handle;

intin[0] = dev;

vdi();

*mode = intout[0];
```

SEE ALSO **vsin_mode()**

vql_attributes()

VOID vql_attributes(***handle, attr*** **)**
WORD *handle*;
WORD ****attr***;**

vql_attributes() returns information regarding current settings which affects line drawing functions.

OPCODE 36

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *attr* is an array of 6 **WORD**s which describe the current parameters for line drawing as follows:

attr[x]	Meaning
0	Line type (see **vsl_type()**).
1	Line color (see **vsl_color()**).
2	Writing mode (see **vswr_mode()**).
3	End style for start of lines (see **vsl_ends()**).
4	End style for end of lines (see **vsl_ends()**).
5	Current line width (see **vsl_width()**).

BINDING

```
contrl[0] = 36;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

attr[0] = intout[0];
attr[1] = intout[1];
attr[2] = intout[2];
attr[3] = intout[3];
attr[4] = intout[4];
```

```
attr[5] = intout[5];
```

SEE ALSO **vqm_attributes(), vqt_attributes(), vqf_attributes()**

vqm_attributes()

VOID vqm_attributes(*handle*, *attr*)
WORD *handle*;
WORD *attr*;

vqm_attributes() returns information regarding current settings which apply to polymarker output.

OPCODE 36

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *attr* points to an array of 5 **WORD**s which specify the current polymarker attributes as follows:

attr[x]	Meaning
0	Marker type (see **vsm_type()**).
1	Marker color (see **vsm_color()**).
2	Writing mode (see **vswr_mode()**).
3	Polymarker width (see **vsm_height()**).
4	Polymarker height (see **vsm_height()**).

BINDING

```
contrl[0] = 36;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

attr[0] = intout[0];
attr[1] = intout[1];
attr[2] = intout[2];
attr[3] = intout[3];
attr[4] = intout[4];
```

SEE ALSO **vql_attributes(), vqt_attributes(), vqf_attributes()**

vqp_error()

WORD vqp_error(*handle*)
WORD *handle*;

vqp_error() returns error information for the camera driver.

OPCODE 5

SUB-OPCODE 96

AVAILABILITY Supported by all camera drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 96;
contrl[6] = handle;

vdi();

return intout[0];
```

RETURN VALUE **vqp_error()** returns the current error state as follows:

Return Value	Error State
0	No error.
1	Open dark slide for print film.
2	No port at location specified by driver.
3	Palette not found at specified port.
4	Video cable disconnected.
5	Memory allocation error.
6	Inadequate memory for buffer.
7	Memory not freed.
8	Driver file not found.
9	Driver file is not correct type.
10	Prompt user to process print film.

COMMENTS Use of this function does not stop the generation of on-screen messages. You must use **vsp_message()** to accomplish that.

SEE ALSO **vsp_message()**

vqp_films()

VOID vqp_films(***handle, films*** **)**
WORD ***handle*****;**
char ****films*****;**

vqp_films() returns strings which represent up to five possible film types for the camera driver to utilize.

OPCODE 5

SUB-OPCODE 91

AVAILABILITY Supported by all camera drivers.

PARAMETERS *handle* specifies a valid workstation handle. *films* is a character pointer to a buffer at least 125 characters in length. Upon return *films* will be filled in with 5 character strings. Bytes 0-24 will contain a string for the first type of film, bytes 25-49 will contain a string for the second type, and so on. These strings are not **NULL**-terminated but are padded with spaces.

BINDING

```
WORD i;

contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 91;
contrl[6] = handle;

vdi();

for(i = 0;i < 125;i++)
       films[i] = (char)intout[i];
```

SEE ALSO **vqp_state()**

vqp_state()

VOID vqp_state(***handle, port, film, lightness, interlace, planes, indices*** **)**
WORD ***handle*****;**
WORD ****port, *film, *lightness, *interlace, *planes, *indices*****;**

vqp_state() returns information regarding the current state of the palette driver.

OPCODE 5

SUB-OPCODE 92

AVAILABILITY Supported by all camera drivers.

PARAMETERS *handle* specifies a valid workstation handle. The rest of the parameters are all **WORD**s which are filled in as follows:

Parameter	Meaning
port	Communication port number.
film	Film type (0 – 4).
lightness	Lightness (-3 – 3). A value of 0 specifies the current f-stop setting. A value of three results in an exposure half as long as normal while a value of 3 results in an exposure twice as long as normal.
interlace	Interlace mode. A value of 0 is non-interlaced, 1 is interlaced.
planes	Number of planes (1 – 4)
indices	This is actually a **WORD** array with at least 16 members. (2 ^ *planes*) members will be filled in with color codes for the driver. *indices[0]* and *indices[1]* will specify the first color, *indices[2]* and *indices[2]* the second, and so on.

BINDING

```
WORD i;

contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 92;
contrl[6] = handle;

vdi();

*port = intout[0];
*film = intout[1];
*lightness = intout[2];
*interlace = intout[3];
*planes = intout[4];

for(i = 0;i < 21;i++)
       indices[i] = intout[5 + i];
```

SEE ALSO **vsp_state()**

vqt_advance()

VOID vqt_advance(*handle, wch, advx, advy, xrem, yrem*)
WORD *handle, wch*;
WORD **advx, *advy, *xrem, *yrem*;

vqt_advance() returns the advance vector and remainder for a character.

OPCODE 247

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *wch* contains the character which you desire information for. Upon return the **WORD**s pointed to by *advx*, *advy*, *xrem*, and *yrem* will be filled in with the correct advance vector and remainders.

BINDING

```
contrl[0] = 247;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = wch;

vdi();

*advx = ptsout[0];
*advy = ptsout[1];
*xrem = ptsout[2];
*yrem = ptsout[3];
```

COMMENTS *advx* and *advy*, when added to the position where the character was rendered will indicate the position to draw the next character. This advance vector works in all directions with all character rotations. *xrem* and *yrem* give the remainder value as a modulus of 16384. These remainders should be summed by an application an managed to nudge the advance vector by a pixel when necessary.

SEE ALSO **vqt_width(), vqt_extent(), vqt_f_extent()**

vqt_advance32()

VOID vqt_advance32(*handle, wch, advx, advy*)
WORD *handle, wch*;
fix31 **advx, **advy*;

vqt_advance32() is a variation of the binding for **vqt_advance()** which returns the advance vector and remainder for a character as two **fix31** values..

OPCODE 247

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *wch* contains the character which you desire information for. Upon return the **fix31**s pointed to by *advx* and *advy* will be filled in with the correct advance vector.

BINDING

```
contrl[0] = 247;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = wch;

vdi();

*advx = (fix31)((ptsout[4] << 16) | ptsout[5]);
*advy = (fix31)((ptsout[6] << 16) | ptsout[7]);
```

COMMENTS *advx* and *advy*, when added to the position where the character was rendered will indicate the position to draw the next character. This advance vector works in all directions with all character rotations.

SEE ALSO **vqt_width(), vqt_extent(), vqt_f_extent()**

vqt_attributes()

VOID vqt_attributes(*handle, attr*)
WORD *handle*;
WORD **attr*;

vqt_attributes() returns information regarding the current attributes which affect text output.

OPCODE 38

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *attr* points to an array containing 10 **WORD**s which are filled in upon function exit as follows:

attr[x]	Meaning
0	Text face (see **vst_font()**).
1	Text color (see **vst_color()**).
2	Text rotation (see **vst_rotation()**).
3	Horizontal alignment (see **vst_alignment()**).
4	Vertical alignment (see **vst_alignment()**).
5	Writing mode (see **vswr_mode()**).
6	Character width (see **vst_height()**).
7	Character height (see **vst_height()**).
8	Character cell width (see **vst_height()**).
9	Character cell height (see **vst_height()**).

BINDING

```
contrl[0] = 38;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

attr[0] = intout[0];
attr[1] = intout[1];
attr[2] = intout[2];
attr[3] = intout[3];
attr[4] = intout[4];
attr[5] = intout[5];
attr[6] = intout[6];
attr[7] = intout[7];
attr[8] = intout[8];
attr[9] = intout[9];
```

COMMENTS The values pertaining to character and cell width and have limited usefulness as they are only constant with non-proportional fonts.

SEE ALSO **vql_attributes(), vqm_attributes(), vqf_attributes()**

vqt_cachesize()

WORD vqt_cachesize(***handle, which, size*** **)**
WORD ***handle, which*****;**
LONG ****size*****;**

vqt_cachesize() returns the size of the largest allocatable block of memory in one of two caches.

OPCODE 255

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *which* specifies which cache. A value of **CACHE_CHAR** (0) selects the character bitmap cache. A value of **CACHE_MISC** (1) selects the miscellaneous cache. The **LONG** pointed to by *size* will be filled in upon function exit with the size of the largest allocatable block of memory in the selected cache.

BINDING

```
contrl[0] = 255;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = which;

vdi();
```

```
*size = (LONG)(((LONG)intin[0] << 16) | (LONG)intin[1]);
```

COMMENTS An application can estimate the amount of memory required to generate a character and print a warning message if the user attempts to exceed it. **FSMGDOS** will simply print a message on screen (you can intercept this with **vst_error()**) and ask the user to reboot. You can estimate the amount of memory required for a particular character in the character bitmap cache with the formula:

(width in pixels + 7)/8 * height in pixels

Likewise, you can estimate the amount of memory needed for the miscellaneous cache as:

84 * (width + height)

SEE ALSO **vst_error(), v_flushcache()**

vqt_devinfo()

VOID vqt_devinfo(***handle, devid, exists, devstr*** **)**
WORD ***handle, devid*****;**
WORD *****exists***;**
char *****devstr***;**

vqt_devinfo() determines if a particular device ID is available, and if so, the name of the device driver.

OPCODE 248

AVAILABILITY Available only with **FONTGDOS, FSM,** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *devid* specifies the device ID as listed in the 'ASSIGN.SYS' file. *exists* is a pointer to a **WORD** which will be filled in with **DEV_INSTALLED** (1) if a device is installed with the specified ID number or **DEV_MISSING** (0) if not. If the device does exist, the character buffer pointer to by *devstr* will be filled in with the filename of the device padded with spaces to the standard **GEMDOS** 8 + 3 format.

BINDING

```
WORD i;

contrl[0] = 248;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = devid;
```

```
vdi();

*exists = ptsout[0];

for(i = 0;i < contrl[4];i++)
       devstr[i] = (char)intout[i];
```

vqt_extent()

VOID vqt_extent(***handle, str, pts*** **)**
WORD ***handle*****;**
char ****str*****;**
WORD ****pts*****;**

vqt_extent() returns the pixel extent of a string of text.

OPCODE 116

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *str* points to a text string to return extent information for. *pts* points to an array of 8 **WORD**s which will be filled in as follows:

pts[x]	Meaning
0	X coordinate of point 1.
1	Y coordinate of point 1.
2	X coordinate of point 2.
3	Y coordinate of point 2.
4	X coordinate of point 3.
5	Y coordinate of point 3.
6	X coordinate of point 4.
7	Y coordinate of point 4.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*str++);

contrl[0] = 116;
contrl[1] = 0;
contrl[3] = --i;
```

```
contrl[6] = handle;

vdi();

pts[0] = ptsout[0];
pts[1] = ptsout[1];
pts[2] = ptsout[2];
pts[3] = ptsout[3];
pts[4] = ptsout[4];
pts[5] = ptsout[5];
pts[6] = ptsout[6];
pts[7] = ptsout[7];
```

COMMENTS This function will also output correct bounding information for rotated text. It is recommended that **vqt_f_extent()** be used for outline fonts as it takes special factors into consideration which makes its output more accurate.

SEE ALSO **vqt_f_extent(), vqt_advance(), vqt_width()**

vqt_f_extent()

VOID vqt_f_extent(***handle*, *str*, *pts*** **)**
WORD *handle*;
char ***str*;
WORD ***pts*;

vqt_f_extent() returns the bounding box required to enclose the specified string of text.

OPCODE 240

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS Same as **vqt_extent()**.

BINDING

```
WORD i = 0;

while(intin[i++] = (WORD)*str++);

contrl[0] = 240;
contrl[1] = 0;
contrl[3] = --i;
contrl[6] = handle;

vdi();

pts[0] = ptsout[0];
pts[1] = ptsout[1];
pts[2] = ptsout[2];
pts[3] = ptsout[3];
pts[4] = ptsout[4];
```

```
pts[5] = ptsout[5];
pts[6] = ptsout[6];
pts[7] = ptsout[7];
```

COMMENTS As opposed to **vqt_extent()**, **vqt_f_extent()** calculates the remainders generated by outline fonts therefore providing more accurate results.

SEE ALSO **vqt_extent(), vqt_width(), vqt_advance()**

vqt_f_extent16()

VOID vqt_f_extent(***handle, wstr, wstrlen, pts*** **)**
WORD *handle*;
WORD **wstr*;
WORD *wstrlen*;
WORD **pts*;

vqt_f_extent16() is a variant binding of **vqt_f_extent()** that returns the bounding box required to enclose the specified string of 16-bit Speedo character indexed text.

OPCODE 240

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *wstr* points to a 16-bit text string composed of Speedo character indexes. *wstrlen* indicates the length of *wstr*. The array pointed to by *pts* is filled in with the same values as **vqt_extent()**.

BINDING

```
WORD i;

for( i = 0; i < wstrlen; i++)
       intin[i] = wstr[i];

contrl[0] = 240;
contrl[1] = 0;
contrl[3] = wstrlen;
contrl[6] = handle;

vdi();

pts[0] = ptsout[0];
pts[1] = ptsout[1];
pts[2] = ptsout[2];
pts[3] = ptsout[3];
pts[4] = ptsout[4];
pts[5] = ptsout[5];
pts[6] = ptsout[6];
pts[7] = ptsout[7];
```

COMMENTS This variation of the **vqt_f_extent()** binding should only be used when **SpeedoGDOS** has been properly configured with **vst_charmap()**.

SEE ALSO **vqt_extent(), vqt_width(), vqt_advance()**

vqt_fontheader()

VOID vqt_fontheader(***handle, buffer, pathname*** **)**
WORD *****handle***;**
char *****buffer, *pathname***;**

vqt_fontheader() returns font-specific information for the currently selected Speedo font.

OPCODE 234

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *buffer* should point to a buffer of at least 421 bytes into which the font header will be copied. *pathname* should point to a buffer of at least 128 bytes into which the full pathname of the font's corresponding '.TDF' file will be copied.

BINDING

```
WORD i;

contrl[0] = 234;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;

vdi();

for(i = 0; i < contrl[4]; i++)
       pathname[i] = (char)intout[i];
```

COMMENTS The font header format and '.TDF' file contents are contained in *Appendix G: **Speedo Fonts***.

SEE ALSO **vqt_fontinfo()**

vqt_fontinfo()

VOID vqt_fontinfo(***handle, first, last, dist, width, effects*** **)**
WORD ***handle*****;**
WORD ****first, *last, *dist, *width, *effects*****;**

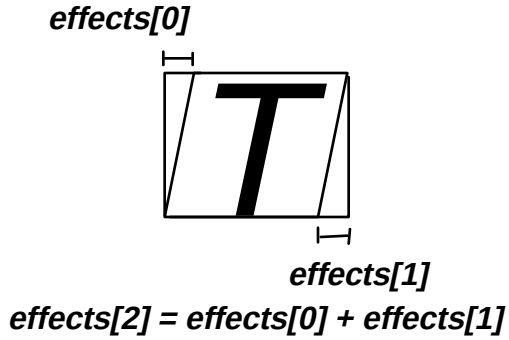
vqt_fontinfo() returns information regarding the current text font.

OPCODE 131

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *first* and *last* each point to a **WORD** which will be filled in with the first and last character in the font respectively. *dist* points to an array of 5 **WORD**s which indicate the distances between the baseline and the point indicated as follows:

width specifies the width of the largest cell in the font in pixels not including effects. *effects* points to an array of 3 **WORD**s which contain information relating to the offsets of the font when printed with the current effects.



effects[0] specifies the number of X pixels of the left slant. *effects[1]* specifies the number of X pixels of the right slant. *effects[2]* specifies the extra number of X

pixels to add to compensate for the special effects.

BINDING

```
contrl[0] = 131;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

*first = intout[0];
*last = intout[1];
*width = ptsout[0];
dist[0] = ptsout[1];
dist[1] = ptsout[3];
dist[2] = ptsout[5];
dist[3] = ptsout[7];
effects[0] = ptsout[2];
effects[1] = ptsout[4];
effects[2] = ptsout[6];
```

CAVEATS **SpeedoGDOS** is not capable of generating values for *dist[1]* or *dist[2]* so *dist[1]* is set to equal *dist[0]* and *dist[2]* is set to equal *dist[3]*.

SEE ALSO **vqt_width()**

vqt_get_table()

VOID vqt_get_table(***handle, map*** **)**
WORD *handle*;
VOID *******map*;

vqt_get_table() returns pointers to seven tables which map the Atari character set to the Bitstream character indexes.

OPCODE 254

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. The location pointed to by map will be filled in with a pointer to seven internal tables, each 224 **WORD** size entries long mapping ASCII characters 32–255 to Bitstream character indexes.

The tables are defined as follows:

Position	Table
1st	Master mapping.
2nd	Bitstream International Character Set
3rd	Bitstream International Symbol Set

4th	Bitstream Dingbats Set
5th	PostScript Text Set
6th	PostScript Symbol Set
7th	PostScript Dingbats Set

BINDING

```
contrl[0] = 254;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

*(VOID *)map = ((LONG)(intout[0] << 16) | (LONG)intout[1]);
```

COMMENTS Use of this call allows access to characters outside of the ASCII range but care must be taken to as this call affects all applications.

vqt_name()

WORD vqt_name(*handle, index, fontname*)
WORD *handle*;
WORD *index*;
char **fontname*;

vqt_name() returns the name of the specified font.

OPCODE 130

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *fontname* points to a character buffer of at least 33 characters which will be filled in with the name of font *index* and a flag which distinguishes bitmap and outline fonts. *fontname[0–31]* will contain the name of the font (not necessarily **NULL**-terminated).

If **FSMGDOS** or **SpeedoGDOS** is installed, *fontname[32]* will contain a flag equalling **OUTLINE_FONT** (1) if the specified font is an outline font or **BITMAP_FONT** (0) if it is a bitmap font.

BINDING

```
WORD i;

contrl[0] = 130;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = index;

vdi();
```

```
for(i = 0;i < 33;i++)
       fontname[i] = intout[i + 1];

return intout[0];
```

RETURN VALUE **vqt_name()** returns the unique code value which identifies this font (and is passed to **vst_font()**).

SEE ALSO **vst_load_fonts(), vst_font()**

vqt_pairkern()

VOID vqt_pairkern(***handle, char1, char2, x, y*** **)**
WORD *char1*, *char2*;
fix31 **x*, **y*;

vqt_pairkern() returns adjustment vector information for the kerning of a character pair.

OPCODE 235

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *char1* and *char2* specify the left and right members of the character pair to inquire. *x* and *y* will be filled with the adjustment vector for the specified character pair.

BINDING

```
contrl[0] = 235;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = char1;
intin[1] = char2;

vdi();

*x = ((LONG)ptsout[0] << 16 ) | ptsout[1];
*y = ((LONG)ptsout[2] << 16 ) | ptsout[3];
```

SEE ALSO **vqt_trackkern(), vst_kern()**

vqt_trackkern()

VOID vqt_trackkern(***handle, x, y*** **)**
fix31 *x, *y;

vqt_trackkern() returns the horizontal and vertical adjustment vector for track kerning.

OPCODE 234

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *x* and *y* are the horizontal and vertical adjustment vectors currently used to modify character spacing in track kerning.

BINDING

```
contrl[0] = 234;
contrl[1] = 0;
contrl[3] = 0;
contrl[6] = handle;

vdi();

*x = ((LONG)ptsout[0] << 16 ) | ptsout[1];
*y = ((LONG)ptsout[2] << 16 ) | ptsout[2];
```

SEE ALSO **vqt_pairkern(), vst_kern()**

vqt_width()

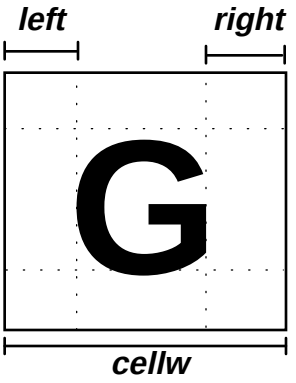
WORD vqt_width(***handle, wch, cellw, left, right*** **)**
WORD *handle, wch;
WORD *cellw, *left, *right;

vqt_width() returns information regarding the width of a character cell.

OPCODE 117

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. The lower eight bits of *wch* specify the ASCII character to return width information about. The following three values are each WORDs which are filled in by the function upon return with information about the width of the specified character in pixels as illustrated here.



BINDING

```
contrl[0] = 117;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = wch;

vdi();

*cellw = ptsout[0];
*left = ptsout[2];
*right = ptsout[4];

return intout[0];
```

RETURN VALUE

vqt_width() returns *wch* or -1 if an error occurred.

CAVEATS

vqt_width() does not take into account remainders when dealing with outline fonts. It is therefore recommended that **vqt_advance()** be used instead when inquiring about outline fonts.

SEE ALSO

vqt_advance()

vr_recfl()

VOID vr_recfl(***handle, pxy*** **)**
WORD ***handle*****;**
WORD ****pxy*****;**

vr_recfl() outputs a filled rectangle.

OPCODE 114

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *pxy* points to an array of 4 **WORD**s which give a **VDI** format rectangle of the object to draw.

BINDING

```
contrl[0] = 114;
contrl[1] = 2;
contrl[3] = 0;
contrl[6] = handle;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];

vdi();
```

COMMENTS **vr_recfl()**, as opposed to **v_bar()**, never draws an outline regardless of the settings of **vsf_perimeter()**.

SEE ALSO **v_bar()**

vr_trnfm()

VOID vr_trnfm(***handle, src, dest*** **)**
WORD ***handle*****;**
MFDB ****src*****,** ****dest*****;**

vr_trnfm() transforms a memory block from device-independent to device-dependent and vice-versa.

OPCODE 110

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *src* specifies the **MFDB** (as defined in **vro_cpyfm()**) wheras *dest* specifies the **MFDB** of the destination.

BINDING

```
contrl[0] = 110;
contrl[1] =contrl[3] = 0;
contrl[6] = handle;
contrl[7] = (WORD)((LONG)src >> 16);
contrl[8] = (WORD)src;
contrl[9] = (WORD)((LONG)dest >> 16);
contrl[10] = (WORD)dest;

vdi();
```

CAVEATS While **vr_trnfm()** will work for in-place transformations, this process can be time-consuming for large forms.

This call will not translate between forms with multiple planes. For instance, you can not translate a 2 plane device-independent image to an 8-plane device-specific image.

COMMENTS To stay compatible with future hardware developments it is recommended that all images be initially either stored or manually translated to device-independent format and subsequently converted with this function to match the planar configuration of the device.

When this call is used to transform forms with either 2 or 4 bit planes, color translation is performed on each pixel as follows:

Four-Plane Transformations

Device	VDI
0000	0
0001	2
0010	3
0011	6
0100	4
0101	7
0110	5
0111	8

Device	VDI
1000	9
1001	10
1010	11
1011	14
1100	12
1101	15
1110	13
1111	1

Two Plane

Device	VDI
00	0
01	2
10	3
11	1

SEE ALSO **vro_cpyfm()**

vro_cpyfm()

VOID vro_cpyfm(***handle, mode, pxy, src, dest*** **)**
WORD ***handle, mode*****;**
WORD ****pxy*****;**
MFDB ****src, *dest*****;**

vro_cpyfm() 'blits' a screen or memory block from one location to another.

OPCODE 109

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies valid workstation handle. *mode* specifies the writing mode as follows:

Name	Mode	Result
ALL_WHITE	0	All zeros.
S_AND_D	1	source AND destination
S_AND_NOTD	2	source AND (NOT destination)
S_ONLY	3 (Replace mode)	source
NOTS_AND_D	4 (Erase mode)	(NOT source) AND destination
D_ONLY	5	destination
S_XOR_D	6 (XOR Mode)	source XOR destination
S_OR_D	7	source OR destination
NOT_SORD	8	NOT (source OR destination)
NOT_SXORD	9	NOT (source XOR destination)
NOT_D	10	NOT destination
S_OR_NOTD	11	source OR (NOT destination)
NOT_S	12	NOT source
NOTS_OR_D	13	(NOT source) OR destination
NOT_SANDD	14	NOT (source AND destination)
ALL_BLACK	15	All ones.

pxy points to an array of eight **WORD**s. *pxy[0–3]* contains the bounding rectangle of the source block. *pxy[4–7]* contains the bounding rectangle of the destination block. *src* and *dest* each point to an **MFDB** structure which describes the source and destination memory form. **MFDB** is defined as follows:

```
typedef struct
{
```

```
        /* Memory address (NULL = current screen). If you specify
        a value of NULL, the rest of the structure will be filled
        out for you. */
        VOID *fd_addr;

        /* Form width in pixels */
        WORD fd_width;

        /* Form height in pixels */
        WORD fd_height;

        /* Form width in WORDs (fd_width + 15)/16 */
        WORD fd_wdwidth;

        /* Format (0 = device-specific, 1 = VDI format) */
        WORD fd_stand;

        /* Number of memory planes */
        WORD fd_planes;

        /* Reserved (set to 0) */
        WORD reserved1;
        WORD reserved2;
        WORD reserved3;
} MFDB;
```

BINDING

```
contrl[0] = 109;
contrl[1] = 4;
contrl[3] = 1;
contrl[6] = handle;
contrl[7] = (WORD)((LONG)src >> 16);
contrl[8] = (WORD)src;
contrl[9] = (WORD)((LONG)dest >> 16);
contrl[10] = (WORD)dest;

intin[0] = mode;

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];
ptsin[4] = pxy[4];
ptsin[5] = pxy[5];
ptsin[6] = pxy[6];
ptsin[7] = pxy[7];

vdi();
```

COMMENTS To ‘blit’ a single-plane form to a multi-plane destination, use **vrt_cpyfm()**.

SEE ALSO **vr_trnfm(), vrt_cpyfm()**

vrq_choice()

VOID vrq_choice(***handle, start, final*** **)**
WORD ***handle, start*****;**
WORD ****final*****;**

vrq_choice() accepts input from the 'choice' device in request mode.

OPCODE 30

AVAILABILITY This call is not guaranteed to be available with any driver and its use should therefore be restricted.

PARAMETERS *handle* specifies a valid workstation handle. *start* indicates the starting value for the choice device (1–???). *final* points to a **WORD** which will be filled in upon exit with the results of the request.

BINDING

```
contrl[0] = 30;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = start;

vdi();

*final = intout[0];
```

COMMENTS Input is sampled until a key is pressed.

SEE ALSO **vsm_choice(), vsin_mode()**

vrq_locator()

VOID vrq_locator(***handle, mx, my, xout, yout, term*** **)**
WORD ***handle, mx, my*****;**
WORD ****xout, *yout, *term*****;**

vrq_locator() inputs information from the 'locator' device in request mode.

OPCODE 28

AVAILABILITY This call is not guaranteed to be available with any driver and its use should therefore be restricted.

PARAMETERS *handle* specifies a valid workstation handle. To start, the mouse cursor is displayed at the location given by *mx* and *my*. When a key or mouse button is pressed, the call returns. The final location of the mouse pointer is filled into the 2 **WORD**s pointed to by *xout* and *yout*. The **WORD** pointed to by *term* is filled in with the ASCII key of the character that terminated input, 32 (0x20) if the left mouse button was struck, or 33 (0x21) if the right mouse button was struck.

BINDING

```
contrl[0] = 28;
contrl[1] = 1;
contrl[3] = 0;
contrl[6] = handle;

ptsin[0] = mx;
ptsin[1] = my;

vdi();

*term = intout[0];

*xout = ptsout[0];
*yout = ptsout[1];
```

COMMENTS Using this function will confuse the **AES**'s mouse input functions.

SEE ALSO **vsm_locator(), vsin_mode()**

vrq_string()

VOID vrq_string(***handle, maxlen, echo, outxy, str*** **)**
WORD ***handle, maxlen, echo*****;**
WORD ****outxy***;**
char ****str***;**

vrq_string() waits for input from the 'string' device in request mode.

OPCODE 31

AVAILABILITY This call is not guaranteed to be available with any driver and its use should therefore be restricted.

PARAMETERS *handle* specifies a valid workstation handle. This call inputs characters from the keyboard into the buffer pointed to by *str* up to *maxlen* + 1 characters. If *echo* is set to 1, characters are echoed to the screen at the location given by the two **WORD**s pointed to by *outxy*. If echo is set to 0, no echoing is performed.

BINDING

```
WORD i;

contrl[0] = 31;
```

```
contrl[1] = 1;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = maxlen;
intin[1] = echo;

ptsin[0] = outxy[0];
ptsin[1] = outxy[1];

vdi();

for(i = 0;i < contrl[4];i++)
       str[i] = (char)intout[i];
```

CAVEATS The *echo* parameter is not functional. Character output is never echoed. However, *outxy* must point to valid memory space or a crash *will* occur.

COMMENTS Though this binding does not allow for it, if *maxlen* is specified as negative, then as many as |*maxlen*| + 1 characters will be read as keycodes rather than ASCII codes. The values in *intout* will occupy the full **WORD** rather than just the lower eight bits. A custom binding could be used to take advantage of this.

SEE ALSO **vsin_mode(), vsm_string()**

vrq_valuator()

VOID vrq_valuator(***handle, start, *final, *term*** **)**
WORD ***handle, start*****;**
WORD ****final, *term*****;**

vrq_valuator() accepts for input from the valuator device until a terminating character is entered in request mode.

OPCODE 29

AVAILABILITY This call is not guaranteed to be available with any driver and its use should therefore be restricted.

PARAMETERS *handle* specifies a valid workstation handle. *start* specifies the initial value of the valuator device (1–100). When a terminating character has been struck, the **WORD** pointed to by *final* will be filled in with the final value of the valuator and the **WORD** pointed to by *term* will be filled in with whatever ASCII character caused termination.

BINDING

```
contrl[0] = 29;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;
```

```
intin[0] = start;

vdi();

*final = intout[0];
*term = intout[1];
```

COMMENTS The 'valuator' is typically the up and down arrow keys. Each key increments or decrements the value by 10 unless the shift key is held in which case it is incremented or decremented by 1.

SEE ALSO **vsm_valuator(), vsin_mode()**

vrt_cpyfm()

VOID vrt_cpyfm(***handle, mode, pxy, src, dest, colors*** **)**
WORD ***handle, mode*****;**
WORD ****pxy*****;**
MFDB ****src, *dest*****;**
WORD ****colors*****;**

vrt_cpyfm() 'blits' a single-plane source form to a multiple-plane destination.

OPCODE 121

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle. *mode* specifies the writing mode (1–4, see **vswr_mode()**). *pxy*, *src*, and *dest* are defined the same as in **vro_cpyfm()**. *colors* points to a 2 **WORD** array which specifies the colors to apply to the 'blitted' image. *colors[0]* is applied to all set bits in the source image and *colors[1]* is applied to all of the cleared bits.

BINDING

```
contrl[0] = 121;
contrl[1] = 4;
contrl[3] = 3;
contrl[6] = handle;
contrl[7] = (WORD)((LONG)src >> 16);
contrl[8] = (WORD)src;
contrl[9] = (WORD)((LONG)dest >> 16);
contrl[10] = (WORD)dest;

intin[0] = mode;
intin[1] = colors[0];
intin[2] = colors[1];

ptsin[0] = pxy[0];
ptsin[1] = pxy[1];
```

```
ptsin[2] = pxy[2];
ptsin[3] = pxy[3];
ptsin[4] = pxy[4];
ptsin[5] = pxy[5];
ptsin[6] = pxy[6];
ptsin[7] = pxy[7];

vdi();
```

COMMENTS The source form must be a monoplane form.

SEE ALSO **vro_cpyfm()**

vs_clip()

VOID vs_clip(***handle, flag, pxy*** **)**
WORD ***handle, flag*****;**
WORD *****pxy***;**

vs_clip() defines the global clipping rectangle and state for the specified workstation.

OPCODE 129

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *flag* is set to **CLIP_OFF** (0) to turn off clipping or **CLIP_ON** (1) to enable clipping. If *flag* is **CLIP_ON** (1) then *pxy* should point to a 4 **WORD** array containing a **VDI** format rectangle which will serve as the clipping rectangle, otherwise, *pxy* can be **NULL**.

BINDING

```
contrl[0] = 129;
contrl[1] = 2;
contrl[3] = 1;
contrl[6] = handle;

if(intin[0] = flag) {
       ptsin[0] = pxy[0];
       ptsin[1] = pxy[1];
       ptsin[2] = pxy[2];
       ptsin[3] = pxy[3];
}

vdi();
```

COMMENTS All **VDI** calls are clipped to that workstations current clipping rectangle.

vs_color()

VOID vs_color(*handle, color, rgb*)
WORD *handle, color*;
WORD **rgb*;

vs_color() sets the color of a palette index.

OPCODE 14

AVAILABILITY Supported by all devices.

PARAMETERS *handle* specifies a valid workstation handle. *color* specifies the color register of the color to modify. *rgb* points to an array of three **WORD**s which contain the red, green, and blue values respectively (0–1000) which will be used to map the color index to the closest color value possible.

BINDING

```
contrl[0] = 14;
contrl[1] = 0;
contrl[3] = 4;
contrl[6] = handle;

intin[0] = color;
intin[1] = rgb[0];
intin[2] = rgb[1];
intin[3] = rgb[2];

vdi();
```

SEE ALSO **Esetcolor(), Setcolor()**

vs_curaddress()

VOID vs_curaddress(*handle, row, column*)
WORD *handle, row, column*;

vs_curaddress() sets the position of the alpha screen text cursor.

OPCODE 5

SUB-OPCODE 11

AVAILABILITY Supported by all screen drivers.

PARAMETERS handle specifies a valid workstation handle. *row* and *column* specify the new

coordinates of the text cursor.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 2;
contrl[5] = 11;
contrl[6] = handle;

intin[0] = row;
intin[1] = column;

vdi();
```

COMMENTS This call is equivalent to the ESC-Y VT-52 code.

SEE ALSO **vq_curaddress()**

vs_palette()

VOID vs_palette(*handle, mode*)
WORD *handle, mode*;

vs_palette() selects a CGA palette.

OPCODE 5

SUB-OPCODE 60

AVAILABILITY This call was originally designed for use on IBM CGA-based computers. Its usefulness and availability are not guaranteed under any driver so it should thus be avoided.

PARAMETERS *handle* specifies a valid workstation handle. A *mode* value of 0 selects a palette of red, green, and blue. A *mode* value of 1 selects a palette of cyan, magenta, and white.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 1;
contrl[5] = 60;
contrl[6] = handle;

intin[0] = mode;

vdi();
```

vsc_form()

VOID vsc_form(*handle, newform*)
MFORM ****newform***;**

vsc_form() alters the appearance of the mouse pointer.

OPCODE 111

AVAILABILITY Supported by all screen drivers.

PARAMETERS *handle* specifies a valid workstation handle. *newform* points to a **MFORM** structure defined as follows:

```
typedef struct
{

       WORD mf_xhot;      /* X 'hot spot' */
       WORD mf_yhot;      /* Y 'hot spot' */
       WORD mf_nplanes;   /* Number of planes (must be 1) */
       WORD mf_fg;        /* Foreground color (should be 0) */
       WORD mf_bg;        /* Background color (should be 1) */
       WORD mf_mask[16]; /* 16 WORDs of mask*/
       WORD mf_data[16];  /* 16 WORDs of data */

} MFORM;
```

BINDING

```
WORD i;

contrl[0] = 111;
contrl[1] = 0;
contrl[3] = 37;
contrl[6] = handle;

for(i = 0;i < 37;i++)
       intin[i] = ((WORD *)newform)[i];

vdi();
```

SEE ALSO **graf_mouse()**

vsf_color()

WORD vsf_color(*handle, color*)
WORD *handle, color*;

vsf_color() changes the current fill color.

OPCODE 25

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *color* specifies the new fill color index.

BINDING

```
contrl[0] = handle;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = color;

vdi();
```

RETURN VALUE **vsf_color()** returns the actual color set (within bounds).

SEE ALSO **vst_color(), vsm_color(), vsl_color(), vsf_attributes()**

vsf_interior()

WORD vsf_interior(*handle, interior*)
WORD *handle, interior*;

vsf_interior() sets the interior type for filled objects.

OPCODE 23

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *interior* specifies the interior type as follows:

Name	*interior*	Meaning
FIS_HOLLOW	0	Hollow interior (color index 0).
FIS_SOLID	1	Solid interior (as set by **vsf_color()**).
FIS_PATTERN	2	Patterned fill. (style set by **vsf_style()**).
FIS_HATCH	3	Hatched fill. (style set by **vsf_style()**).
FIS_USER	4	User-defined fill (as set by **vsf_udpat()**).

BINDING

```
contrl[0] = 23;
contrl[1] = 0;
contrl[3] = interior;
contrl[6] = handle;
```

```
intin[0] = interior;

vdi();
```

RETURN VALUE This call returns the color value actually set (within bounds).

SEE ALSO **vsf_style()**

vsf_perimeter()

WORD vsf_perimeter(*handle, flag*)
WORD *handle, flag*;

vsf_perimeter() sets whether a border will be drawn around most **VDI** objects.

OPCODE 104

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *flag* is set to **PERIMETER_OFF** (0) to turn off perimeter drawing and **PERIMETER_ON** (1) to enable it.

BINDING

```
contrl[0] = 104;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

vdi();
```

RETURN VALUE This function returns the new value of the perimeter visibility flag.

vsf_style()

WORD vsf_style(*handle, style*)
WORD *handle, style*;

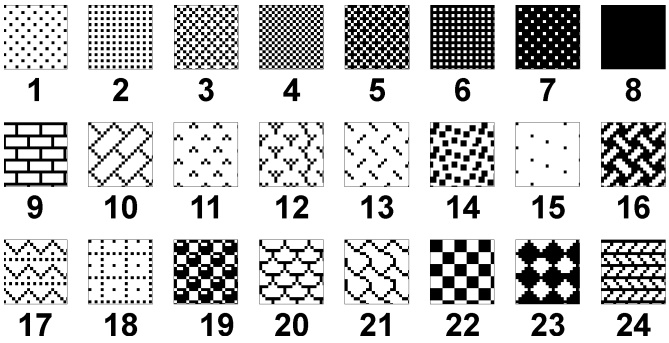
vsf_style() defines the style of fill pattern applied to filled objects.

OPCODE 24

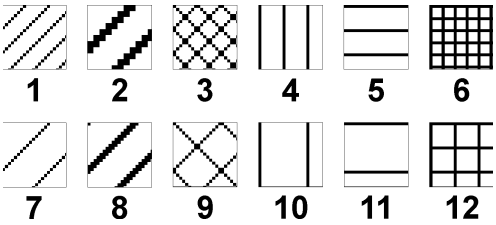
AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *style* specifies the pattern or hatch index depending upon the last setting of **vsf_interior()**. Valid pattern indexes are

as follows:



Valid hatch indexes are as follows:



BINDING

```
contrl[0] = 24;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = style;

vdi();
```

RETURN VALUE This call returns the actual style set by the call.

COMMENTS The interior type should be set first with **vsf_interior()**.

SEE ALSO **vsf_interior()**

vsf_udpat()

VOID vsf_udpat(***handle, pattern, planes*** **)**
WORD ***handle*****;**
WORD ****planes***;**
WORD ***planes*****;**

vsf_udpat() creates the user-defined fill pattern.

OPCODE 112

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. In palette-based modes, *pattern* points to an array of (16 * *planes*) **WORD**s which provide the bit pattern for the fill.

In true-color modes, *pattern* points to a 16x16 array of **LONG**s (256 in total) which each contain 32-bit color information. *planes* specifies the number of color planes for the fill. Use 1 for a monochrome fill on any display, a value equal to the number of planes on the current device for a palette-based color fill or 32 for a true-color display.

BINDING

```
WORD i;

contrl[0] = 112;
contrl[1] = 0;
contrl[3] = (16 * planes);
contrl[6] = handle;

for(i = 0;i < (16 * planes);i++)
       intin[i] = pattern[i];

vdi();
```

SEE ALSO **vsf_interior()**

vsin_mode()

WORD vsin_mode(***handle, device, mode*** **)**
WORD ***handle, device, mode*****;**

vsin_mode() chooses between request or sample mode for the specified device.

OPCODE 33

AVAILABILITY Supported in ROM by all Atari computers.

PARAMETERS *handle* specifies a valid workstation handle. A *mode* value of **REQUEST_MODE** (1) sets the device to operate in request mode whereas a value of **SAMPLE_MODE** (2) operates the device in sample mode. Valid devices are:

Name	*device*	Device
LOCATOR	1	Locator
VALUATOR	2	Valuator
CHOICE	3	Choice
STRING	4	String

BINDING

```
contrl[0] = 33;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = device;
intin[1] = mode;

vdi();

return intout[0];
```

RETURN VALUE **vsin_mode()** returns *mode*.

COMMENTS Using this function will cause the **AES** to function improperly.

SEE ALSO **vrq_valuator(), vrq_string(), vrq_choice(), vrq_locator(), vsm_valuator(), vsm_string(), vsm_choice(), vsm_locator()**

vsl_color()

WORD vsl_color(*handle, color*)
WORD *handle, color*;

vsl_color() sets the color for line-drawing functions and objects with perimeters.

OPCODE 17

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *color* specifies the new color to define for line-drawing.

BINDING

```
contrl[0] = 17;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = color;

vdi();

return intout[0];
```

RETURN VALUE This function returns the new color set (within bounds).

SEE ALSO **vst_color(), vsm_color(), vsf_color()**

vsl_ends()

VOID vsl_ends(*handle, start, end*)
WORD *handle, start, end*;

vsl_ends() sets the style of end point for the starting and ending points of lines drawn by the **VDI** in line-drawing functions and perimeter drawing.

OPCODE 108

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *start* and *end* specify the type of end cap to use at the start and end of lines respectively as follows:

Name	*start/end*	Shape
SQUARE	0	
ARROWED	1	
ROUND	2	

BINDING

```
contrl[0] = 108;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;
```

```
intin[0] = start;
intin[1] = end;

vdi();
```

SEE ALSO **vsl_type()**

vsl_type()

WORD vsl_type(*handle, type*)
WORD *handle, type*;

vsl_type() defines the style of line used in line-drawing functions and perimeter drawing.

OPCODE 15

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *type* defines the style of line as follows:

Name	*type*	Style
SOLID	0	
LDASHED	1	
DOTTED	2	
DASHDOT	3	
DASH	4	
DASHDOTDOT	5	
USERLINE	6	User-defined with **vsl_udsty()**.

BINDING

```
contrl[0] = 15;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;
```

```
intin[0] = type;

vdi();

return intout[0];
```

RETURN VALUE **vsl_style()** returns the newly set line type.

SEE ALSO **vsl_udsty()**

vsl_udsty()

VOID vsl_udsty(***handle, pattern*** **)**
WORD ***handle, pattern*****;**

vsl_udsty() sets the user-defined line type.

OPCODE 113

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *pattern* is a **WORD** which defines the **USERLINE** style. It is essentially a bit mask which is applied to a solid line and repeated along the length of the line. A value of 0xFFFF would create a solid line. A value of 0xAAAA would produce a line where every other pixel was set.

BINDING

```
contrl[0] = 113;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = pattern;

vdi();
```

COMMENTS You must call **vsl_style(** *handle*, 6 **)** to actually utilize this style.

SEE ALSO **vsl_style()**

vsl_width()

VOID vsl_width(*handle, width*)
WORD *handle, width*;

vsl_width() determines the width of lines drawn with line-drawing functions and as perimeters to other objects.

OPCODE 16

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *width* specifes the width future lines drawn will be.

BINDING

```
contrl[0] = 16;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = width;

vdi();
```

COMMENTS The **VDI** is only capable of drawing lines an odd number of pixels thick. Values will be rounded down to the first odd number.

Setting a line width higher than 1 may nullify line styles other than solid. Check **vq_extnd()** for details.

SEE ALSO **vq_extnd()**

vsm_choice()

WORD vsm_choice(*handle, xout*)
WORD *handle*;
WORD **xout*;

vsm_choice() returns the current value of the ‘choice’ device.

OPCODE 30

AVAILABILITY This call is not guaranteed to be available with any driver and its use should therefore be restricted.

PARAMETERS *handle* specifies a valid workstation handle. *xout* points to a **WORD** which is filled in on function exit with the current value of the choice device.

BINDING

```
contrl[0] = 30;
contrl[1] = contrl[3] = 0;
contrl[6] = handle;

vdi();

*xout = intout[0];

return contrl[4];
```

RETURN VALUE **vsm_choice()** returns 1 if an input from the 'choice' device was made or 0 otherwise.

SEE ALSO **vsin_mode(), vrq_choice()**

vsm_color()

WORD vsm_color(*handle, color*)
WORD *handle, color*;

vsm_color() defines the color used to render markers.

OPCODE 20

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *color* specifies the new color to define for markers.

BINDING

```
contrl[0] = 20;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

vdi();

return intout[0];
```

RETURN VALUE **vsm_color()** returns the new marker color actually set (within bounds).

SEE ALSO **v_pmarker(), vsl_color(), vst_color(), vsf_color()**

vsm_height()

WORD vsm_height(*handle, size*)
WORD *handle, size*;

vsm_height() sets the height of markers.

OPCODE 19

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *size* specifies the height (and width) of markers to draw in pixels.

BINDING

```
contrl[0] = 19;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = size;

vdi();

return intout[0];
```

RETURN VALUE **vsm_height()** returns the marker height actually set.

COMMENTS The **DOT** marker is not affected by this call. It is always one pixel high and wide.

SEE ALSO **v_pmarker()**

vsm_locator()

WORD vsm_locator(*handle, mx, my, xout, yout, term*)
WORD *handle, mx, my*;
WORD **xout, *yout, *term*;

vsm_locator() receives data from the 'locator' device in sample mode.

OPCODE 28

AVAILABILITY This call is not guaranteed to be available with any driver and its use should therefore be restricted.

PARAMETERS *handle* specifies a valid workstation handle. The mouse pointer is initially drawn

at location (*mx*, *my*). The call returns with the final position of the mouse in the **WORD**s pointed to by *xout* and *yout*.

The **WORD** pointed to by *term* will be filled in with a value which specifies the ASCII value of the key pressed. *term* will be set to 0x20 if the left mouse button was pressed or 0x21 if the right mouse button was pressed.

BINDING

```
contrl[0] = 28;
contrl[1] = 1;
contrl[3] = 0;
contrl[6] = handle;

ptsin[0] = mx;
ptsin[1] = my;

vdi();

*xout = ptsout[0];
*yout = ptsout[1];

*term = intout[0];

return ((contrl[4] << 1) | contrl[2]);
```

RETURN VALUE **vsm_locator()** returns one of the following based on its result:

Return Value	Meaning
0	Mouse has not moved nor was any key pressed.
1	Mouse has been moved (*xout* and *yout* are valid).
2	Key or mouse button has been struck (*term* is valid).
3	Mouse has moved and a key or mouse button has been struck (*xout*, *yout*, and *term* are valid).

CAVEATS Using this call will confuse the **AES**.

SEE ALSO **vrq_locator(), vsin_mode()**

vsm_string()

WORD vsm_string(*handle, maxlen, echo, echoxy, str*)
WORD *handle, maxlen, echo*;
WORD **echoxy*;
char **str*;

vsm_string() retrieves input from the ‘string’ device.

OPCODE 31

AVAILABILITY This call is not guaranteed to be available with any driver and its use should therefore be restricted.

PARAMETERS *handle* specifies a valid workstation handle. This call inputs characters from the keyboard into the buffer pointed to by *str* up to (*maxlen* + 1) characters. If *echo* is set to 1, characters are echoed to the screen at the location given by the two **WORD**s pointed to by *outxy*. If echo is set to 0, no echoing is performed.

BINDING

```
WORD i;

contrl[0] = 31;
contrl[1] = 1;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = maxlen;
intin[1] = echo;

ptsin[0] = echoxy[0];
ptsin[1] = echoxy[1];

vdi();

for(i = 0;i < contrl[4];i++)
       str[i] = (char)intout[i];

return contrl[4];
```

RETURN VALUE **vsm_string()** returns the number of characters actually read.

CAVEATS Using this function will confuse the **AES**.

COMMENTS Though this binding does not allow for it, if *maxlen* is specified as negative, then as many as (|*maxlen*| + 1) characters will be read as keycodes rather than ASCII codes. The values in *intout* will occupy the full **WORD** rather than just the lower eight bits. A custom binding could be used to take advantage of this.

SEE ALSO **vsin_mode()**

vsm_type()

WORD vsm_type(*handle, type*)
WORD *handle, type*;

vsm_type() sets the current type of marker.

OPCODE 18

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *type* changes the marker type as follows:

Name	*type*	Shape
MRKR_DOT	1	Single Pixel
MRKR_PLUS	2	
MRKR_ASTERISK	3	
MRKR_BOX	4	
MRKR_CROSS	5	
MRKR_DIAMOND	6	
—	7...	Device Dependent

BINDING

```
contrl[0] = 18;
contrl[1] = 0;
contrl[3] = type;
contrl[6] = handle;

intin[0] = type;

vdi();
```

RETURN VALUE **vsm_type()** returns the type of marker actually set.

SEE ALSO **v_pmarker()**

vsm_valuator()

VOID vsm_valuator(*handle, x, xout, term, status*)
WORD *handle, x*;
WORD **xout, *term, *status*;

vsm_valuator() retrieves input from the 'valuator' device in sample mode.

OPCODE 29

AVAILABILITY This call is not guaranteed to be available with any driver and its use should therefore be restricted.

PARAMETERS *handle* specifies a valid workstation handle. *x* sets the intial value of the 'valuator'. The **WORD** pointed to by *xout* is filled in with the final value of the device. If a key was pressed its ASCII code is returned in the **WORD** pointed to by *term*. The **WORD** pointed to by *status* contains a value as follows:

status	Meaning
0	No input was taken.
1	Valuator changed.
2	Key press occurred.

BINDING

```
contrl[0] = 29;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = x;

vdi();

*xout = intout[0];
*term = intout[1];

*status = contrl[4];
```

SEE ALSO **vsin_mode(), vrq_valuator()**

vsp_message()

VOID vsp_message(*handle*)
WORD *handle*;

vsp_message() causes the suppression of palette driver messages from the screen.

OPCODE 5

SUB-OPCODE 95

AVAILABILITY Supported by all camera drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 95;
contrl[6] = handle;

vdi();
```

SEE ALSO **vqp_error()**

vsp_save()

VOID vsp_save(*handle*)
WORD *handle*;

vsp_save() saves the current state of the driver to disk.

OPCODE 5

SUB-OPCODE 94

AVAILABILITY Supported by all camera drivers.

PARAMETERS *handle* specifies a valid workstation handle.

BINDING

```
contrl[0] = 5;
contrl[1] = contrl[3] = 0;
contrl[5] = 94;
contrl[6] = handle;

vdi();
```

vsp_state()

VOID vsp_state(***handle, port, film, lightness, interlace, planes, indexes*** **)**
WORD ***handle, port, film, lightness, interlace, planes*****;**
WORD ****indexes***;**

vsp_state() sets the palette driver state.

OPCODE 5

SUB-OPCODE 93

AVAILABILITY Supported by all camera drivers.

PARAMETERS *handle* specifies a valid workstation handle. *port* specifies the communication port number of the camera device. *film* specifies the index of the desired type of film (0–4).

lightness specifies the modification to apply to the camera's default f-stop setting (-3–3). A value of 0 uses the default setting. A value of -3 results in an exposure of half of the default length whereas a value of 3 doubles the exposure time. *interlace* is set to 0 for non-interlaced or 1 for interlaced output.

planes specifies the number of planes to output (1–4). *indexes* points to an array of 16 **WORD**s which define the color codes for the palette.

BINDING

```
WORD i;

contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 20;
contrl[5] = 93;
contrl[6] = handle;

intin[0] = port;
intin[1] = film;
intin[2] = lightness;
intin[3] = interlace;
intin[4] = planes;
for(i = 0;i < 16;i++)
       intin[i + 5] = indexes[i];

vdi();
```

SEE ALSO **vqp_state()**

vst_alignment()

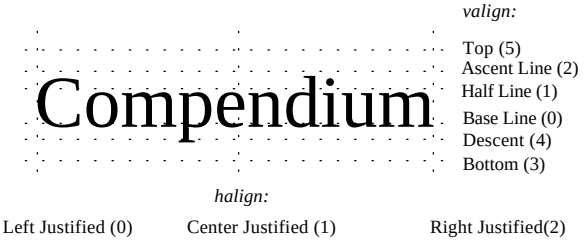
VOID vst_alignment(***handle, halign, valign, *hout, *vout*** **)**
WORD ***handle, halign, valign*****;**
WORD ***hout, *vout*****;**

vst_alignment() affects the vertical and horizontal alignment of normal and justified text.

OPCODE 39

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. halign and valign affects where the coordinate specified by **v_gtext()** or **v_justified()** actually applies to as follows:



On return, the **WORD**s pointed to by *hout* and *vout* are filled in with the values actually set.

BINDING

```
contrl[0] = 39;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = halign;
intin[1] = valign;

vdi();

*hout = intout[0];
*vout = intout[1];
```

SEE ALSO **v_gtext(), v_justified()**

vst_arbpt()

WORD vst_arbpt(***handle, point, wchar, hchar, wcell, hcell*** **)**
WORD ***handle*****;**
WORD ***point*****;**
WORD ****wchar, *hchar, *wcell, *hcell*****;**

vst_arbpt() selects any point size for an outline font.

OPCODE 246

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *point* specifies the point size at which to render outline text.

Upon return, the **WORD**s pointed to by *wchar*, *hchar*, *wcell*, and *hcell* will be filled in with the width and height of the character and the width and height of the character cell respectively.

BINDING

```
contrl[0] = 246;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = point;

vdi();

*wchar = ptsout[0];
*hchar = ptsout[1];
*wcell = ptsout[2];
*hcell = ptsout[3];

return intout[0];
```

RETURN VALUE **vst_arbpt()** returns the point size actually selected.

COMMENTS This call only works with outline fonts, however, it is not restricted by the point sizes listed in the 'ASSIGN.SYS' file.

To specify a fractional point size, use **vst_arbpt32()**.

SEE ALSO **vst_arbpt32(), vst_point(), vst_height()**

vst_arbpt32()

fix31 vst_arbpt(***handle, point, wchar, hchar, wcell, hcell*** **)**
WORD ***handle*****;**
fix31 ***point*****;**
WORD ****wchar, *hchar, *wcell, *hcell*****;**

vst_arbpt32() selects a fractional point size for an outline font.

OPCODE 246

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *point* specifies the point size at which to render outline text as a **fix31** value.

Upon return, the **WORD**s pointed to by *wchar*, *hchar*, *wcell*, and *hcell* will be filled in with the width and height of the character and the width and height of the character cell respectively.

BINDING

```
contrl[0] = 246;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = (WORD)(point >> 16);
intin[1] = (WORD)(point & 0xFFFF);

vdi();

*wchar = ptsout[0];
*hchar = ptsout[1];
*wcell = ptsout[2];
*hcell = ptsout[3];

return (((fix31)intout[0] << 16) | (fix31)intout[1]);
```

RETURN VALUE **vst_arbpt32()** returns the point size actually selected.

COMMENTS This call only works with outline fonts, however, it is not restricted by the point sizes listed in the ‘ASSIGN.SYS’ file.

SEE ALSO **vst_arbpt(), vst_point(), vst_height()**

vst_charmap()

VOID vst_charmap(***handle, mode*** **)**
WORD ***handle, mode*****;**

vst_charmap() chooses between the standard Atari ASCII interpretation of text strings or translation of Bitstream character indexes.

OPCODE 236

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *mode* should be **MAP_ATARI** (1) to specify Atari ASCII characters or **MAP_BITSTREAM** (0) for Bitstream mappings.

BINDING

```
contrl[0] = 236;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = mode;

vdi();
```

COMMENTS Bitstream character indexes are **WORD** sized rather than **BYTE** sized. A list of Bitstream character mappings can be found in Appendix G.

vst_color()

WORD vst_color(***handle, color*** **)**
WORD ***handle, color*****;**

vst_color() sets the current text color.

OPCODE 22

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *color* specifies the new color to apply to text.

BINDING

```
contrl[0] = 22;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;
```

```
intin[0] = color;

vdi();

return intout[0];
```

RETURN VALUE **vst_color()** returns the text color actually set (within bounds).

SEE ALSO **vsl_color(), vsm_color(), vsf_color()**

vst_effects()

WORD vst_effects(*handle, effects*)
WORD *handle, effects*;

vst_effects() defines which special effects are to be applied to text.

OPCODE 106

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *effects* is a bit mask which specifies one or more special effects to apply to text as follows:

Name	Bit	Meaning
THICKENED	0	Thickened
LIGHT	1	Lightened
SKEWED	2	Skewed
UNDERLINED	3	Underlined
OUTLINED	4	Outlined
SHADOWED	5	Shadowed (not currently supported)

BINDING

```
contrl[0] = 106;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = effects;

vdi();

return intout[0];
```

RETURN VALUE **vst_effects()** returns the actual effects set by the call.

COMMENTS Special effects do not, in general, work well with outline text (besides

underlining). To compensate, most type families have bold and italic faces in addition to the **vst_skew()** call.

SEE ALSO **vst_skew()**

vst_error()

VOID vst_error(*handle, mode, error*)
WORD *handle, mode*;
WORD **error*;

vst_error() provides a method to obtain errors from **GDOS** and suppress text messages on screen.

OPCODE 245

AVAILABILITY Available only with **FONTGDOS, FSM,** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *mode* specifies the error reporting mode. A value of **SCREEN_ERROR** (1) (default) causes error messages to be outputted to the screen as text.

A value of **APP_ERROR** (0) suppresses these messages and instead places an error code in the **WORD** pointed to by *error* whenever an error occurs leaving it up to the application to process errors correctly. Prior to making this call and after each reported error, the application is responsible for resetting the value pointed to by *error* to 0.The following is a list of possible error codes:

Name	*error*	Meaning
NO_ERROR	0	No error.
CHAR_NOT_FOUND	1	Character not found in font.
FILE_READERR	8	Error reading file.
FILE_OPENERR	9	Error opening file.
BAD_FORMAT	10	Bad file format.
CACHE_FULL	11	Out of memory/cache full.
MISC_ERROR	-1	Miscellaneous error.

BINDING

```
contrl[0] = 245;
contrl[1] = 0;
contrl[3] = 3;
contrl[6] = handle;

intin[0] = mode;
*(LONG *)&intin[1] = (LONG)error;
```

```
vdi();
```

COMMENTS Once setting the error mode to 0, an application should check the error variable after each of the following calls:

v_gtext()	**v_justified()**	**vst_point()**
vst_height()	**vst_font()**	**vst_arbpt()**
vqt_advance()	**vst_setsize()**	**vqt_fontinfo()**
vqt_name()	**vqt_width()**	**vqt_extent()**
v_opnwk()	**v_opnvwk()**	**vst_load_fonts()**
vst_unload_fonts()	**v_ftext()**	**vqt_f_extent()**

vst_font()

WORD vst_font(*handle, index*)
WORD *handle, index*;

vst_font() sets the current text font.

OPCODE 21

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *index* specifies the index (as returned by **vqt_name()**) of the font to enable.

BINDING

```
contrl[0] = 21;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = index;

vdi();

return intout[0];
```

RETURN VALUE **vst_font()** returns the index of the font actually set.

SEE ALSO **vqt_name()**

vst_height()

VOID vst_height(***handle, height, wchar, hchar, wcell, hcell*** **)**
WORD ***handle, height*****;**
WORD ****wchar, *hchar, *wcell, *hcell*****;**

vst_height() sets the height of the current text face (in pixels).

OPCODE 12

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *height* specifies the height (in pixels) at which to render text. Upon return, the **WORD**s pointed to by *wchar*, *hchar*, *wcell*, and *hcell* will be filled in with the width and height of the character and the width and height of the character cell respectively.

BINDING

```
contrl[0] = 12;
contrl[1] = 1;
contrl[3] = 0;
contrl[6] = handle;

ptsin[0] = 0;
ptsin[1] = height;    /* Passed in ptsin[1] because of VDI bug.
       */

vdi();

*wchar = ptsout[0];
*hchar = ptsout[1];
*wcell = ptsout[2];
*hcell = ptsout[3];
```

COMMENTS **vst_height()** works on both bitmap and outline fonts. The font will be scaled to fit within the height given. This doesn't always give good results with bitmap text.

SEE ALSO **vst_point(), vst_arbpt()**

vst_kern()

VOID vst_kern(***handle, tmode, pmode, tracks, pairs*** **)**
WORD ***handle, tmode, pmode*****;**
WORD ****tracks, *pairs*****;**

vst_kern() sets the track and pair kerning values.

OPCODE 237

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *tmode* specifies the track kerning mode as follows:

Name	*tmode*	Meaning
TRACK_NONE	0	No track kerning
TRACK_NORMAL	1	Normal track kerning
TRACK_TIGHT	2	Tight track kerning
TRACK_VERYTIGHT	3	Very tight track kerning

Setting *pmode* to **PAIR_ON** (1) turns pair kerning on. Setting it to **PAIR_OFF** (0) turns pair kerning off.

The **WORD** pointed to by *tracks* is filled in with the track kerning mode actually set. *pairs* points to a **WORD** which is filled in with the number of defined character kerning pairs.

BINDING

```
contrl[0] = 237;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = tmode;
intin[1] = pmode;

vdi();

*tracks = intout[0];
*pairs = intout[1];
```

SEE ALSO **vqt_trackkern(), vqt_pairkern()**

vst_load_fonts()

WORD vst_load_fonts(*handle, rsrvd*)
WORD *handle*, *rsrvd*;

vst_load_fonts() loads disk-based font information into memory.

OPCODE 119

AVAILABILITY Available with any form of **GDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *rsrvd* is currently unused and must be 0.

BINDING

```
contrl[0] = 119;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = rsrvd;

vdi();
```

RETURN VALUE **vst_load_fonts()** returns the number of extra fonts loaded.

COMMENTS Calling this function more than once before calling **vst_unload_fonts()** will return 0.

SEE ALSO **vst_unload_fonts(), vqt_name()**

vst_point()

WORD vst_point(***handle, point, wchar, hchar, wcell, hcell*** **)**
WORD ***handle, height*****;**
WORD ****wchar, *hchar, *wcell, *hcell*****;**

vst_point() sets the height of the current text face in points (1/72 inch).

OPCODE 107

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *point* specifies a valid point size to set the current text face to. This means an appropriate bitmap font or a point size enumerated in the 'EXTEND.SYS' file.

Upon return, the **WORD**s pointed to by *wchar*, *hchar*, *wcell*, and *hcell* will be filled in with the width and height of the character and the width and height of the character cell respectively.

BINDING

```
contrl[0] = 107;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = point;

vdi();
```

```
*wchar = ptsout[0];
*hchar = ptsout[1];
*wcell = ptsout[2];
*hcell = ptsout[3];

return intout[0];
```

RETURN VALUE **vst_point()** returns the point size actually set.

COMMENTS If a point size which doesn't exist for the current face is selected, the next valid size down is selected.

SEE ALSO **vst_arbpt(), vst_height()**

vst_rotation()

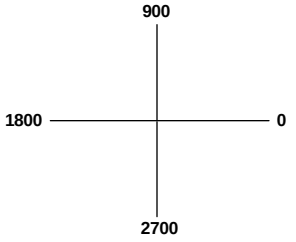
WORD vst_rotation(*handle, angle*)
WORD *handle, angle*;

vst_rotation() sets the angle at which graphic text is drawn.

OPCODE 13

AVAILABILITY Supported by all drivers. For specific character rotation abilities, check the values returned in **vq_extnd()**.

PARAMETERS *handle* specifies a valid workstation handle. *angle* specifies the angle at which to rotate text in tenths of degrees as follows:



BINDING

```
contrl[0] = 13;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = angle;

vdi();

return intout[0];
```

RETURN VALUE **vst_rotation()** returns the value of rotation actually set.

COMMENTS Bitmap fonts may only be rotated at 0, 90, and 270 degrees. Outline fonts may be rotated at any angle with **FSM**.

vst_scratch()

VOID vst_scratch(*handle, mode*)
WORD *handle, mode*;

vst_scratch() allows **FSMGDOS** or **SpeedoGDOS** to change its method of allocating a scratch buffer for better efficiency.

OPCODE 244

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *mode* specifies the scratch buffer allocation mode as follows:

Name	*mode*	Meaning
SCRATCH_BOTH	0	Scratch buffers should be allocated which are large enough for **FSM/Speedo** and bitmap fonts with any combination of special effects.
SCRATCH_BITMAP	1	Scratch buffers should be allocated which are large enough for **FSM/Speedo** fonts with no effects and bitmap fonts with effects.
SCRATCH_NONE	2	Scratch buffers should be allocated which are large enough for **FSM/Speedo** fonts and bitmap fonts with no special effects.

BINDING

```
contrl[0] = 244;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = mode;

vdi();
```

COMMENTS Atari recommends that at least mode 1 be set prior to a **vst_load_fonts()** call to prevent scratch buffer overruns.

The size of the scratch buffer is based on the size of the largest point size specified in the 'EXTEND.SYS' file. Attempting to add effects to a character higher in point size than this will cause a buffer overrun.

vst_setsize()

WORD vst_setsize(***handle, point, wchar, hchar, wcell, hcell*** **)**
WORD ***handle*****;**
WORD ***point*****;**
WORD ****wchar, *hchar, *wcell, *hcell*****;**

vst_setsize() sets the width of outline characters.

OPCODE 252

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a vaid workstation handle.

point specifies the width of the character in points (1/72 inch). A value for *point* equivalent to the same point size specified in **vst_arbpt()** will result in a correctly proportioned character.

Upon return, the **WORD**s pointed to by *wchar*, *hchar*, *wcell*, and *hcell* will be filled in with the width and height of the character and the width and height of the character cell respectively.

BINDING

```
contrl[0] = 252;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = point;

vdi();

*wchar = ptsout[0];
*hchar = ptsout[1];
*wcell = ptsout[2];
*hcell = ptsout[3];

return intout[0];
```

RETURN VALUE **vst_setsize()** returns the size actually set.

COMMENTS This call only works with outline fonts. At the next **vst_point()**, **vst_height()**, or **vst_arbpt()** the size will be reset to the correct proportions (width in points = height in points).

To set a fractional size, use **vst_setsize32()**.

SEE ALSO **vst_arbpt(), vst_setsize32()**

vst_setsize32()

fix31 vst_setsize(***handle, point, wchar, hchar, wcell, hcell*** **)**
WORD ***handle*****;**
fix31 ***point*****;**
WORD ****wchar, *hchar, *wcell, *hcell*****;**

vst_setsize() sets the width of outline characters as a **fix31** fractional value.

OPCODE 252

AVAILABILITY Available only with **SpeedoGDOS**.

PARAMETERS *handle* specifies a vaid workstation handle.

point specifies the width of the character in points (1/72 inch). A value for *point* equivalent to the same point size specified in **vst_arbpt()** will result in a correctly proportioned character.

Upon return, the **WORD**s pointed to by *wchar*, *hchar*, *wcell*, and *hcell* will be filled in with the width and height of the character and the width and height of the character cell respectively.

BINDING

```
contrl[0] = 252;
contrl[1] = 0;
contrl[3] = 2;
contrl[6] = handle;

intin[0] = (WORD)(point >> 8);
intin[1] = (WORD)point;

vdi();

*wchar = ptsout[0];
*hchar = ptsout[1];
*wcell = ptsout[2];
*hcell = ptsout[3];

return ((fix31)intout[0] << 16) | (fix31)intout[1];
```

RETURN VALUE **vst_setsize32()** returns the size actually set.

COMMENTS This call only works with outline fonts. At the next **vst_point()**, **vst_height()**, or **vst_arbpt()** the size will be reset to the correct proportions (width in points = height in points).

SEE ALSO **vst_setsize(), vst_arbpt()**

vst_skew()

WORD vst_skew(*handle, skew*)
WORD *handle, skew*;

vst_skew() sets the skew amount for fonts.

OPCODE 253

AVAILABILITY Available only with **FSMGDOS** or **SpeedoGDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *skew* specifies the amount to skew in tenths of degrees from -900 to 900. Negative values skew to the left and positive values skew to the right. *skew* values of -900 or 900 will result in a flat line.

BINDING

```
contrl[0] = 253;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = skew;

vdi();

return intout[0];
```

RETURN VALUE **vst_skew()** returns the skew value actually set.

COMMENTS This call should only be used with outline fonts. Note that this call generates a true 'skew' effect independent of that generated by **vst_effects()** which is an algorithmic 'skew'. The algorithmic 'skew' may be used on bitmap fonts but is rather unpleasant applied to outline fonts.

SEE ALSO **vst_effects()**

vst_unload_fonts()

VOID vst_unload_fonts(*handle, select*)
WORD *handle*, select;

vst_unload_fonts() frees memory associated with disk-loaded fonts.

OPCODE 120

AVAILABILITY Available under any form of **GDOS**.

PARAMETERS *handle* specifies a valid workstation handle. *select* is reserved and should be 0.

BINDING

```
contrl[0] = 120;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = select;

vdi();
```

SEE ALSO **vst_load_fonts()**

vswr_mode()

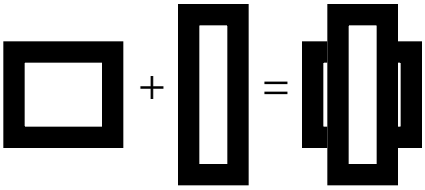
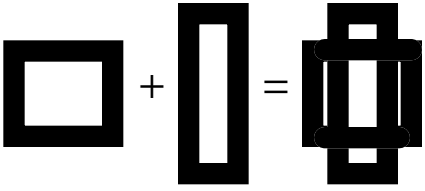
WORD vswr_mode(*handle, mode*)
WORD *handle, mode*;

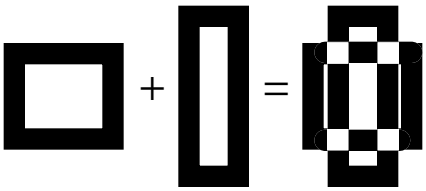
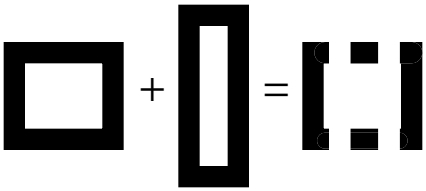
vswr_mode() defines the writing mode for rendering **VDI** objects.

OPCODE 32

AVAILABILITY Supported by all drivers.

PARAMETERS *handle* specifies a valid workstation handle. *mode* specifies a writing mode as follows:

Name	*mode*	Example
MD_REPLACE	1	
MD_TRANS	2	

MD_XOR	3	
MD_ERASE	4	

BINDING

```
contrl[0] = 32;
contrl[1] = 0;
contrl[3] = 1;
contrl[6] = handle;

intin[0] = mode;

vdi();

return intout[0];
```

RETURN VALUE **vswr_mode()** returns the writing mode set.

COMMENTS In true-color modes, **MD_ERASE** and **MD_TRANS** work a little differently, they write (or avoid writing on) whatever color is currently held in VDI color 0 (as opposed to the actual register reference of 0).

vt_alignment()

VOID vt_alignment(*handle, dx, dy*)
WORD *handle, dx, dy*;

vt_alignment() allows an offset to be specifies that will be applied to all coordinates output from the graphics tablet.

OPCODE 5

SUB-OPCODE 85

AVAILABILITY Supported by all tablet drivers.

PARAMETERS *handle* specifies a valid workstation handle. *dx* and *dy* are the delta offsets from

(0, 0) to apply to values from the graphics tablet.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 2;
contrl[5] = 85;
contrl[6] = handle;

intin[0] = dx;
intin[1] = dy;

vdi();
```

COMMENTS This call is used to 'fine-tune' the true starting point of the tablet.

SEE ALSO **vt_origin()**

vt_axis()

VOID vt_axis(*handle, xres, yres, *xout, *yout*)
WORD *handle, xres, yres*;
WORD **xout, *yout*;

vt_axis() sets the horizontal and vertical resolution for the graphics tablet (in lines).

OPCODE 5

SUB-OPCODE 82

AVAILABILITY Supported by all tablet drivers.

PARAMETERS *handle* specifies a valid workstation handle. *xres* and *yres* specify the new horizontal and vertical resoultion of the tablet respectively. Upon return, the **WORD**s pointer to by *xout* and *yout* are filled in with the resolution actually set.

BINDING

```
contrl[0]= 5;
contrl[1] = 0;
contrl[3] = 2;
contrl[5] = 82;
contrl[6] = handle;

intin[0] = xres;
intin[1] = yres;

vdi();

*xout = intout[0];
*yout = intout[1];
```

SEE ALSO **vt_alignment(), vt_origin()**

vt_origin()

VOID vt_origin(*handle, xorigin, yorigin*)
WORD *handle, xorigin, yorigin*;

vt_origin() sets the origin point for the tablets' upper-left point.

OPCODE 5

SUB-OPCODE 83

AVAILABILITY Supported by all tablet drivers.

PARAMETERS *handle* specifies a valid workstation handle. *xorigin* and *yorigin* specify the new upper-left point recognized by the tablet.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 2;
contrl[5] = 83;
contrl[6] = handle;

intin[0] = xorigin;
intin[1] = yorigin;

vdi();
```

SEE ALSO **vt_axis(), vt_alignment()**

vt_resolution()

VOID vt_resolution(*handle, xres, yres, *xout, *yout*)
WORD *xres, yres*;
WORD **xout, *yout*;

vt_resolution() sets the horizontal and vertical resolution of the graphics tablet (in lines per inch).

OPCODE 5

SUB-OPCODE 81

AVAILABILITY Supported by all tablet drivers.

PARAMETERS *handle* specifies a valid workstation handle. *xres* and *yres* specify the new horizontal and vertical resolution values for the tablet respectively. Upon return, the **WORD**s pointed to by *xout* and *yout* are filled in with the values actually set.

BINDING

```
contrl[0] = 5;
contrl[1] = 0;
contrl[3] = 2;
contrl[5] = 81;
contrl[6] = handle;

intin[0] = xres;
intin[1] = yres;

vdi();

*xout = intout[0];
*yout = intout[1];
```

SEE ALSO **vt_axis()**

– CHAPTER 8 –

LINE-A

Overview

The **Line-A** portion of the operating system is so named because it uses a special exception vector of 680x0 processors triggered when the first nibble of the a command word is $A. On Atari systems this vector is routed to the operating system ROMs and provides a low-level yet high-speed graphics interface.

The **Line-A** system is included in this document for completeness only. It is recommended that its use be avoided and that the counterpart **VDI** calls be used instead. Atari has not guaranteed that it will maintain **Line-A** compatibility in future systems. Its functionality has already been limited as video capabilities have advanced beyond its design.

The Line-A Variable Table

The **Line-A** opcode $A000 will return a pointer to an internal variable table in D0 and A0. This table is used by the **Line-A** functions as a parameter passing mechanism as opposed to using the stack or internal registers.

Members of the **Line-A** variable table are accessed via offsets from the base address. The function, location, and size of documented variables are as follows:

Name	Offset	Size	Contents
RESERVED	-910	**LONG**	Reserved for future use.
CUR_FONT	-906	**LONG**	Pointer to the current font header.
RESERVED	-902	92 **BYTE**s	Reserved for future use.
M_POS_HX	-856	**WORD**	X Offset into the mouse form of the 'hot spot'.
M_POS_HY	-854	**WORD**	Y Offset into the mouse form of the 'hot spot'.
M_PLANES	-852	**WORD**	Writing mode for the mouse pointer (1 = **VDI** Mode, -1 = XOR Mode). Defaults to **VDI** mode.
M_CDB_BG	-850	**WORD**	Mouse pointer background color.
M_CDB_FG	-848	**WORD**	Mouse pointer foreground color.
MASK_FORM	-846	32 **WORD**s	Image and Mask for the mouse pointer. Data is stored in the following format: Line 0 Mask Line 0 Image Line 1 Mask Line 1 Image etc.
INQ_TAB	-782	46 **WORD**s	This area contains 45 **WORD**s of information returned from a **vq_extnd()** of the physical screen workstation plus one extra reserved **WORD**.
DEV_TAB	-692	46 **WORD**s	This area contains the first 45 **WORD**s of information returned from a **v_opnwk()** of the physical screen workstation plus one extra reserved **WORD**.
GCURX	-602	**WORD**	Current mouse pointer X position.
GCURY	-600	**WORD**	Current mouse pointer Y position.

M_HID_CT	-598	**WORD**	Current mouse 'hide' count (number of times mouse has been hidden, 0 = visible).
MOUSE_BT	-596	**WORD**	Bitmap of the current mouse button status.
REQ_COL	-594	48 **WORD**s	Contains 48 **WORD**s of RGB data for the first 16 **VDI** color registers as would be returned by **vq_color()**.
SIZ_TAB	-498	15 **WORD**s	This table contains the final 12 **WORD**s of information returned from a **v_opnwk()** of the physical screen workstation plus 3 reserved **WORD**s.
RESERVED	-468	**WORD**	Reserved for future use.
RESERVED	-466	**WORD**	Reserved for future use.
CUR_WORK	-464	**LONG**	Pointer to the current **VDI** workstation attribute table.
DEF_FONT	-460	**LONG**	Pointer to the default font header.
FONT_RING	-456	4 **LONG**s	This area contains three pointers and a **NULL**. The first two pointers point to linked lists of system font headers. The third pointer points to the linked list of **GDOS** based fonts.
FONT_COUNT	-440	**WORD**	Total number of fonts pointed to by the ***FONT_RING*** pointers.
RESERVED	-438	90 **BYTE**s	Reserved for future use.
CUR_MS_STAT	-348	**BYTE**	Bitmap of mouse status since the last interrupt as follows: **Bit** — **Meaning** 0 — Left mouse status (0=up) 1 — Right mouse status (0=up) 2 — Reserved 3 — Reserved 4 — Reserved 5 — Mouse move flag (1=moved) 6 — Right mouse status flag (0=hasn't changed) 7 — Left mouse status flag (0=hasn't changed)
RESERVED	-347	**BYTE**	Reserved for future use.
V_HID_CNT	-346	**WORD**	Number of times the text cursor has been hidden (0 = visible).
CUR_X	-344	**WORD**	X position where mouse pointer will be drawn.
CUR_Y	-342	**WORD**	Y position where mouse pointer will be drawn.
CUR_FLAG	-340	**BYTE**	Mouse redraw flag (if non-zero, mouse pointer will be redrawn at the next vertical blank interrupt).
MOUSE_FLAG	-339	**BYTE**	Mouse interrupt flag (0=disable interrupts)
RESERVED	-338	**LONG**	Reserved for future use.
V_SAV_XY	-334	**2 WORD**s	X and Y position of the text cursor as saved by the VT-52 emulator.
SAVE_LEN	-330	**WORD**	Height of the form saved in ***SAVE_AREA*** in pixels.
SAVE_ADDR	-328	**LONG**	Address of the first **WORD** of screen data contained in ***SAVE_AREA***.
SAVE_STAT	-324	**LONG**	Save status flag as follows: **Bit** — **Meaning** 0 — Save buffer valid? (0=no) 1 — Width of save (0=16 bits, 1=32 bits)
SAVE_AREA	-322	256 **BYTE**s	Save buffer for the mouse pointer,

USER_TIM	-66	**LONG**	Pointer to a routine which occurs at each timer tick. (use **vex_timv()** instead). Routine ends by jumping to function pointed to by ***NEXT_TIM***.
NEXT_TIM	-62	**LONG**	See above.
USER_BUT	-58	**LONG**	Pointer to a routine called each time a mouse button is pressed (use **vex_butv()** instead).
USER_CUR	-54	**LONG**	Pointer to a routine called each time the mouse needs to be rendered (use **vex_curv()** instead).
USER_MOT	-50	**LONG**	Pointer to routine called each time the mouse is moved (use **vex_motv()** instead).
V_CEL_HT	-46	**WORD**	Current text cell height.
V_CEL_MX	-44	**WORD**	Number of text columns – 1.
V_CEL_MY	-42	**WORD**	Number of text rows – 1.
V_CEL_WR	-40	**WORD**	Number of bytes between character cells.
V_CEL_BG	-38	**WORD**	Text background color.
V_COL_FG	-36	**WORD**	Text foreground color.
V_CUR_AD	-34	**LONG**	Text cursor physical address.
V_CUR_OF	-30	**WORD**	Offset (in bytes) from physical screen address to the top of the first text character.
V_CUR_XY	-28	**2 WORD**s	X and Y character position of the text cursor.
V_PERIOD	-24	**BYTE**	Current cursor blink rate.
V_CUR_CT	-23	**BYTE**	Countdown timer to next blink.
V_FNT_AD	-22	**LONG**	Pointer to system font data (monospaced).
V_FNT_ND	-18	**WORD**	Last ASCII character in font.
V_FNT_ST	-16	**WORD**	First ASCII character in font.
V_FNT_WD	-14	**WORD**	Width of the system font form in bytes.
V_REZ_HZ	-12	**WORD**	Horizontal pixel resolution.
V_OFF_AD	-10	**LONG**	Pointer to font offset table.
RESERVED	-6	**WORD**	Reserved for future use.
V_REZ_VT	-4	**WORD**	Vertical pixel resolution.
BYTES_LIN	-2	**WORD**	Bytes per screen line.
PLANES	0	**WORD**	Number of planes in the current resolution.
WIDTH	2	**WORD**	Width of the destination form in bytes.
CONTRL	4	**LONG**	Pointer to the *CONTRL* array.
INTIN	8	**LONG**	Pointer to the *INTIN* array.
PTSIN	12	**LONG**	Pointer to the *PTSIN* array.
INTOUT	16	**LONG**	Pointer to the *INTOUT* array.
PTSOUT	20	**LONG**	Pointer to the *PTSOUT* array.
COLBIT0	24	**WORD**	Color bit value used for plane 0.
COLBIT1	26	**WORD**	Color bit value used for plane 1.
COLBIT2	28	**WORD**	Color bit value used for plane 2.
COLBIT3	30	**WORD**	Color bit value used for plane 3.
LSTLIN	32	**WORD**	Last pixel draw flag (0=draw, 1=don't draw). Used to prevent the last pixel in a polyline segment drawn in XOR mode from overwriting the first pixel in the next line.
LNMASK	34	**WORD**	Line draw pattern mask.
WMODE	36	**WORD**	VDI writing mode.
X1	38	**WORD**	X coordinate for point 1.
Y1	40	**WORD**	Y coordinate for point 1.
X2	42	**WORD**	X coordinate for point 2.
Y2	44	**WORD**	Y coordinate for point 2.
PATPTR	46	**LONG**	Fill-pattern pointer.

PATMSK	50	**WORD**	This value is AND'ed with the value in Y1 to give an index into the current fill pattern for the current line.
MFILL	52	**WORD**	Multiplane fill pattern flag (0=Mono).
CLIP	54	**WORD**	Clipping flag (0=disabled).
XINCL	56	**WORD**	Left edge of clipping rectangle.
XMAXCL	58	**WORD**	Right edge of clipping rectangle.
YMINCL	60	**WORD**	Top edge of clipping rectangle.
YMAXCL	62	**WORD**	Bottom edge of clipping rectangle.
XDDA	64	**WORD**	Text scaling accumulator (set to $8000 prior to blitting text).
DDAINC	66	**WORD**	Scaling increment. If *SIZE1* is the actual point size and *SIZE2* is the desired point size then to scale up use: $DDAINC = 256 * \frac{(SIZE\ 2 - SIZE\ 1)}{SIZE\ 1}$ To scale down use: $DDAINC = 256 * \frac{SIZE\ 2}{SIZE\ 1}$
SCALDIR	68	**WORD**	Text scaling direction (0=down, 1=up).
MONO	70	**WORD**	Monospaced font flag.
SOURCEX	72	**WORD**	X coordinate of character in font form.
SOURCEY	74	**WORD**	Y coordinate of character in font form.
DESTX	76	**WORD**	X position on screen to output character at.
DESTY	78	**WORD**	Y position on screen to output character at.
DELX	80	**WORD**	Width of the character to output.
DELY	82	**WORD**	Height of the character to output.
FBASE	84	**LONG**	Pointer to the font character image block.
FWIDTH	88	**WORD**	Width of the font form in bytes.
STYLE	90	**WORD**	Special effects flag bitmap as follows: **Bit** — **Meaning** 0 — Thickening 1 — Lightening 2 — Skewing 3 — Underlining (not supported by Line-A) 4 — Outlining
LITEMASK	92	**WORD**	Mask to lighten text (usually $5555).
SKEWMASK	94	**WORD**	Mask to skew text (usually $5555).
WEIGHT	96	**WORD**	Width to thicken characters by.
ROFF	98	**WORD**	Offset above baseline used for italicizing.
LOFF	100	**WORD**	Offset below baseline used for italicizing.
SCALE	102	**WORD**	Text scaling flag (0=no scale).
CHUP	104	**WORD**	Character rotation angle in tenths of degrees (supported only in 90 degree increments).
TEXTFG	106	**WORD**	Text foreground color.
SCRTCHP	108	**LONG**	Pointer to two contiguous scratch buffers used in creating text special effects.
SCRPT2	112	**WORD**	Offset from first buffer to second (in bytes).
TEXTBG	114	**WORD**	Text background color.
COPYTRAN	116	**WORD**	Copy raster mode (0=Opaque, 1=Transparent).

SEEDABORT	118	**LONG**	Pointer to a routine called by the seedfill routine at each line. If not needed during a seed fill you should point it to a routine like the following:
			
			`seedabort:`
			`sub.l d0,d0`
			`rts`

Line-A Font Headers

Raster system and **GDOS** fonts are linked to form a list of font headers which contain the information needed to render text. Outline text generated by **FSM** is inaccessible in this manner.

Each monospaced font contains a font header, character and horizontal offset table, and font form. All data types are in "Little Endian" (Intel format) and as such must be byte-swapped before use.

The font form is a raster form with each character laid side-by-side on the horizontal plane. The first character is **WORD** aligned but padding within the form only occurs at the end of a scanline to force the next scanline to be **WORD** aligned.

Each font header contains a pointer to the next font in the list. The list is terminated by a **NULL** pointer. The font header format is as follows:

Name	Offset	Type	Contents
font_id	0	**WORD**	Font ID number (must be unique).
point	2	**WORD**	Point size of font.
name	4	**32 BYTE**s	ASCII Name of font.
first_ade	36	**UWORD**	First ASCII character in font.
last_ade	38	**UWORD**	Last ASCII character in font.
top	40	**UWORD**	Distance from the top line of the font to the baseline.
ascent	42	**UWORD**	Distance from the ascent line of the font to the baseline.
half	44	**UWORD**	Distance from the half line of the font to the baseline.
descent	46	**UWORD**	Distance from the descent line of the font to the baseline.
bottom	48	**UWORD**	Distance from the bottom line of the font to the baseline.
max_char_width	50	**UWORD**	Width of the widest character in the font.
max_cell_width	52	**UWORD**	Width of the widest character cell in the font.
left_offset	54	**UWORD**	Amount character slants left when skewed.
right_offset	56	**UWORD**	Amount character slants right when skewed.
thicken	58	**UWORD**	Number of pixels to smear for thickening.
ul_size	60	**UWORD**	Size of an appropriate underline for the font.
lighten	62	**UWORD**	Mask for character lightening.
skew	64	**UWORD**	Mask for character skewing.
flags	66	**UWORD**	Font type flags.
hor_table	68	**LONG**	Pointer to the horizontal offset table. The horizontal offset table is an array of bytes with one entry per character denoting the pixel offset to the character.

off_table	72	**LONG**	Pointer to the character offset table. The character offset table is an array of **WORD**s with one entry per character denoting the byte offset into the font form of the character.
dat_table	76	**LONG**	Pointer to the character data.
form_width	80	**UWORD**	Width of the font form in bytes.
form_height	82	**UWORD**	Height of the font form in pixels.
next_font	84	**LONG**	Pointer to the next font in the list (0=no more fonts).
reserved	88	**UWORD**	Reserved for future use.

Line-A Function Calling Procedure

Line-A functions are called by simply inserting the opcode into the instruction stream. For example, the 'Hide Mouse' function is called with the following assembly language instruction:

```
dc.w    $A00A
```

Generally, the **Line-A** initialization function is called ($A000) and the address of the variable and/or font header tables are stored. Prior to each **Line-A** call variables are set as explained in the ***Line-A*** *Function Reference* and the function is then called. There is no method of error reporting available.

LINE-A Function Reference

$A000 - Initialize

Return pointers to the **Line-A** variable structures.

EXAMPLE BINDING

```
; Retrieve Line-A variable table address
; and store in A5 for other bindings

            .dc.w           $A000
            .move.l         a0,a5    ; Line-A variables
            .move.l         a1,a6    ; System font headers
```

RETURN VALUE The initialize function returns the following information:

Register	Contents
D0	Pointer to **Line-A** variable table.
A0	Pointer to **Line-A** variable table.
A1	Pointer to a **NULL** terminated array of pointers to system font headers.
A2	Pointer to a longword array containing sixteen pointers which are addresses of the actual **Line-A** functions in memory. For example, JSR'ing through the pointer in the first array element has the same result as calling the **Initialize** instruction by an exception except that the function must be called from supervisor mode.

COMMENTS This call is required to return the address of the **Line-A** variable structure needed for all other **Line-A** calls. All processes (including the **VDI**) share this structure so don't expect variables to remain constant between calls.

SEE ALSO **v_opnvwk()**

$A001 - Plot Pixel

Plot a single pixel at the specified coordinates.

PARAMETERS *INTIN* points to a **WORD** containing the color register of the pixel to plot at the specified coordinates. *PTSIN* points to two **WORD**s which are the X and Y coordinates respectively.

EXAMPLE BINDING

```
; Plot a pixel at ( 10, 10 ) using color 1

            move.l          #intin,8(a5)
            move.l          #ptsin,12(a5)
            .dc.w           $A001

            .data
intin:
            .dc.w           1
ptsin:
```

```
                .dc.w           10, 10
```

SEE ALSO **v_pmarker()**

$A002 - Get Pixel

Get the color register of the pixel at the specified coordinates.

PARAMETERS *PTSIN* points to two words which are the X and Y coordinates of the pixel to read.

EXAMPLE BINDING

```
; Read the color index of point ( 10, 10 )

            move.l      #ptsin,12(a5)
            .dc.w       $A002

            .data
ptsin:
            .dc.w       10, 10
```

RETURN VALUE The color register of the pixel is returned in D0.

SEE ALSO **v_getpixel()**

$A003 - Arbitrary Line

Draw a line between any two coordinates.

PARAMETERS *COLBIT0-4* are set appropriately to determine the line color. *LSTLIN* is a flag in which a value of 0 specifies to draw the last point in each line or a value of 1 which specifies not to. *LNMASK* specifies the pattern mask to apply to the line. *WRMODE* specifies the write mode of the function (0-3). (*X1*, *Y1*), and (*X2*, *Y2*) give the starting and ending coordinates of the line.

EXAMPLE BINDING

```
;Draw a solid line from ( 0, 0 ) to ( 100, 100 )

       move.w       #1,24(a5)       ; COLBIT 0
       move.w       #1,26(a5)       ; COLBIT 1
       move.w       #1,28(a5)       ; COLBIT 2
       move.w       #1,30(a5)       ; COLBIT 3
       move.w       #0,32(a5)       ; LSTLIN
       move.w       #$FFFF,34(a5)       ; LNMASK
       move.w       #0,36(a5)       ; WRMODE
       move.w       #0,38(a5)       ; X1
       move.w       #0,40(a5)       ; Y1
       move.w       #100,42(a5)     ; X2
       move.w       #100,42(a5)     ; Y2
       .dc.w        $A003
```

CAVEATS *LNMASK* is modified as a result of this call.

SEE ALSO **$A004, v_pline()**

$A004 - Horizontal Line

Draw a horizontal line between the specified coordinates.

PARAMETERS *COLBIT0-3* defines the color of the line and *WRMODE* determines the write mode (0-3). (*X1*, *Y1*) and (*X2*, *Y1*) determine the starting and ending points of the line. *PATMSK* is AND'ed with *Y1* to determine a line index into the pattern pointed to by *PATPTR*. *PATMSK* is normally the number of lines in the pattern (should be an even power of 2) minus one. If *MFILL* is non-zero, *WMODE* is disregarded and the fill is colored from the values in *COLBIT0-3*.

EXAMPLE BINDING

```
;Draw a horizontal dashed line from ( 0, 10 ) to ( 100, 10 )

            move.w          #1,24(a5)       ; COLBIT 0
            move.w          #1,26(a5)       ; COLBIT 1
            move.w          #1,28(a5)       ; COLBIT 2
            move.w          #1,30(a5)       ; COLBIT 3
            move.w          #0,36(a5)       ; WRMODE
            move.w          #0,38(a5)       ; X1
            move.w          #0,40(a5)       ; Y1
            move.w          #100,42(a5)     ; X2
            move.l          #pat,46(a5)     ; PATPTR
            move.w          #0,50(a5)       ; PATMSK
            move.w          #0,52(a5)       ; MFILL
            .dc.w           $A004
```

SEE ALSO **v_pline()**

$A005 - Filled Rectangle

Draw a filled rectangle at the specified coordinates.

PARAMETERS *CLIP* is a flag which when set to 1 enables clipping and when set to 0 disables it. All output of this function is confined to the region bounded by (*XMINCL*, *YMINCL*) and (*XMAXCL*, *YMAXCL*). Other parameters are consistent with the definitions given under **$A004**.

EXAMPLE BINDING

```
; Draw a filled rectangle with its upper
; left corner at ( 0, 0 ) and its lower
; right corner at ( 100, 100 ). Clip the
; rectangle to within ( 10, 10 ) and
; ( 90, 90 )

            move.w          #1,24(a5)       ; COLBIT0
```

```
                move.w          #1,26(a5)       ; COLBIT1
                move.w          #1,28(a5)       ; COLBIT2
                move.w          #1,30(a5)       ; COLBIT3
                move.w          #0,36(a5)       ; WRMODE
                move.w          #0,38(a5)       ; X1
                move.w          #0,40(a5)       ; Y1
                move.w          #100,42(a5)     ; X2
                move.w          #100,44(a5)     ; Y2
                move.l          #stipple,46(a5) ; PATPTR
                move.w          #1,50(a5)       ; PATMSK
                move.w          #0,52(a5)       ; MFILL
                move.w          #1,54(a5)       ; CLIP
                move.w          #10,56(a5)      ; XMINCL
                move.w          #10,58(a5)      ; YMINCL
                move.w          #90,60(a5)      ; XMAXCL
                move.w          #90,62(a5)      ; YMAXCL
                .dc.w           $A005

                .data
stipple:
                .dc.w           $AAAA
                .dc.w           $5555
```

SEE ALSO **v_bar(), vr_recfl()**

$A006 - Filled Polygon

Draw a filled polygon line-by-line.

PARAMETERS *PTSIN* contains the X/Y coordinate pairs of the vertices of the polygon with the last point being equal to the first. *CONTRL[1]* specifies the number of vertices. The rest of the variables are consistent with previous usages.

EXAMPLE BINDING

```
; Draw a filled polygon with vertices at
; ( 0, 0 ), ( 319, 120 ), and ( 25, 199 ).

move.l      #ptsin,12(a5)       ; PTSIN
move.l      #contrl,4(a5)       ; CONTRL
move.w      #1,24(a5)       ; COLBIT0
move.w      #1,26(a5)       ; COLBIT1
move.w      #1,28(a5)       ; COLBIT2
move.w      #1,30(a5)       ; COLBIT3
move.w      #0,36(a5)       ; WRMODE
move.w      #stipple,46(a5) ; PATPTR
move.w      #1,50(a5)       ; PATLEN
move.w      #0,52(a5)       ; MFILL
move.w      #0,54(a5)       ; CLIP

; loop to draw the polygon
move.w      #0,40(a5)       ; upper Y line
move.w      #199,d4         ; lowest Y line
                            ; - upper Y line
loop:
            .dc.w           $A006
addq.w      #1,40(a5)
```

```
dbra        d4,loop

            .data
ptsin:
            .dc.w           0, 0, 319, 120, 25, 199, 0, 0
contrl:
            .dc.w           0, 3
stipple:
            .dc.w           $AAAA
            .dc.w           $5555
```

CAVEATS Register A0, *X1*, and *X2* are destroyed as a result of this call.

SEE ALSO **v_fillarea()**

$A007 - BitBlt

Perform a bit-block transfer.

PARAMETERS The address of a **BitBlt** parameter block is passed in register A6. That structure is defined with the following members:

Member	Offset/Type	Meaning
B_WD	+0 (**WORD**)	Width of block to blit (in pixels)
B_HT	+2 (**WORD**)	Height of block to blit (in pixels)
PLANE_CT†	+4 (**WORD**)	Number of bit planes to blit.
FG_COL†	+6 (**WORD**)	Bit array used to create index into **OP_TAB**. **FG_COL** contributes its bit #'n' (where 'n' is the plane number) to bit #1 of the index used to select the operation code from **OP_TAB**.
BG_COL†	+8 (**WORD**)	Bit array used to create index into **OP_TAB**. **BG_COL** contributes its bit #'n' (where 'n' is the plane number) to bit #0 of the index used to select the operation code from **OP_TAB**.
OP_TAB	+10 (**LONG**)	**OP_TAB** is a 4 byte array containing four logic operation codes (0 to 16) to be applied to the image. The table is indexed by using the bit in **FG_COL** and **BG_COL** corresponding to the current plane as bit #1 and bit #0 respectively yielding an offset into **OP_TAB** of 0-3.
S_XMIN	+14 (**WORD**)	X pixel offset to source upper left.
S_YMIN	+16 (**WORD**)	Y pixel offset to source upper left.
S_FORM	+18 (**WORD**)	Address of the source form.
S_NXWD	+22 (**LONG**)	Number of bits per pixel.
S_NXLN	+24 (**WORD**)	Byte width of form.
S_NXPL	+26 (**WORD**)	Byte offset between planes (always 2).
D_XMIN	+28 (**WORD**)	X pixel offset to destination upper left.
D_YMIN	+30 (**WORD**)	Y pixel offset to destination upper left.

D_FORM	+32 (**LONG**)	Address of the destination form.
D_NXWD	+36 (**WORD**)	Number of bits per pixel.
D_NXLN	+38 (**WORD**)	Byte width of form.
D_NXPL	+40 (**WORD**)	Byte offset between planes (always 2).
P_ADDR	+42 (**LONG**)	Address of pattern buffer (0 = no pattern).
P_NXLN	+46 (**WORD**)	Bytes of pattern per line (should be even).
P_NXPL	+48 (**WORD**)	Bytes of pattern per plane (if using a single plane fill with a multi-plane destination, this should be 0).
P_MASK	+50 (**WORD**)	**P_MASK** is found by the expression: If **P_NXLN** = 2 ^ n then **P_MASK** = (length in words - 1) << n
SPACE	+52 (**WORD**)	24 bytes of blank space which must be reserved as work area for the function.

†These members may be altered by this function.

EXAMPLE BINDING

```
; Perform a blit using the information located
; at bprmblk

            lea          bprmblk,a6
            .dc.w            $A007
```

SEE ALSO **vro_cpyfm(), vrt_cpyfm()**

$A008 - TextBlt

Blit a single character to the screen.

PARAMETERS When performing this call, the following **Line-A** variables are evaluated:

Variable	Meaning
WMODE	Writing mode (see comments below).
CLIP, XMINCL, YMINCL, XMAXCL, YMAXCL	Standard clipping flags and extents.
XDDA	Scaling accumulator (should be initialized to $8000 prior to each **TextBlt** call when scaling).
DDAINC	This amount specifies the fractional amount to scale the character outputted by. If scaling down, this value may by found by the formula: 0x100 * scaled size / actual size If scaling up, this value may be found with the formula: 0x100 * (scaled size - actual size) / actual size This variable is only evaluated if scaling is active.
SCALDIR	Scaling direction (1 = up, 0 = down).

MONO	If 1 set to monospacing mode, if 0 set to proportional spacing mode.
SOURCEX, SOURCEY	**SOURCEX** is the pixel offset into the font form of the character you wish to render. **SOURCEY** is usually 0 indicating that you wish to render the character from the top.
DESTX, DESTY	**DESTX** and **DESTY** specify the destination screen coordinates of the character.
DELX, DELY	**DELX** and **DELY** specify the width and height of the character to print.
FBASE	Pointer to start of font data.
FWIDTH	Width of font form.
STYLE	**STYLE** is a mask of the following bits indicating special effects: 0x01 = Bold 0x02 = Light 0x04 = Italic 0x08 = Underlined 0x10 = Outlined
LITEMASK	Mask used to lighten text (usually $5555).
SKEWMASK	Mask used to italicize text (usually $5555).
WEIGHT	Width by which to thicken boldface text (should be set from font header).
ROFF	Offset above character baseline when skewing (set from font header).
LOFF	Offset below character baseline when skewing (from font header).
SCALE	Scaling flag (0 = no scaling, 1 = scale text).
CHUP	Character rotation vector (may be 0, 900, 1800, or 2700).
TEXTFG	Text foreground color.
SCRTCHP	Pointer to start of text special effects buffer (should be twice as large as the largest distorted character and is only required when using a special effect).
SCRPT2	Offset of scaling buffer in **SCRTCHP** (midpoint).
TEXTBG	Text background color.

EXAMPLE BINDING

```
; Print a NULL-terminated string with
; no effects or clipping

            move.w          #0,36(a5)       ; WMODE
            move.w          #0,54(a5)       ; CLIP
            move.w          #1,106(a5)      ; TEXTFG
            move.w          #0,114(a5)      ; TEXTBG
            move.w          #100,76(a5)     ; DESTX
            move.w          #100,78(a5)     ; DESTY
            move.w          #4,90(a5)       ; STYLE
            move.w          #0,102(a5)      ; SCALE
            move.w          #1,70(a5)       ; MONO

; Find the 8x8 font
            move.w          4(a6),a6        ; Address of 8x8
                                            ; font
            move.w          76(a6),84(a5)       ; FBASE
            move.w          80(a6),88(a5)       ; FWIDTH
            move.w          82(a6),82(a5)       ; DELY

; Print the string
            lea             string,a2
            move.l          72(a6),a3       ; offset table
```

```
                moveq.l         #0,d0
print:
                move.b          (a2)+,d0        ; Get next char
                ble             end
                sub.w           36(a6),d0       ; Fix offset
                lsl.w           #1,d0           ; Double for
                                                ; WORD offset
                move.w          0(a3,d0),72(a5) ; SOURCEX
                move.w          2(a3,d0),d0     ; x of next char
                sub.w           72(a5),d0       ; get true width
                move.w          d0,80(a5)       ; DELX
                moveq.l         #0,74(a5)       ; SOURCEY
                movem.l         a0-a2,-(sp)     ; Save a0-a2
                .dc.w           $A008
                movem.l         (a7)+,a0-a2     ; Restore regs
                bra         print
end:
                rts

                .data
string:
                .dc.b           "The Atari Compendium",0
```

COMMENTS The value for *WMODE* is a special case with **TextBlt**. Values from 0-3 translate to the standard **VDI** modes. Values from 4-19 translate to the **BitBlt** modes 0-15.

SEE ALSO **v_gtext()**

$A009 - Show Mouse

Show the mouse cursor.

PARAMETERS No parameters required. Optionally, *INTIN* can be made to point to a **WORD** value of 0 to force the mouse cursor to be displayed regardless of the number of times it was hidden.

EXAMPLE BINDING

```
; Show the mouse regardless of the number
; of times it was hidden

                move.l          #intin,8(a5)    ; INTIN
                .dc.w           $A009

                .data
intin:
                .dc.w           0
```

COMMENTS 'Show' and 'Hide' mouse calls are nested, that is, in order to return the mouse cursor to its original state, it must be 'shown' the same number of times it was 'hidden'.

SEE ALSO **v_show_c(), graf_mouse()**

$A00A - Hide Mouse

Hide the mouse cursor.

EXAMPLE BINDING

```
; Remove the mouse from the screen

                .dc.w           $A00A
```

COMMENTS See '**Show Mouse**'.

SEE ALSO **v_hide_c(), graf_mouse()**

$A00B - Transform Mouse

Change the mouse's form.

PARAMETERS On entry *INTIN* should point to a structure containing the new mouse form data. The format of the structure is defined under the entry for **vsc_form()**.

EXAMPLE BINDING

```
; Change the mouse form to the data held in
; the newmouse structure.

                move.b          -339(a5),d0     ; Save old value
                move.b          #0,-339(a5)     ; Disable mouse
                                                ; interrupts
                move.l          #newmouse,8(a5) ; INTIN
                .dc.w           $A00B
                move.b          d0,-339(a5)     ; Restore
                                                ; MOUSE_FLAG
```

COMMENTS The old data can be saved from the information stored in the **Line-A** variable table at offset -356. To avoid 'mouse droppings' you should disable mouse interrupts by setting *MOUSE_FLAG* (offset -339) to 0 and restoring it when done.

SEE ALSO **vsc_form(), graf_mouse()**

$A00C - Undraw Sprite

Undraw a previously drawn sprite.

PARAMETERS Prior to calling this function, A2 should be loaded with a pointer to the 'sprite save block' defined when drawing the sprite. For the format of this data, see '**Draw Sprite**'

EXAMPLE

```
; 'Undraw' sprite previously drawn from data
```

BINDING

```
; stored in savesprite.

                lea             savesprite,a2
                .dc.w               $A00C
```

CAVEATS

Register A6 is destroyed as a result of this call.

COMMENTS

When 'undrawing' sprites, they should be removed in reverse order of drawing to avoid the possibility of creating garbage on screen.

$A00D - Draw Sprite

Draw a 16x16 sprite on the screen.

PARAMETERS

Prior to calling this function, four 68x00 registers must be initialized. D0 and D1 should contain the horizontal and vertical position respectively of the coordinates of the sprite to draw. This is relative to the 'hot spot' of the sprite as defined in the sprite definition block.

A0 should contain a pointer to a sprite definition block defined as follows:

Offset/Type	Meaning
0x0000 (**WORD**)	X offset of 'hot spot'. This value is subtracted from the value given in D0 to yield the actual screen position of the upper-left pixel.
0x0002 (**WORD**)	Y offset of 'hot spot'. This value is subtracted from the value given in D1 to yield the actual screen position of the upper-right pixel.
0x0004 (**WORD**)	Format flag. This value specifies the mode in which the mouse pointer will be drawn. A value of 1 specifies '**VDI** mode' whereas -1 specifies X-OR mode. The default is 1.
0x0006 (**WORD**)	Background color of sprite.
0x0008 (**WORD**)	Foreground color of sprite.
0x000A (32 **WORD**s)	Sprite form data. The bitmap data consists of two 16x16 rasters, one each for the mask and data portion of the form. The data is presented in interleaved format. The first **WORD** of the mask portion is first, followed by the first **WORD** of the data portion, and so on.

Register A2 is a pointer to a buffer which will be used to save the screen area where the sprite is drawn. The size of the buffer can be determined by the following formula:

$$(10 + (VPLANES * 64))$$

EXAMPLE BINDING

```
; Draw a sprite at ( 100, 100 ) whose data
; is stored at spritedef with a valid save
; buffer at savebuf.

                move.w          #100,d0         ; X position
```

```
                move.w          #100,d1         ; Y position
                move.l          #spritedef,a0       ; Sprite form
                move.l          #savebuf,a2     ; Save buffer
                .dc.w           $A00D
```

CAVEATS Register A6 is destroyed as a result of this call.

COMMENTS In order to avoid the mouse form running into any sprites you draw, the mouse should be hidden before drawing and restored afterwards. It may also be advisable to call **Vsync()** prior to each call to avoid screen flicker.

$A00E - Copy Raster

Copy a raster form using opaque or transparent mode.

PARAMETERS *INTIN* should point to a **WORD** array whose first entry specifies the write mode of the operation. In transparent mode, this is a **VDI** standard mode (0-3), however in opaque mode the full range of **BitBlt** modes (0-15) are available. In transparent mode, the second and third array entries of *INTIN* contain the foreground and background color of the destination copy respectively.

CONTRL should point to a memory buffer which is filled in with the source and destination **MFDB**'s (Memory Form Definition Block's) at offsets 14 and 18 respectively. The structure of an **MFDB** is discussed under **vro_cpyfm()**.

PTSIN should point to an array of 8 **WORD**'s containing the pixel offsets for the blit in the order SX1, SY1, SX2, SY2, DX1, DY1, DX2, DY2.

COPYTRAN specifies the write mode. A value of 0 indicates an opaque copy while a value of 1 indicates a transparent copy.

The settings for *CLIP*, *XMINCL*, *YMINCL*, *XMAXCL*, and *YMAXCL* are utilitized by this call.

EXAMPLE BINDING

```
; Copy a 32x32 raster form 'myrast' from a
; buffer in memory to the ST medium resolution
; screen at ( 100, 100 ) using transparent mode.

                move.l          #contrl,4(a5)           ; CONTRL
                move.l          #srcmfdb,contrl+14
                move.l          #destmfdb,contrl+18

                move.l          #intin,4(a5)        ; INTIN
                move.l          #ptsin,4(a5)        ; PTSIN
                move.w          #1,116(a5)          ; COPYTRAN
                move.w          #0,54(a5)           ; CLIP

; Fill in some info for MFDB's
```

```
                move.l          #myrast,srcmfdb  ; Source raster
                move.w          #$02,-(sp)       ; Physbase()
                trap            #14
                addq.l          #2,sp
                move.l          d0,destmfdb

                .dc.w           $A00E

                .data
contrl:
                .dc.w           0, 0, 0, 0, 0, 0, 0, 0, 0, 0
intin:
                .dc.w           0, 1, 0
ptsin:
                .dc.w           0, 0, 15, 15, 100, 100, 115, 115
srcmfdb:
                .dc.w           0, 0, 16, 16, 1, 0, 0, 0, 0, 0
destmfdb:
                .dc.w           0, 0, 320, 200, 16, 0, 2, 0, 0, 0
myrast:
                .dc.w           $AAAA,$AAAA,$AAAA,$AAAA
                .dc.w           $5555,$5555,$5555,$5555
                .dc.w           $AAAA,$AAAA,$AAAA,$AAAA
                .dc.w           $5555,$5555,$5555,$5555
                .dc.w           $AAAA,$AAAA,$AAAA,$AAAA
                .dc.w           $5555,$5555,$5555,$5555
                .dc.w           $AAAA,$AAAA,$AAAA,$AAAA
                .dc.w           $5555,$5555,$5555,$5555
```

COMMENTS For a more indepth explanation, refer to the **VDI** calls parallel to these, **vro_cpyfm()** and **vrt_cpyfm()**.

SEE ALSO **vro_cpyfm(), vrt_cpyfm()**

$A00F - Seed Fill

Seed fill an irregularly shaped region.

PARAMETERS *INTIN* points to a word value which specifies the mode of this function. If the value is negative, color mode is used. In color mode, the fill spreads from the initial point until it hits a color other than that of the initial point. If the value is positive, outline mode is used. It then is interpreted as the **VDI** color index value at which to stop the fill.

PTSIN points to an array of two **WORD**s which specify the X and Y coordinates respectively of the inital fill point.

CUR_WORK should point to a **WORD** array of 16 words with the sixteenth **WORD** being the fill color specified as a **VDI** color index.

WMODE specified the **VDI** writing mode of the fill (0-3). *PATPTR* and *PATMSK*

define the fill pattern (as defined in '**Horizontal Line**').

SEEDABORT points to a user routine which can abort the fill, if desired, when called. This routine is called once for each line of the fill. It should zero register D0 to continue or place a non-zero value in it to abort.

EXAMPLE BINDING

```
; Seed fill an area starting at ( 100, 100 )
; in color mode with a clip region defined
; as the VDI rectangle ( 50, 50 ), ( 200, 200 ).

            move.l          #intin,8(a5)        ; INTIN
            move.l          #ptsin,12(a5)           ; PTSIN
            move.l          #cur_work,-464(a5)  ; CUR_WORK
            move.l          #seedabort,118(a5)  ; SEEDABORT
            move.w          #0,36(a5)           ; WMODE
            move.l          #stipple,46(a5)     ; PATPTR
            move.w          #0,50(a5)           ; PATMASK
            move.w          #0,52(a5)           ; MFILL
            move.w          #50,56(a5)          ; XMINCL
            move.w          #50,58(a5)          ; YMINCL
            move.w          #200,60(a5)         ; XMAXCL
            move.w          #200,62(a5)         ; YMAXCL
            .dc.w           $A00F

seedabort:
            moveq.l         #0, d0              ; Clear D0
            rts

            .data
intin:
            .dc.w           -1
ptsin:
            .dc.w           100, 100
cur_work:
            .dc.w           0, 0, 0, 0, 0, 0, 0, 0
            .dc.w           0, 0, 0, 0, 0, 0, 0, 1
stipple:
            .dc.w           $AAAA
            .dc.w           $5555
```

COMMENTS

The clipping variables *XMINCL*, *YMINCL*, *XMAXCL*, and *YMAXCL* must always be set as they are interpreted regardless of the clipping flag.

SEE ALSO

v_contourfill()

– CHAPTER 9 –

DESKTOP

Overview

The 'Desktop' is a **GEM** application that is started after the operating system is initialized and all '\AUTO' folder programs and desk accessories are loaded. The desktop is responsible for providing basic file management and program launching abilities to the user.

Normally, the desktop is contained in ROM, however under **MultiTOS**, the desktop may be soft-loaded by placing the following command line inside the 'GEM.CNF' file:

```
shell [new shell filename]
```

If the 'shell' command fails, the normal desktop is started.

If an installed shell program exits under **MultiTOS**, the OS will display a single menu from which programs may be launched.

MultiTOS Considerations

Messages

The desktop may be sent messages using the **AES**'s **shel_write()** command. The desktop currently recognizes two special messages as follows:

Message	Number	Meaning
SH_WDRAW	72	This message tells the desktop that files on a particular drive have been modified so it can update the information in any open windows. *msg[3]* should contain the drive number (0 = A:, 1 = B:, etc.). A value of -1 will force the desktop to update all of its open windows.
AP_DRAGDROP	63	The desktop included with **AES** 4.1 now accepts all drag & drop messages and places the dropped object on the desktop.

Extendibility

The **MultiTOS** desktop allows the replacement of file copy, rename, and delete, and disk copy and format commands. To replace the file commands, place the filename of an application designed to replace them in the environment variable DESKCOPY. Likewise, a disk command replacement application can be placed in the environment variable DESKFMT.

The file command replacement will be called with one of three command line formats as follows:

1. Copy a file(s): `-c [-options...] [filename(s)] [destination path]`

2. Delete a file(s): `-d [-options...] [filename(s)]`

3. Move a file(s): `-m [-options...] [filename(s)] [destination path]`

The following are valid options to appear on the command line:

Option	Meaning
-A	Confirm file copies.
-B	Do not confirm file copies.
-C	Confirm file deletes.
-D	Do not confirm file deletes.
-E	Confirm file overwrites.
-F	Do not confirm file overwrites.
-R	Prompt to rename destination file(s).

An application which is installed to replace disk operations will receive one of two command lines as follows:

1. Format a drive (ex: A:): `-f A:`

2. Copy a disk (ex: A: to B:): `-c A: B:`

TOS Application Launching

When the user uses the desktop to launch a .TOS or .TTP application under **MultiTOS**, the desktop looks for an environment variable called TOSRUN. If it finds one, it attempts to launch whatever application is specified in that variable with the TOS filename as its parameters.

If the environment variable does not exist, it opens a pipe called 'U:\PIPE\TOSRUN' and writes to it the filename and any parameters separated by spaces terminated by a **NULL** byte.

Desktop Files

DESKTOP.INF

The desktop in **TOS** versions less than 2.00 place configuration defaults such as window size and position, drive icons, etc. in the DESKTOP.INF file. In addition, some control panel settings (from CONTROL.ACC, not XCONTROL.ACC) are stored in the file as well.

The DESKTOP.INF file is in standard ASCII text format. This file was not designed to be edited by the user or programmer, but, rather from the desktop itself and will not be discussed in detail.

NEWDESK.INF

As of **TOS** 2.00, the desktop now looks for a file called NEWDESK.INF rather than DESKTOP.INF. This file contains the same information as its predecessor with some additions. Icons which appear on the desktop or in windows may now be linked to icons in the DESKICON.RSC file (as described below). Other entries are still reserved and should be left unmodified.

A creative install program wishing to install custom icons may do so by adding the icons to the DESKICON.RSC file and adding information to NEWDESK.INF which points to the new icons. The install application must be careful to avoid disturbing the original information and icons and must not reorder the icons in the DESKICON.RSC file. The following two lines show example entries in NEWDESK.INF that identify an icon for a file and folder respectively.

```
#I 2C 2C 000 @ *.TXT@ @
#D 1A 1A 000 @ FOLDER@ @
```

The '#I' identifies a file icon and the '#D' identifies a folder icon. The next two numbers should be identical hexadecimal indexes to the icon in the DESKICON.RSC file. The entry '000' is unused and should be included only as a placeholder.

The filename specified on the line can contain wildcard characters and identify the file or folder name(s) which are to be linked. All spaces and '@' characters must appear exactly as above or the system may behave strangely.

DESKICON.RSC

The DESKICON.RSC file is a standard **GEM** resource file (see *Appendix C: **Native File Formats***) with one object tree containing a **BOX** object at the **ROOT** (object #0) with the icons as children. The position of the icons in the object tree determine their index as referenced by the NEWDESK.INF file.

DESKCICN.RSC

This file is supported as of **TOS** 4.0 and is looked for before DESKICON.RSC. It has an identical format except that it supports the new resource file format and contains color icons rather than monochrome ones.

— CHAPTER 10 —

XCONTROL

The Extensible Control Panel

Overview

XCONTROL is a desk accessory which provides a shell for Control Panel Extensions (CPX's). Typical uses for CPX's include:

- System Configuration (volume, key click, etc.)
- Hardware Configuration (serial port speed, disk access rate, etc.)
- TSR Configuration

Most CPX's require only 512 bytes of system memory for header storage when not being executed as they are loaded only when selected by the user.

Applications, games, and other programs not used for configuration purposes should not be created as CPX's.

CPX Executable Format

A CPX executable is identical to a standard **GEMDOS** executable with the exception of an additional 512 byte header which precedes the standard 28 byte **GEMDOS** header. When **XCONTROL** is initialized at boot time, the header of each CPX contained in the user's designated CPX directory is loaded and stored. The header data contains the following information:

```
typedef struct _cpxhead
{
       UWORD magic;                    /* Magic = 100 dec */

       struct {
            unsigned reserved : 13;    /* Reserved */
            unsigned resident : 1;          /* Resident CPX if set */
            unsigned bootinit : 1;          /* Boot initialize if set*/
            unsigned setonly  : 1;          /* Set only CPX if set */
       } flags;

       LONG      cpx_id;               /* CPX ID Value */
       UWORD     cpx_version;          /* CPX Version */
       char      i_text[14];           /* Icon Text */
       UWORD     sm_icon[48];          /* Icon Bitmap 32x24 */
       UWORD     i_color;              /* Icon Color */
       char      title[18];            /* Title (16 char max) */
       UWORD     t_color;              /* Title text color */
       char      buffer[64];           /* User-storage */
       char      reserved[306];        /* Reserved */
} CPXHEAD;
```

Following the 512-byte CPX header the 28-byte **GEMDOS** header and executable follow. CPX's do not have a '**main()**' function. Execution begins at the first instruction of the TEXT segment. The first source file you should link should resemble the following:

```
          .xref    _cpx_init
```

```
            .text
cpxstart:
            jmp     _cpx_init

            .end
```

Every CPX must have a **cpx_init()** function.

If you plan to store defaults back into the CPX using **CPX_Save()** (described later) you should add to the first source file a statement allocating as much storage as you will need at the beginning of the DATA segment. For example, the following is a complete stub for a CPX requiring 10 **LONG**s of data for permanent storage.

```
            .xref   _cpx_init
            .globl  _save_vars

            .text
cpxstart:
            jmp     _cpx_init

          .data

_save_vars:
            .dc.l       0, 0, 0, 0, 0, 0, 0, 0, 0, 0

            .end
```

XCONTROL Structures

CPXINFO

A pointer to a CPX's **CPXINFO** structure must be returned by the **cpx_init()** function ('Set Only' CPX's return **NULL**). The **CPXINFO** structure is filled in with pointers to user functions as follows:

```
typedef struct
{
        WORD (*cpx_call)( GRECT * );
        VOID (*cpx_draw)( GRECT * );
        VOID (*cpx_wmove)( GRECT * );
        VOID (*cpx_timer)( WORD * );
        VOID (*cpx_key)( WORD, WORD, WORD * );
        VOID (*cpx_button)( MRETS *, WORD * );
        VOID (*cpx_m1)( MRETS *, WORD * );
        VOID (*cpx_m2)( MRETS *, WORD * );
        WORD (*cpx_hook)( WORD, WORD *, MRETS *, WORD *, WORD * );
        WORD (*cpx_close)( WORD );
} CPXINFO;
```

Form CPX's use only **cpx_call()** and (optionally) **cpx_close()**. Event CPX's use the remaining members. Members not being used should be set to **NULL**.

XCPB

A pointer to the "XControl Parameter Block" is passed to the **cpx_call()** function. This pointer should be copied to a static variable on entry so that other functions may utilize its members. **XCPB** is defined as follows:

```
typedef struct
{
        WORD      handle;
        WORD      booting;
        WORD      reserved;
        WORD      SkipRshFix;
        VOID      *reserve1;
        VOID      *reserve2;
        VOID      (*rsh_fix)( WORD, WORD, WORD, WORD, OBJECT *, TEDINFO *, char *,
                  ICONBLK *, BITBLK *, LONG *, LONG *, LONG *,   VOID * );
        VOID      (*rsh_obfix)( OBJECT *, WORD );
        WORD      (*Popup)( char *items[], WORD, WORD, WORD,
                  GRECT *, GRECT * );
        VOID      (*Sl_size)( OBJECT *, WORD, WORD, WORD, WORD,
              WORD, WORD );
        VOID      (*Sl_x)( OBJECT *, WORD, WORD, WORD, WORD, WORD,
                  void (*)();
        VOID      (*Sl_y)( OBJECT *, WORD, WORD, WORD, WORD, WORD,
                  void (*)() );
        VOID      (*Sl_arrow)( OBJECT *, WORD, WORD, WORD, WORD,
              WORD, WORD, WORD *, WORD, void (*)() );
        VOID      (*Sl_dragx)( OBJECT *, WORD, WORD, WORD, WORD,
              WORD *, void (*)() );
        VOID      (*Sl_dragy)( OBJECT *, WORD, WORD, WORD, WORD,
              WORD *, void (*)() );
        WORD      (*Xform_do)( OBJECT *, WORD, WORD * );
        GRECT *   (*GetFirstRect)( GRECT * );
        GRECT *   (*GetNextRect)( VOID );
        VOID      (*Set_Evnt_Mask)( WORD, MOBLK *, MOBLK *, LONG );
        WORD      (*XGen_Alert)( WORD );
        WORD      (*CPX_Save)( VOID *, LONG );
        VOID *    (*Get_Buffer)( VOID );
        WORD      (*getcookie)( LONG, LONG * );
        WORD      Country_Code;
        VOID      (*MFSave)( WORD, MFORM * );
} XCPB;
```

Almost all of **XCPB**'s members are pointers to utility functions covered in the **XCONTROL** Function Reference at the end of this chapter. The remaining utilized members have the following meaning:

XCPB Member	Meaning
handle	This value contains the physical workstation handle returned by **graf_handle()** to the Control Panel for use in calling **v_opnvwk()**.
booting	When **XCONTROL** is initializing as the result of a power-on, reset, or resolution change, it loads each CPX and calls its **cpx_init()** function with *booting* set to **TRUE**. At all other times, **XCONTROL** sets *booting* to **FALSE**.

SkipRshFix	When a CPX is first called after being loaded, its *SkipRshFix* flag is set to **FALSE**. The application should then use **xcpb->rsh_fix()** to fix its internal resource tree. **xcpb->rsh_fix()** sets the CPX's *SkipRshFlag* to **TRUE** so that the CPX can skip this step on subsequent calls.
Country_Code	This value indicates the country which this version of the Control Panel was compiled for as follows: ***Country_Code*** — **Country** 0 — USA 1 — Germany 2 — France 3 — United Kingdom 4 — Spain 5 — Italy 6 — Sweden 7 — Swiss (French) 8 — Swiss (German) 9 — Turkey 10 — Finland 11 — Norway 12 — Denmark 13 — Saudi Arabia 14 — Holland

CPX Flavors

Boot Initialization

Any CPX which has its *_cpxhead.bootinit* flag set will have its **cpx_init()** function called when **XCONTROL** initializes upon bootup. This provides a way for CPX's to set system configuration from data the user has saved in previous sessions.

cpx_init() is always called each time the user selects your CPX from the **XCONTROL** CPX list prior to calling **cpx_call()**. If the CPX is being initialized at boot time, the *xcpb->booting* flag will be **TRUE**.

Resident CPX's

CPX's which have their *_cpxhead.resident* flag set will be retained in memory after being initialized at bootup. In general, this option should not be used unless absolutely necessary.

Resident CPX's should be aware that variables stored in their DATA and BSS segments will not be reinitialized each time the CPX is called.

Set-Only CPX's

Set-Only CPX's are designed to initialize system configuration options each time **XCONTROL** initializes (during boot-ups and resolution changes) by calling the **cpx_init()** function. These CPX's will not appear in the **XCONTROL** list of CPX's.

Form CPX's

Every CPX must be either a 'Form' or 'Event' CPX. Most CPX's will be Form CPX's.

In a Form CPX, **XCONTROL** handles most user-interaction and messaging by relaying messages through a callback function. **XCONTROL** is responsible for redraws (although the CPX does have a hook to do non-**AES** object redraws) and form handling. A simple 'C' outline for a Form CPX follows:

```
/* Example Form CPX Skeleton */

#include "skel.h"
#include "skel.rsh"
#include <cpxdata.h>

CPXINFO *cpx_init();
BOOLEAN cpx_call();

XCPB *xcpb;
CPXINFO cpxinfo;

CPXINFO
*cpx_init( Xcpb )
XCPB *Xcpb;
{
       xcpb = Xcpb;

       appl_init();

       if(xcpb->booting)
       {

        /* CPX's that do boot-time initialization do it here */

        /* Returning TRUE here tells XCONTROL to retain the header
         * for later access by the user. If CPX is Set-Only,
         * return FALSE.
         */

        return ( (CPXINFO *) TRUE )
       }
       else
       {
        /* If you haven't already done so, fix resource tree.
         *
         * DEFINE's and variables are from an RSH file generated
         * by the Atari Resource Construction Set.
         */

        if(!SkipRshFix)
```

```
            (*xcpb->rsh_fix)( NUM_OBS, NUM_FRSTR, NUM_FRIMG,    NUM_TREE,
        rs_object,                 rs_tedinfo, rs_strings, rs_iconblk, rs_bitblk,
        rs_frstr, rs_frimg,                rs_trindex, rs_imdope );

          cpxinfo.cpx_call = cpx_call;
          cpxinfo.cpx_draw = NULL;
          cpxinfo.cpx_wmove = NULL;
          cpxinfo.cpx_timer = NULL;
          cpxinfo.cpx_key = NULL;
          cpxinfo.cpx_button = NULL;
          cpxinfo.cpx_m1 = NULL;
          cpxinfo.cpx_m2 = NULL;
          cpxinfo.cpx_hook = NULL;
          cpxinfo.cpx_close = NULL;

          /* Tell XCONTROL to send generic and keyboard
           * messages.
           */

          return ( &cpxinfo );
        }
}

BOOLEAN
cpx_call( rect )
GRECT *rect;
{
        /* Put MAINFORM tree in *tree for object macros */

        OBJECT *tree = (OBJECT *)rs_trindex[ MAINFORM ];
        WORD button, quit = FALSE;
        WORD msg[8];

        ObX( ROOT ) = rect->g_x;
        ObY( ROOT ) = rect->g_y;

        objc_draw( tree, ROOT, MAX_DEPTH, PTRS( rect ) );

        do
        {
          button = (*xcpb->Xform_do)( tree, 0, msg );

          /* Be sure and mask off double-clicks if you're
           * not interested in them.
           */

          if( ( button & 0x8000 ) && ( button != 0xFFFF ) ) {
              button &= 0x7FFF;

          button &= 0x7FFF;

          switch( button )
          {
              /* Check for EXIT or TOUCHEXIT resource objects */

              case OK:
                  break;
              case CANCEL:
                  break;
              case -1:
```

```
                switch( msg[0] )
                {
                     case WM_REDRAW:
                          break;
                     case AC_CLOSE:
                          quit = TRUE;
                          break;
                     case WM_CLOSED:
                          quit = TRUE;
                          break;
                     case CT_KEY:
                          break;
                }
                break;
          }
        } while( !quit );

        return( FALSE );
}
```

Event CPX's

CPX's which are not possible as Form CPX's may be designed as Event CPX's.

Event CPX's accomplish most of their work in several callback functions identified to the Control Panel by the **CPXINFO** structure and called when the appropriate message is received. An outline for a typical Event CPX follows:

```
/* Example Event CPX Skeleton */

#include “skel.h”
#include “skel.rsh”
#include <cpxdata.h>

CPXINFO *cpx_init();
BOOLEAN cpx_call();
void cpx_draw(), cpx_wmove(), cpx_key();

XCPB *xcpb;
CPXINFO cpxinfo;

CPXINFO
*cpx_init( Xcpb )
XCPB *Xcpb;
{
        xcpb = Xcpb;

        appl_init();

        if(xcpb->booting)
        {

          /* CPX's that do boot-time initialization do it here */

          /* Returning TRUE here tells XCONTROL to retain the header
           * for later access by the user. If CPX is Set-Only,
           * return FALSE.
           */
```

```
        return ( (CPXINFO *) TRUE )
      }
      else
      {
        /* If you haven't already done so, fix resource tree.
         *
         * DEFINE's and variables are from RSH file generated
         * by the Atari Resource Construction Set.
         */

        if(!SkipRshFix)
            (*xcpb->rsh_fix)( NUM_OBS, NUM_FRSTR, NUM_FRIMG,    NUM_TREE,
      rs_object,                rs_tedinfo, rs_strings, rs_iconblk, rs_bitblk,
      rs_frstr, rs_frimg,               rs_trindex, rs_imdope );

        cpxinfo.cpx_call = cpx_call;
        cpxinfo.cpx_draw = cpx_draw;
        cpxinfo.cpx_wmove = cpx_wmove;
        cpxinfo.cpx_timer = NULL;
        cpxinfo.cpx_key = cpx_key;
        cpxinfo.cpx_button = NULL;
        cpxinfo.cpx_m1 = NULL;
        cpxinfo.cpx_m2 = NULL;
        cpxinfo.cpx_hook = NULL;
        cpxinfo.cpx_close = NULL;

        /* Tell XCONTROL to send generic and keyboard
         * messages.
         */

        (*xcpb->Set_Evnt_Mask)( MU_MESAG | MU_KEYBD, NULL, NULL, -1L );

        return ( &cpxinfo );
      }
}

BOOLEAN
cpx_call( rect )
GRECT *rect;
{
      /* Put MAINFORM tree in *tree for object macros */

      OBJECT *tree = (OBJECT *)rs_trindex[ MAINFORM ];

      ObX( ROOT ) = rect->g_x;
      ObY( ROOT ) = rect->g_y;

      objc_draw( tree, ROOT, MAX_DEPTH, PTRS( rect ) );

      return ( TRUE );
}

VOID
cpx_draw( rect )
GRECT *rect;
{
      OBJECT *tree = (OBJECT *)rs_trindex[ MAINFORM ];
      GRECT *xrect, rect;

      xrect = (*xcpb->GetFirstRect)( rect );
```

```
        while( xrect )
        {
          rect = *xrect;
          objc_draw( tree, ROOT, MAX_DEPTH, ELTS( rect ) );
          xrect = (*xcpb->GetNextRect)();
        }
}

VOID
cpx_wmove( work )
GRECT *work;
{
        OBJECT *tree = (OBJECT *)rs_trindex[ MAINFORM ];

        ObX( tree ) = work->g_x;
        ObY( tree ) = work->g_y;
}

VOID
cpx_key( kstate, key, quit )
WORD kstate, key;
WORD *quit;
{
        /* Substitute case values for values you're interested
          * in.
          */

        switch( key )
        {
          case KEY_1:
          case KEY_2:
        }
}
```

CPX File Formats

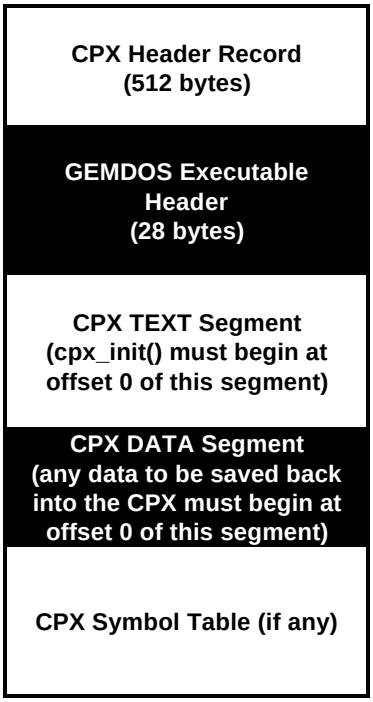
File Naming

Several standard naming conventions for CPX executables and development files follow:

File Name	Meaning
*.CPX	Standard CPX ready for execution by the Control Panel.
*.CP	CPX missing the 512 byte header.
* R.CPX	A resident CPX.
*_S.CPX	A "Set-only" CPX.
*.HDR	A 512 byte CPX header file.
*.CPZ	An inactive CPX.
*.RSH	An "embeddable" resource file. CPX's can't execute a **rsrc_load()** so all resource files must be in this format.

The CPX File Format

A CPX file can be represented graphically as follows:



XCONTROL Function Calling Procedure

Calling Conventions

XCONTROL uses "right–left" stack-based parameter passing for all of its functions and expects that user defined callback functions are similarly "right–left" stack-based. Compilers which do not default to this method should use either the 'cdecl' or '_stdargs' keyword depending on your compiler.

Function entry stubs must also consider the longword return code placed on the stack by the 68x00 'JSR' function. 'C' compilers always expect this. For example, the pointer to the **XCPB** passed to the **cpx_init()** function can be stored through the following machine language statement:

```
_cpx_init:
              move.l       4(sp),xcpb
```

Stack Space

CPX programmers should note that all CPX operations use the default Control Panel stack space (2048 bytes) and should therefore restrict heavy usage of automatic variables and other large consumers of stack space.

XCONTROL Function Reference

XCONTROL Callback Functions

The **XCONTROL** callback functions are user-supplied functions which are identified to the Control Panel in the **CPXINFO** structure returned by the **cpx_init()** function which is also described in this section. When creating a Form CPX, the only callback function that is utilized is **cpx_call()**. The remaining functions are used only when creating Event CPX's. The **XCONTROL** callback functions are:

- **cpx_button()**
- **cpx_call()**
- **cpx_close()**
- **cpx_draw()**
- **cpx_hook()**
- **cpx_init()**
- **cpx_key()**
- **cpx_m1()**
- **cpx_m2()**
- **cpx_timer()**
- **cpx_wmove()**

cpx_button()

VOID (*cpx_button)(*mrets*, *nclicks*, *event*)
MRETS *_mrets_;
WORD _nclicks_;
WORD *_event_;

cpx_button() is called in an Event CPX when a **MU_BUTTON** event has occurred.

PARAMETERS

mrets points to a structure containing the mouse event which triggered the function as follows:

```
typedef struct
{
       WORD x;       /* X position of mouse */
       WORD y;       /* Y position of mouse */
       WORD buttons; /* Mask of buttons depressed */
       WORD kstate;  /* Keyboard shift state */
} MRETS;
```

nclicks specifies the number of clicks processed. If this event should terminate the CPX, the function should place a 1 in the **WORD** pointed to by *event*.

BINDING

```
cpxinfo.cpx_button = cpx_button;

return ( &cpxinfo );
```

COMMENTS

This function will only be called if **Set_Evnt_Mask()** is called with **MU_BUTTON** specified as an event to wait for.

cpx_call()

BOOLEAN (*cpx_call)(*work*)
GRECT *_work_;

cpx_call() is called immediately after the **cpx_init()** function when the user activates the CPX.

PARAMETERS

Upon entry, the **GRECT** structure pointed to by work contains the current rectangular extent of the control panel window work area.

BINDING

```
cpxinfo.cpx_call = cpx_call;

return ( &cpxinfo );
```

RETURN VALUE The **cpx_call()** function should return **TRUE** if it wants to continue processing events through the event handlers specified in the **CPXINFO** structure or **FALSE** to indicate the CPX is finished.

COMMENTS When exiting the **cpx_call()** function, the CPX must deallocate any allocated memory and close any **VDI** workstations opened.

cpx_close()

VOID (*cpx_close)(*flag*)
BOOLEAN *flag*;

cpx_close() is called in an Event CPX when a **WM_CLOSED** or **AC_CLOSE** message is received by the control panel.

PARAMETERS *flag* contains **TRUE** if a **WM_CLOSED** message was received or **FALSE** if **AC_CLOSE** was received.

BINDING

```
cpxinfo.cpx_close = cpx_close;

return ( &cpxinfo );
```

COMMENTS This function will only be called if **Set_Evnt_Mask()** is called with **MU_MESAG** specified as an event to wait for.

WM_CLOSED messages should be treated as equivalent to ‘OK’ whereas **AC_CLOSE** messages should be treated as ‘Cancel’.

cpx_draw()

VOID (*cpx_draw)(*clip*)
GRECT **clip*;

cpx_draw() is called when a **WM_REDRAW** message is received by the control panel in an Event CPX.

PARAMETERS *clip* points to a **GRECT** structure specifiying the dirtied area.

BINDING

```
cpxinfo.cpx_draw = cpx_draw;

return ( &cpxinfo );
```

COMMENTS This routine should utilize **GetFirstRect()** and **GetNextRect()** to obtain the true rectangles of the area to redraw.

This function will only be called if **Set_Evnt_Mask()** is called with **MU_MESAG** specified as an event to wait for.

cpx_hook()

BOOLEAN (*cpx_hook)(*event, msg, mrets, key, nclicks*)
WORD *event*;
WORD **msg*;
WORD **mrets*;
WORD *key, nclicks*;

cpx_hook() is called in an Event CPX immediately after the Control Panel's **evnt_multi()** function returns before the message is processed.

PARAMETERS All parameters share counterparts with the **evnt_multi()** function. For a detailed explanation of the return values please consult the documentation for that function. *event* contains the event mask of one or more events that occurred. *msg* points to an array of eight **WORD**s containing the message buffer. *mrets* and *nclicks* point to the mouse event (if any) as described in **cpx_button()**. *key* points to a **WORD** containing the keyboard scancode of the key pressed (if any).

BINDING

```
cpxinfo.cpx_hook = cpx_hook;

return ( &cpxinfo );
```

RETURN VALUE The function should return **TRUE** to override default event handling or **FALSE** to continue processing the message.

cpx_init()

CPXINFO (*cpx_init)(*xcpb*)
XCPB **xcpb*;

cpx_init() is called upon bootup and every subsequent time the CPX is opened by the user.

PARAMETERS *xcpb* points to an XControl Parameter Block structure as described in the beginning of this chapter.

BINDING The **cpx_init()** function is called by JSR'ing to the first location in the CPX's TEXT segment. 'C' programmers should assemble and link the following code as the first object file in the link to ensure that the correct function is properly called:

```
; Startup stub for CPX's without save area

        .xref   _cpx_init

        .text

cpxstart:
        jmp     _cpx_init

        .end
```

If the CPX has default data which is to be saved back into the CPX with the **CPX_Save()** function, the following stub should be used (substitute the '.dc.w 1' statement with the appropriate amount of space required to store your data):

```
; Startup stub for CPX's with save area

        .xref   _cpx_init
        .globl  _save_vars

        .text

cpxstart:
        jmp     _cpx_init

        .data

_save_vars:
        .dc.w       1

        .end
```

RETURN VALUE The **cpx_init()** function returns a pointer to its **CPXINFO** structure to allow the Control Panel to access its other routines. If it is a 'Set-Only' CPX, it should return **NULL**.

COMMENTS A CPX can distunguish when a CPX is booting by checking the *xcpb->booting* structure member.

It is recommended that the CPX to create a copy of *xcpb* each time **cpx_init()** is called for the other callback functions to utilize.

cpx_key()

VOID (*cpx_key)(*kstate*, *key*, *event*)
WORD *kstate*;
WORD *key*;
WORD **event*;

cpx_key() is called in an Event CPX when a **MU_KEYBD** event has occurred.

PARAMETERS *kstate* specifies the state of the keyboard shift keys as in **evnt_keybd()**. key specifies the keyboard scan code of the key struck. The **WORD** pointed to by *event* should be filled in with a 1 if this event should terminate the CPX.

BINDING

```
cpxinfo.cpx_key = cpx_key;

return ( &cpxinfo );
```

COMMENTS This function will only be called if **Set_Evnt_Mask()** is called with **MU_KEYBD** specified as an event to wait for.

cpx_m1()

VOID (*cpx_m1)(*mrets*, *event*)
MRETS ****mrets***;**
WORD *event*;

cpx_m1() is called when a **MU_M1** event has occurred in an Event CPX.

PARAMETERS *mrets* will contain a pointer to a **MRETS** structure as specified in **cpx_button()** which contains the mouse state as it satisfied the condition. The **WORD** pointed to by event should be filled in with 1 if this event should terminate the CPX.

BINDING

```
cpxinfo.cpx_m1 = cpx_m1;

return ( &cpxinfo );
```

COMMENTS This function will only be called if **Set_Evnt_Mask()** is called with **MU_M1** specified as an event to wait for.

SEE ALSO **cpx_m2()**

cpx_m2()

VOID (*cpx_m2)(*mrets*, *event*)
MRETS ****mrets***;**
WORD *event*;

cpx_m2() is called when a **MU_M2** event has occurred in an Event CPX.

PARAMETERS See **cpx_m1()**.

BINDING

```
cpxinfo.cpx_m2 = cpx_m2;

return ( &cpxinfo );
```

COMMENTS This function will only be called if **Set_Evnt_Mask()** is called with **MU_M2** specified as an event to wait for.

SEE ALSO **cpx_m1()**

cpx_timer()

VOID (*cpx_timer)(*event*)
WORD ****event***;**

cpx_timer() is called when a **MU_TIMER** event has occurred in an Event CPX.

PARAMETERS The **WORD** pointed to by event should be filled in with 1 if this event should terminate the CPX.

BINDING

```
cpxinfo.cpx_timer = cpx_timer;
return ( &cpxinfo );
```

COMMENTS This function will only be called if **Set_Evnt_Mask()** is called with **MU_TIMER** specified as an event to wait for.

cpx_wmove()

VOID (*cpx_wmove)(*work*)
GRECT ****work***;**

cpx_wmove() is called when a **WM_MOVED** message is received by the Control Panel in an Event CPX.

PARAMETERS *work* is a pointer to a **GRECT** containing the new coordinates of the window work area.

BINDING

```
cpxinfo.cpx_wmove = cpx_wmove;
return ( &cpxinfo );
```

COMMENTS This function will only be called if **Set_Evnt_Mask()** is called with **MU_MESAG** specified as an event to wait for.

XCONTROL Utility Functions

The **XCONTROL** utility functions are accessed via the **XCPB** (XControl Parameter Block) in the following format for users of 'C':

```
ret = (*xcpb->Function)( param1, param2, ... )
```

These functions provide functions useful mostly to CPX's as well as functions that closely resemble **AES** functions better suited for CPX's. The **XCONTROL** Utility Functions are:

- **(*xcpb->CPX_Save)()**
- **(*xcpb->Get_Buffer)()**
- **(*xcpb->getcookie)()**
- **(*xcpb->GetFirstRect)()**
- **(*xcpb->GetNextRect)()**
- **(*xcpb->MFsave)()**
- **(*xcpb->Popup)()**
- **(*xcpb->rsh_fix)()**
- **(*xcpb->rsh_obfix)()**
- **(*xcpb->Set_Evnt_Mask)()**
- **(*xcpb->Sl_arrow)()**
- **(*xcpb->Sl_dragx)()**
- **(*xcpb->Sl_dragy)()**
- **(*xcpb->Sl_size)()**
- **(*xcpb->Sl_x)()**
- **(*xcpb->Sl_y)()**
- **(*xcpb->Xform_do)()**
- **(*xcpb->XGen_Alert)()**

(*xcpb->CPX_Save)()

BOOLEAN (*xcpb->CPX_Save)(***ptr , num*** **);**
VOIDP ***ptr*****;**
LONG ***num*****;**

CPX_Save() writes the specified data to the CPX on disk at the beginning of the CPX's DATA segment.

PARAMETERS *ptr* is a pointer to the data to save. *num* specifies the length of the data in bytes.

BINDING

```
(*xcpb->CPX_Save)( ptr, num );
```

RETURN VALUE **CPX_Save()** returns **TRUE** if the operation was successful or **FALSE** if an error occurred.

COMMENTS **CPX_Save()** stores the specified data on disk in the original CPX file at the start of the DATA segment of the program. For this reason, enough space should be allocated to account for this data. See **cpx_init()** for an example method of accomplishing this.

SEE ALSO **(*xcpb->Get_Buffer)()**

(*xcpb->Get_Buffer)()

VOIDP (*xcpb->Get_Buffer)(VOID)

Get_Buffer() returns the address of a 64-byte static storage location for the calling CPX.

BINDING

```
bufptr = (*xcpb->Get_Buffer)();
```

RETURN VALUE **Get_Buffer()** returns a pointer to a 64-byte static storage location which can be used by the CPX to preserve data between invocations.

COMMENTS Data stored in this area is lost upon a reboot. Permanent data should be stored using **CPX_Save()**.

SEE ALSO **(*xcpb->CPX_Save)()**

(*xcpb->getcookie)()

WORD (*xcpb->getcookie)(***cookie*****,** ***pvalue*** **)**
LONG ***cookie*****;**
LONG ***pvalue*****;**

getcookie() searches the 'cookie jar' for a given cookie and if found returns its stored longword.

PARAMETERS *cookie* contains the longword cookie (usually a packed 4 character ASCII code) to search for. If found, the value of the cookie is placed in the **LONG** pointed to by *pvalue*.

BINDING

```
err = (*xcpb->getcookie)( cookie, pvalue );
```

RETURN VALUE **getcookie()** returns **TRUE** if the value placed in *pvalue* is valid or **FALSE** if the cookie was not found.

COMMENTS This function is useful in locating TSR's or other resident processes which a CPX is designed to configure.

(*xcpb->GetFirstRect)()

GRECT *(*xcpb->GetFirstRect)(***prect*** **)**
GRECT ***prect*****;**

GetFirstRect() returns the first member of the Control Panel's rectangle list intersected by *prect*.

PARAMETERS *prect* points to a **GRECT** containing the extent of the dirtied area.

BINDING

```
rdraw = (*xcpb->GetFirstRect)( prect );
```

RETURN VALUE **GetFirstRect()** will return a pointer to a **GRECT** containing the first intersecting rectangle to redraw or **NULL** if none of the CPX's rectangles intersect the dirtied area.

COMMENTS **Xform_do()** handles resource object redraws in Form CPX's. Other objects requiring a redraw in Form CPX's and all objects in Event CPX's must be redrawn with using these functions when a redraw message is generated.

SEE ALSO **(*xcpb->GetNextRect)()**

(*xcpb->GetNextRect)()

GRECT *(*xcpb->GetNextRect)(VOID)

GetNextRect() returns subsequent rectangles needing to be redrawn after first calling **GetFirstRect()**.

BINDING

```
rdraw = (*xcpb->GetNextRect)();
```

RETURN VALUE

GetNextRect() returns a pointer to a **GRECT** structure containing a subsequent rectangle needing to be redrawn.

COMMENTS

When a redraw message is received, it should be handled as illustrated below (the example given is for an Event CPX but it may be applied to the **WM_REDRAW** message handling section of a Form CPX as well):

```
VOID
cpx_draw( clip )
GRECT *clip;
{
       GRECT *rdraw;

       rdraw = (*xcpb->GetFirstRect)( clip );

       while( rdraw )
       {
        /* User redraw function */
        my_redraw( rdraw );
        rdraw = (*xcpb->GetNextRect)();
       }
}
```

SEE ALSO

(*xcpb->GetFirstRect)()

(*xcpb->MFsave)()

VOID (*xcpb->MFsave)(*flag*, *mf*)
BOOLEAN *flag*;
MFORM **mf*;

MFsave() saves the current mouse form so that a custom application mouse form is not destroyed when the CPX calls **graf_mouse()** or **vsc_form()** to change the shape of the mouse.

PARAMETERS

flag specifies the action to take. If *flag* is **MFSAVE** (1), the current mouse form will be written into the **MFORM** structure pointed to by *mf*. If *flag* is **MFRESTORE** (0), the mouse form will be restored from the **MFORM** structure

pointed to by *mf*. See **vsc_form()** for the definition of **MFORM**.

BINDING

```
(*xcpb->MFsave)( flag, mf );
```

(*xcpb->Popup)()

WORD (*xcpb->Popup)(***items, num_items, default, font, button, world*** **);**
CHAR ***items*****[];**
WORD ***num_items, default, font*****;**
GRECT ***button, *world*****;**

Popup() displays and controls user interaction with a popup menu.

PARAMETERS

items points to an array of character pointers pointing to the text of the items. Each string must be padded in front with at least 2 spaces and should be of equal length (at least as long as the longest string). *num_items* specifies the number of items to display in the popup. If *num_items* exceeds five, the popup will only show three items with two arrows to allow scrolling.

default indicates the default item (the default item is displayed with a checkmark) or -1 to indicate no default item.

font specifies the font size (3 = large, 5 = small) of the items in the popup.

button points to a **GRECT** containing the rectangular extent of the button pressed to call the popup. *world* points to a **GRECT** containing the current extent of the CPX work area.

BINDING

```
ret = (*xcpb->Popup)( items, num_items, default, font, button,
       world );
```

RETURN VALUE

Popup() returns the item selected (0 based) or -1 if no selection was made (the user clicked outside of the popup area).

COMMENTS

This function is unique to CPX's and is not the same as **menu_popup()**.

Button objects which are to be used as popups should be **TOUCHEXIT** objects. In addition, as a matter of style, popup buttons should be **SHADOWED**.

(*xcpb->rsh_fix)()

VOID (*xcpb->rsh_fix)(***num_objs, num_frstr, num_frimg, num_tree, rs_object, rs_tedinfo, rs_strings, rs_iconblk, rs_bitblk, rs_frstr, rs_frimg, rs_trindex, rs_imdope*** **);**
WORD ***num_objs, num_frstr, num_frimg, num_tree*****;**
OBJECT *****rs_object***;**
TEDINFO *****rs_tedinfo***;**
char *****rs_strings***[];**
ICONBLK *****rs_iconblk***;**
BITBLK *****rs_bitblk***;**
LONG *****rs_frstr, *rs_frimg, *rs_trindex***;**
struct foobar *****rs_imdope***;**

rsh_fix() fixes up a resource tree in memory based on an 8x16 character font.

PARAMETERS

When using the Atari Resource Construction Set the parameters are generated in the .RSH file created by the compiler.

When using other resource construction sets you should refer to their instructions for applying their resource structure to this function or use the CPX function **rsh_obfix()** on each **OBJECT**.

BINDING

```
(xcpb->rsh_fix)( num_objs, num_frstr, num_frimg, num_tree,
       rs_object, rs_tedinfo, rs_strings, rs_iconblk, rs_bitblk,
       rs_frstr, rs_frimg, rs_trindex, rs_imdope );
```

COMMENTS

rsrc_load(), **rsrc_obfix()**, and **rsrc_rcfix()** fix up a resource file based upon the current screen character size. CPX resource data is always fixed up based upon an 8x16 character font.

Resources should be designed on a screen that supports an 8x16 ratio. When using the Atari Resource Construction Set, the resouce should be designed as a ‘Panel’ rather than a ‘Dialog’. With other resource construction applications the same effect is acheived by turning snap off.

Resources should only be fixed up when the *xcpb->SkipRshFix* flag is 0. This prevents resources from being fixed up more than once.

SEE ALSO

(*xcpb->rsh_obfix)()

(*xcpb->rsh_obfix)()

VOID (*xcpb->rsh_obfix)(***tree, curob*** **)**
OBJECT * ***tree*****;**
WORD ***curob*****;**

rsh_obfix() converts the specified object from character to pixel based coordinates based on an 8x16 character font.

PARAMETERS *tree* points to the **OBJECT** tree which contains the object *curob* to fix up.

BINDING

```
(*xcpb->rsh_obfix)( tree, curob );
```

COMMENTS See **rsh_fix()**.

SEE ALSO **(*xcpb->rsh_fix)()**

(*xcpb->Set_Evnt_Mask)()

VOID (*xcpb->Set_Evnt_Mask)(***mask, m1, m2, time*** **)**
WORD ***mask*****;**
MOBLK * ***m1*****;**
MOBLK * ***m2*****;**
LONG ***time*****;**

Set_Evnt_Mask() defines which events an Event CPX will process with its callback functions.

PARAMETERS *mask* is a bit mask of events (**MU_MESAG**, **MU_TIMER**, etc...) that the CPX wishes to process as in **evnt_multi()**. *m1* and *m2* point to **MOBLK** structures which define mouse rectangles to wait for if the CPX wishes to wait for **MU_M1** and/or **MU_M2** events as in **evnt_mouse()**. **MOBLK** is defined as follows:

```
typedef struct
{
       WORD m_out; /* 0 = enter, 1 = exit */
       WORD m_x;
       WORD m_y;
       WORD m_w;
       WORD m_h;
} MOBLK;
```

time specifies the length of time to specify for the **MU_TIMER** event if appropriate.

BINDING

```
(*xcpb->Set_Evnt_Mask)( mask, m1, m2, time );
```

COMMENTS This function is only valid for Event CPX's.

(*xcpb->Sl_arrow)()

VOID (*xcpb->Sl_arrow)(***tree, base, slider, obj, inc, min, max, numvar, dir, foo*** **)**
OBJECT * ***tree*****;**
WORD ***base, slider, obj, inc, min, max*****;**
WORD * ***numvar*****;**
WORD ***dir*****;**
VOID (* ***foo*****)();**

Sl_arrow() is called by a CPX when the user clicks on an arrow element of an 'active' slider.

PARAMETERS *tree* points to the object tree containing the slider elements. *base* is the object index of the slider 'track'. *slider* is the object index of the slider 'elevator'. *obj* is the index of the arrow element clicked on by the user.

inc specifies the increment amount for each slider step (+/-). *min* specifies the minimum value the slider can represent. *max* specifies the maximum value the slider can represent.

numvar points to a **WORD** containing the value which the slider represents and which is to be updated as the slider is moved. *dir* specifies the direction of the slider movement (**VERTICAL** (0) or **HORIZONTAL** (1)).

foo is a pointer to a user-defined callback function which is called once for each step of the slider to allow the user's action to 'actively' update the slider. *foo* may be **NULL** if no updating is desired.

BINDING

```
(*xcpb->Sl_arrow)( tree, base, slider, obj, inc, min, max,
       numvar, dir, foo );
```

COMMENTS Slider paging can be accomplished with this function. To do so use a method similar to the following (this example is for vertical sliders):

```
graf_mkstate( &mx, &my, &dum, &dum );
objc_offset( tree, slider, &ox, &oy );
inc = ( ( my < oy ) ? ( -1 ) : ( 1 ) );
(*xcpb->Sl_arrow( tree, base, slider, base, inc, min, max,
       &numvar, VERTICAL, foo );
```

(*xcpb->Sl_dragx)()

VOID (*xcpb->Sl_dragx)(***tree, base, slider, min, max, numvar, foo*** **)**
OBJECT *_tree_;
WORD _base, slider, min, max_;
WORD *_numvar_;
VOID (*_foo_)();

Sl_dragx() is called by a CPX when a user clicks on the horizontal slider 'elevator' of an 'active' slider.

PARAMETERS

tree points to an **OBJECT** tree containing the slider elements. *base* is the object index of the slider 'track'. *slider* is the object index of the slider 'elevator'.

min specifies the minimum value the slider can represent. *max* specifies the maximum value the slider can represent.

numvar points to a **WORD** containing the value which the slider represents and which is to be updated as the slider is moved.

foo points to a user-defined routine which is called each time the slider value *numvar* is modified. *foo* may be **NULL** if no updating is desired.

BINDING

```
(*xcpb->Sl_dragx)( tree, base, slider, min, max, numvar, foo );
```

COMMENTS

It is appropriate to change the shape of the mouse to **FLAT_HAND** while the user is dragging a slider.

SEE ALSO **(*xcpb->Sl_dragy)()**

(*xcpb->Sl_dragy)()

VOID (*xcpb->Sl_dragx)(***tree, base, slider, min, max, numvar, foo*** **)**
OBJECT *_tree_;
WORD _base, slider, min, max_;
WORD *_numvar_;
VOID (*_foo_)();

Sl_dragy() is called by a CPX when a user clicks on the vertical slider 'elevator' of an 'active' slider.

PARAMETERS See **Sl_dragx()**.

BINDING

```
(*xcpb->Sl_dragy)( tree, base, slider, min, max, numvar, foo );
```

COMMENTS It is appropriate to change the shape of the mouse to **FLAT_HAND** while the user is dragging a slider.

SEE ALSO **(*xcpb->Sl_dragx)()**

(*xcpb->Sl_size)()

VOID (*xcpb->Sl_size)(***tree, base, slider, num_items, visible, direction, min_size*** **)**
OBJECT * ***tree*****;**
WORD ***base, slider, num_items, visible, direction, min_size*** **;**

Sl_size() adjusts the size of the slider 'track' relative to the size of the slider 'elevator'.

PARAMETERS *tree* points to the **OBJECT** tree containing the slider elements. *base* is the object index of the slider 'track'. *slider* is the object index of the slider 'elevator'.

num_items is the total number of items represented by the slider. *visible* is the number of items actually seen by the user.

direction specifies the direction of the slider as either **VERTICAL** (0) or **HORIZONTAL** (1). *min_size* represents the minimum pixel size of the adjusted slider elevator.

BINDING

```
(*xcpb->Sl_size)( tree, base, slider, num_items, visible,
       direction, min_size );
```

COMMENTS This function does not redraw the slider.

(*xcpb->Sl_x)()

VOID (*xcpb->Sl_x)(***tree, base, slider, value, min, max, foo*** **)**
OBJECT * ***tree*****;**
WORD ***base, slider, value, min, max*****;**
VOID (* ***foo*****)();**

Sl_x() updates the position of a horizontal slider within its base.

PARAMETERS *tree* points to an **OBJECT** tree containing the slider elements. *base* is the object index of the slider 'track'. *slider* is the object index of the slider 'elevator'.

value is the value the slider should represent. *min* and *max* are the minimum and maximum values the slider can represent respectively.

If *foo* is not **NULL**, it points to a user-function which is called to redraw the slider.

BINDING

```
(*xcpb->Sl_x)( tree, base, slider, value, min, max, foo );
```

SEE ALSO **(*xcpb->Sl_y)()**

(*xcpb->Sl_y)()

VOID (*xcpb->Sl_y)(*tree, base, slider, value, min, max, foo*)
OBJECT ****tree*;
WORD *base, slider, value, min, max*;
VOID (foo*)();**

Sl_y() updates the position of a vertical slider within its base.

PARAMETERS See **Sl_x()**.

BINDING

```
(*xcpb->Sl_y)( tree, base, slider, value, min, max, foo );
```

SEE ALSO **(*xcpb->Sl_x)()**

(*xcpb->Xform_do)()

WORD (*xcpb->Xform_do)(*tree, editobj, msg*)
OBJECT ****tree*;
WORD *editobj*;
WORD ****msg*;

Xform_do() is a specialized version of **form_do()** designed to handle a CPX object tree and window messages concurrently.

PARAMETERS *tree* should point to an **OBJECT** tree containing a form with the root object being 256x176. *editobj* specifies the editable text object to initially display the text cursor at (or 0 if no editable object exists on the form).

msg should point to an 8 **WORD** array used by the function to store special messages returned by **evnt_multi()**.

BINDING

```
ret = (*xcpb->Xform_do)( tree, editobj, msg );
```

RETURN VALUE

Xform_do() returns the positive object number of the **EXIT** or **TOUCHEXIT** object selected. The high bit of this value indicates if the object was double-clicked and should therefore be masked off if unused. If **Xform_do()** returns a -1, then a message should be processed as contained in *msg*. The structure of messages are the same as in **evnt_multi()**. Possible messages are:

WM_REDRAW
AC_CLOSE
WM_CLOSE
CT_KEY

CT_KEY (53) is a special **XCONTROL** message indicating that a key was pressed. The scancode of the key pressed is contained in *msg[3]*. Only special keyboard keys such as HELP, F1–F10, UNDO, ALT-X, etc... will be returned as the standard alphabetic keys are processed in editable fields.

COMMENTS

The **Xform_do()** function automatically handles and redraws of the given **OBJECT** tree. Any other items needing to be redrawn should be handled at the appropriate window redraw message.

WM_CLOSED messages should always be treated as 'OK' while **AC_CLOSE** messages should be treated as 'Cancel'.

(*xcpb->XGen_Alert)()

BOOLEAN (*xcpb->XGen_Alert)(*id*)
WORD *id*;

XGen_Alert() displays a specialized alert centered in the Control Panel's work area.

PARAMETERS

id specifies the alert to display as follows:

Name	*id*	Alert
SAVE_DEFAULTS	0	Save Defaults?
MEM_ERR	1	Memory Allocation Error
FILE_ERR	2	File I/O Error
FILE_NOT_FOUND	3	File Not Found Error

BINDING

```
ret = (*xcpb->XGen_Alert)( id );
```

RETURN VALUE **XGen_Alert()** returns **TRUE** if 'OK' was selected or **FALSE** if 'Cancel' was selected. Alerts 1-3 always returns **TRUE**.

– CHAPTER 11 –

GEM USER INTERFACE GUIDELINES

Overview

Maintaining consistent elements of style in a user-interface is an important aspect of programming which should not be overlooked. An extremely powerful application will have its usefulness compromised by an interface that is unlike the majority of other applications a user will be exposed to.

In an effort to create a more standardized method of application programming, this reference will diagram many interface elements that every Atari programmer should use, regardless of whether you are applying them to existing parts of **GEM** or programmer-defined elements.

In a case where you provide an enhanced interface element that departs from these specifications, you should at least allow the user to disable the option in a 'Settings...' dialog.

The Basics

All **GEM** applications should contain a menu bar providing access to program features. Desk accessories should appear in a window.

'Dialogware' and 'Alertware' applications are strongly discouraged. Each performs user interaction exclusively in one or more dialogs or alerts respectively. This makes it impossible for the user to take advantage of other programs or desk accessories while in use.

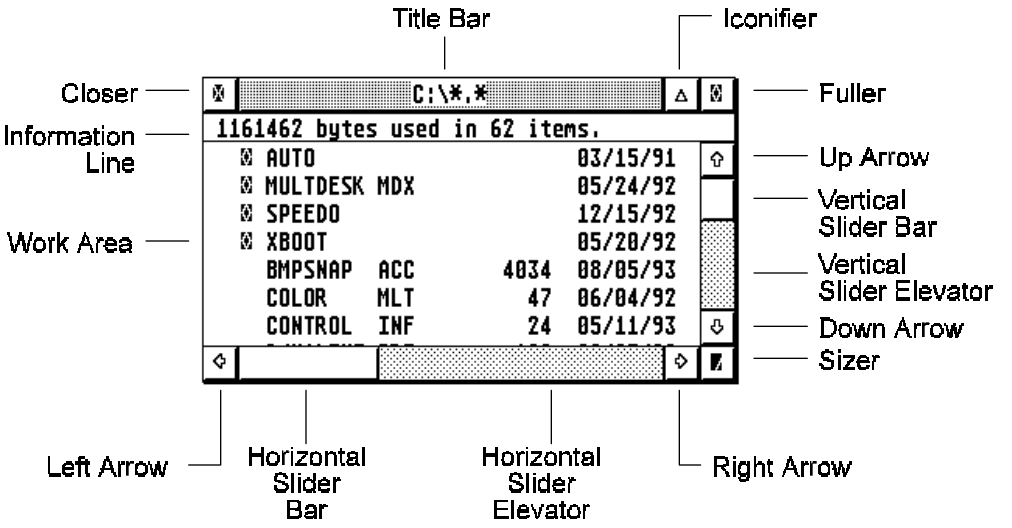
Document-oriented applications that are launched with one or more valid documents specified on the command line should launch those documents into their own windows, otherwise the application should initialize in one of two other ways:

- Open an empty document window with the default parameters labeled "Untitled."
- Present a dialog allowing three choices. "New" opens a blank document (as above), "Open" presents a file selector used to select a document to open, "Cancel" removes the dialog and leaves the user with the menu bar to make other selections.

Windows

A window is a viewport through which all or part of an application's document may be viewed. Windows are modeless forms of input. This means that they do not restrict the user from switching to another window or executing a command.

Normal document windows should have a title bar and should be moveable (these characteristics are set with the **wind_create()** function – see *Chapter 6: **AES***). The following illustration shows a window with all window components identified:



Here are some other basic rules to use when creating windows:

- Windows should almost always have the **MOVE** characteristic set.
- If it is possible that the contents of the information displayed in the window might overflow, provide sliders (horizontal and/or vertical) as appropriate. The sliders should be updated as necessary to ensure that they are proportional in size and position to the amount of information viewable in the window versus the size of the entire document.
- Generally, all document windows will include all window elements (with the possible exception of the information line). Only exclude an element if its use would be inappropriate in the current context.

Window Messages

An application's use of windows depends on either the **evnt_mesag()** or **evnt_multi()** functions of the **AES**. These functions return messages which in turn must be responded to by the application for any changes to occur. The following list illustrates all messages that a window may receive along with an appropriate action(s) that should be taken.

Message	Action
WM_REDRAW	Redraw the rectangular portion of the window which was dirtied (as specified in the message). Always use **wind_get()** with **WF_FIRSTXYWH** and **WF_NEXTXYWH** to walk the rectangle list and enable clipping to the appropriate regions. If the window had a **SMALLER** gadget, check prior to drawing whether you are drawing the actual window contents or an iconified representation. If the window has an attached toolbar that requires special redrawing, use **wind_get()** with **WF_FTOOLBAR** and **WF_NTOOLBAR** as parameters to walk the rectangle list and enable clipping to the returned regions. In some situations you may want to redraw the entire window upon each **WM_REDRAW** call. You must still walk the rectangle list as specified above.
WM_TOPPED	Call **wind_set()** with a parameter of **WF_TOP** to actually top the window. Do not redraw the window. Your application will receive **WM_REDRAW** messages for portions of the window uncovered by the call. Also, set the mouse form as desired.
WM_SIZED	Call **wind_set()** with a parameter of **WF_CURRXYWH** to actually change the current size of the window. Update slider positions as necessary to reflect the new size of the window. Applications will automatically receive a redraw message if any portion of the window was uncovered. If you need to redraw the entire window each time the window size changes, send your own application a **WM_REDRAW** message with **appl_write()** to cause a redraw.
WM_MOVED	Call **wind_set()** with a parameter of **WF_CURRXYWH** to actually change the current size of the window. This message and the message **WM_SIZED** are usually handled by common code.

WM_ARROWED	Scroll the contents of the document window as necessary and redraw the window (using the rectangle list). When an arrow indicator is clicked, scroll the window by one 'line' (a small increment in a non-text oriented application). When the exposed area of the slider bar is clicked, scroll the contents of the document window by one 'page' (current viewable portion of the document) minus one 'line'.
WM_VSLID	Scroll the contents of the document window in proportion with the new position of the slider elevator.
WM_HSLID	Scroll the contents of the document window in proportion with the new position of the slider elevator.
WM_FULLED	Restore the size of the window using **wind_get()** with a parameter of **WF_PREVXYWH**. Update slider bars as necessary.
WM_CLOSED	Close the window. If the window context required a positive or negative answer from the user ('Yes/No' or 'OK/Cancel'), assume positive. If the window contains a document which *has* been altered since the last time it was saved to disk, it is appropriate to ask the user if the document should be saved before proceeding.
WM_BOTTOMED	Call **wind_set()** with a parameter of **WF_BOTTOM** to send the window to the bottom of the window stack.
WM_ICONIFY	See below.
WM_UNICONIFY	See below.
WM_ALLICONIFY	See below.
WM_TOOLBAR	Respond as necessary to the toolbar event.
WM_ONTOP	Set the mouse form appropriately for your application.
WM_UNTOPPED	No action is mandated by this message.

Clipping Rectangles

In every instance where text or graphics are rendered in a window, you should walk the rectangle list in order to ensure that the screen is properly updated. This includes all instances when the contents of the window are updated as a response to a user command (as opposed to a **WM_REDRAW** message) or dynamic interaction (i.e. selection or animation).

Window Titles

The title bar of a window should accurately reflect its basic contents. If a window contains a document the title bar should contain the filename of the document or 'Untitled' if it is a new document that has not been saved yet. If the window does not contain a document, the title bar should serve to clearly explain the purpose of the menu. For example, if you were to implement a find and replace dialog in a window, the window should be titled "Find & Replace."

In some cases you may wish to provide an option (though a menu or keystroke) which allows the user to open a duplicate copy of the document in another window. This allows the user to select separate views in each open window yet changes in one window are reflected in others. In this case, suffix the document name with a colon and the window number such as "FILENAME.DOC:1". The numbering should only be present when more than one document window actually exists.

Iconified Windows

AES versions 4.1 and above support the **SMALLER** gadget for window iconification. The basic rules for iconification follow:

Action	Is a 'program group' iconified window already open?	Response
User wishes to iconify a single window.	No	Iconify the single window.
User wishes to iconify a single window.	Yes	Close the window the user wishes to iconify and add it to those represented by the 'program group' window.
User wishes to iconify all windows.	No	Create a new, iconified window as a 'program group' and close all other windows.
User wishes to iconify all windows.	Yes	Add all open windows to those represented by the 'program group' window and close all other windows.
User wishes to uniconify a single window.	N/A	Uniconify the window.
User wishes to uniconify a 'program group' window.	Yes	Close the iconified window and open all of the windows in the 'program group'.

Here are some other hints that are helpful when dealing with iconification:

- Due to the smaller size of the window title line, it may be desirable to adjust the title text when a window is iconified.

- Draw an icon which represents the contents of the window when drawing a single iconified window. When drawing a 'program group' iconified window, draw an icon which represents the application.
- Use **graf_growbox()** and **graf_shrinkbox()** to graphically show the user the iconification/uniconification process.

Window Information Line

When appropriate, the addition of the **INFO** component of a window should serve to provide additional information about the objects visible in the window. This information should change to provide the most useful information. A vector graphics editor might display the document size, statistics, and zoom factor normally, but provide information on the number and extent of selected objects when at least one object is selected.

Window Colors

AES versions 3.0 and above allow the color of each window component to be modified. An application should never modify the global settings. Allow the user to use the Window Colors CPX to choose global colors of his/her choice.

If your application wants to draw a visual distinction between windows by displaying them in different colors, provide a dialog where the user may choose color preferences or (at least) enable/disable this option.

Dialog Boxes

A dialog box is the modal counterpart to a window. When a dialog box is displayed, all of the user's input is exclusively directed towards it until the user releases control by satisfying the needs of the dialog. Here are some basic rules regarding dialog boxes:

- Prior to drawing a dialog and calling **form_do()**, call the **AES** function **wind_update(BEG_UPDATE)**. Do not release control with **END_UPDATE** until the dialog box is removed and input with it is finished.
- If a dialog box controls a physical attribute (such as text face or fill type), provide a 'Sample' area where changes are automatically displayed prior to exiting the dialog.
- Dialogs that position themselves automatically at the center of the active window or mouse location are convenient to some users, annoying to others. When providing this feature, allow it to be disabled.

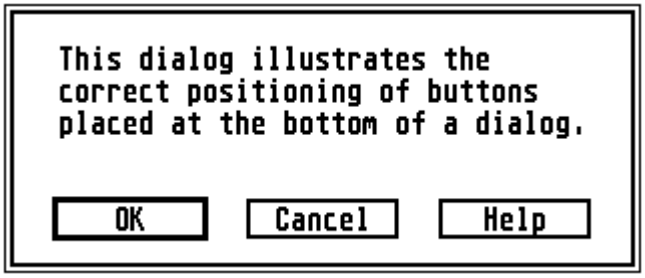
Button Positioning

Most dialogs consist of several resource objects that can be edited or changed by the user and several exit buttons which terminate the dialog (or cause a supplementary action). Dialogs which supply information should have an 'OK' button and a 'Help' button if additional information is available. Dialogs which manipulate settings should have an 'OK' button to accept changes, a 'Cancel' button to revert to the state prior to entering the dialog, and an 'Help' button if help is to be provided.

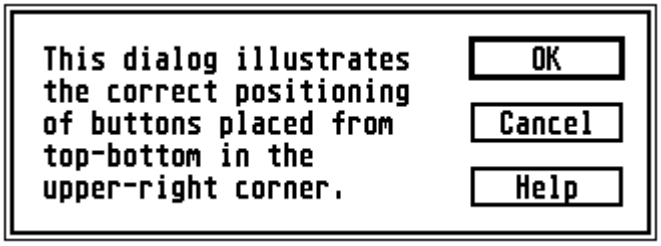
Buttons should always appear in the order ‘OK’, ‘Cancel’, ...other buttons..., ‘Help’ when working left to right or top to bottom. ‘OK’ should be in all capitals. All other buttons should be capitalized. When other wording is appropriate (such as ‘Yes/No’) the positive answer should always precede the negative answer.

All dialogs should have a default exit button which exits the dialog. In most cases this will be the positive ‘OK’ or ‘Yes’ response. In a case where an action is irreversible and data will be changed (for example, formatting a disk), it is appropriate for the negative response to be made default rather than the positive one.

Exit buttons should be placed in a dialog so that they are either centered at the bottom of the dialog or listed from top to bottom starting at the upper-righthand corner of a dialog as pictured in the following diagrams:



Dialog w/Horizontal Buttons



Dialog w/Vertical Buttons

When using the ‘top-down’ style, buttons with complementary meanings may be grouped by inserting one space between groups. The dialog pictured above shows an example of a dialog with an ‘OK’, ‘Cancel’, and ‘Help’ button correctly positioned.

Unfolding Dialogs

In some cases a dialog may contain features for both the common and advanced user. In this case it is recommended that an ‘unfolding’ dialog be presented.

An unfolding dialog contains a button such as ‘Options >>’ or ‘More >>’ which, when pressed, expands the dialog to reveal additional features. When this happens the ‘Options >>’ button

becomes '<< Options' (or 'More >>' becomes '<< Less' which, when pressed, will return the dialog box to its original state.

User-Defined Controls.

When adding custom objects to dialog boxes using **G_PROGDEF** objects or other means, it is important to keep the interface with these objects consistent with an already existing object. For instance, a custom text control should respond to keystrokes in the same manner as the **G_FTEXT** object. If a custom object departs from these standards, its implementation should be capable of being disabled.

Alerts

Alerts are special dialog boxes which provide information and/or a limited choice of options to the user. Alerts are often used to present an error condition to the user or to inform them of a choice. Some basic rules regarding alert boxes follow:

- In general apply rules regarding button text (such as capitalization, the default object, etc.) to alerts.
- Whenever possible, provide the user with more than one option in an alert box. Alerts with only one button are frustrating and should only be used when only one possible course of action exists.
- Never provide an 'OK' button and a 'Cancel' button when either button will lead to the same action/inaction.
- Avoid using the word 'error' or any other text which might blame the user.
- If an error has occurred, suggest a remedy (possibly using a dialog box for data reentry).
- Use 'Cannot' instead of 'Can't' or 'Can not'.
- If an error alert might occurring during multi-tasking while another process has focus, make the first line of the alert text the program name followed by a colon.
- A message such as "Not enough memory to load file TEST.DOC." is much better than "Insufficient memory."
- Minor warnings to a user might become increasingly apparent by having the response to the first incorrect action be the system bell and the second occurrence being a dialog box politely guiding the user along.
- Message text should be left-aligned.
- If message text is too long to fit into the 5 line/30 character per line limit, consider downsizing the message for clarity, or if necessary, place the alert in a form. Never use consecutive alerts.
- Alerts should be capitalized by standard grammatical rules and should be punctuated with a period or question mark (not an exclamation mark).

Alerts boxes may be displayed with one of three icons (or no icon at all). The following lists examples of when to use a specific icon:

Icon	Uses
None	Program credits, reminders, general help.
	Error conditions, conditions requiring immediate action.
	Inquiries, most confirmations.
	Potentially program-fatal errors, confirmation of an irreversible action.
	Informational alerts. These usually have only an 'OK' button. Alerts with more than one choice might be better suited for the question mark icon.
	General disk errors and requests.

The File Selector

Several important style guidelines are important to follow when using the system calls **fsel_input()** or **fsel_exinput()** to provide the common system file selector to the user. If your application provides a custom file selector unique to your application, always allow the user the choice of using the system file selector as opposed to your own. In general, it is better to use the internal selector rather than provide a customized one. The user may install a third-party file selector replacement if they want the extra features that custom file selectors usually provide. This provides more user-interface consistency throughout the system.

If you commonly use a third-party replacement file selector on the system you test applications on, always test your application with the replacement file selector disabled. Several third-party file selectors handle screen redraws and pathname parsing differently than the internal file selector does.

When your application needs to display the file selector, always ensure that the pathname that is going to be passed to the file selector call is valid. If the pathname becomes invalid, revert to a system default path such as that of your applications own. It is also courteous to the user to store the last used path in a global buffer so that each time the file selector is accessed the user doesn't have to change directories again.

If your application requires that its files be loaded and saved with a specific file extension, append that file mask to the end of the pathname so that the user's choices are restricted. If during a save operation the user chooses to override your default extension, either allow it or prompt the user as to their true intention.

When the file selector call returns, if the filename field is blank, treat it as a 'Cancel'. If a filename was entered but it contains no file extension, append your default file extension (if appropriate) to it.

Progress Indicators

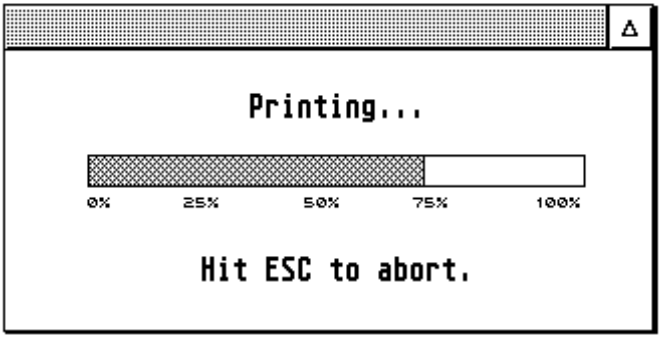
When an application begins a task that may require a substantial amount of time to complete, it is normally appropriate to change the mouse to a **BUSY_BEE** form to indicate to the user a long action is taking place.

If the screen display does not reflect the actual task in real time, it is helpful to display a progress bar (sometimes referred to as a thermometer) indicator on screen to remind the user that an task is indeed taking place and that the computer has not entered a locked state. In this case, you may leave the mouse form in the **ARROW** shape so that the user may perform other functions in a multitasking environment.

It is helpful to place a progress bar for potentially long operations into a window so that other applications or desk accessories may be accessed. When possible, the exact length of the operation might be stated like "Time Left: xx:xx".

The progress bar should move as closely as possible to a true proportional representation of time (i.e. avoid circumstances where it might take ten seconds to move from 25% to 50% but only a second to move from 50% to 100%).

An example progress bar showing a task in progress is shown below:

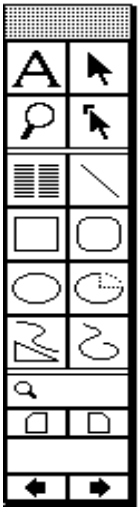


Toolboxes

Toolboxes are groups of buttons (usually **G_IMAGE** or **G_ICON**) which either select between editing modes (often in graphic editors or DTP applications) or choose object properties. A toolboxes may be contained in its own window or appear 'attached' in the document window aligned with the upper-left corner of the work area. A toolbox in its own window should have its 'un-toppable' characteristic set under **MultiTOS** (see **wind_set()**) to prevent the user from having to click twice to select a button.

Buttons on these specialized dialog/window combinations fall into three categories, exclusive buttons (such as a pointer tool and rectangle tool), non-exclusive buttons (such as zoom on/off), and style buttons (such as fill style and line style).

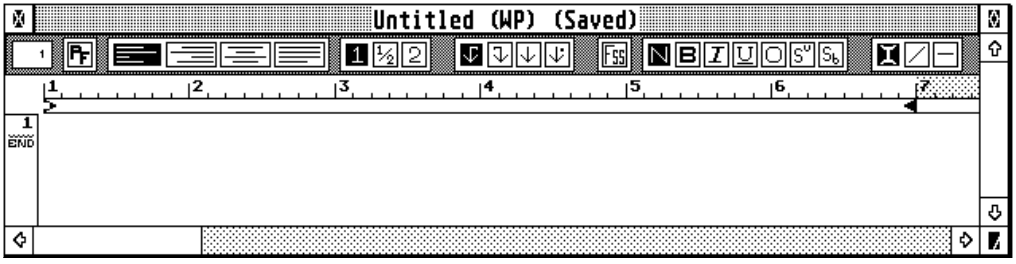
Buttons should reflect their state by appearing either inverted or depressed. The currently selected exclusive button as well as any selected non-exclusive button retains this state until a new object is chosen or it is deselected. Style buttons are only selected until the user has completed the operation. When available, toolbox buttons should appear in color using a **G_CICON**. An example of a toolbox window follows:



Example from Soft-Logic's Pagestream 2.2.

Toolbars

Toolbars (sometimes referred to as 'Ribbons') are single-strip toolboxes placed at the top of the document work area which contain buttons or combo boxes which are usually used to alter properties of the document. An example of a control bar embedded in a window follows:



Example from Atari Works.

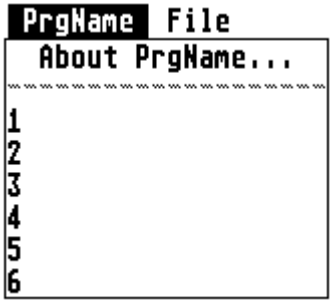
Newer versions of the **AES** provide built-in support for toolbars, though they can be implemented in applications running in an OS that does not support the new calls.

Menus

The Menu Bar

Each application in the system should initialize a menu bar as soon as it is called. The menu bar consists of several titles which when pointed to by the mouse cause a list of individual menu items to be displayed.

The leftmost menu title (commonly referred to as the 'Desk' menu) should be the application name[1]. An example of the first menu title/items are shown below:



The first item in the menu should be "About *PRGNAME*...". *PRGNAME* should be substituted with the name of the application. The lines below are reserved for desk accessories and applications (when running under **MultiTOS**)..

An application should call **menu_register()** (under **MultiTOS**) to change its entry in the menu from the filename to the program title.

The second and third menu titles should be "File" and "Edit" as appropriate (though the inclusion of both of these menus is highly recommended). Application defined menus should be placed after these. If a "Help" menu is available it should be the rightmost title. A "Window" menu should be placed rightmost second only to "Help" if it exists. An example title bar follows:

Menu entries should be grouped by function under appropriate titles and subgrouped by placing separator bars between them (disabled dashes).

Menu entries which end in an ellipsis should lead to a dialog box. Those without ellipsis should carry out an action with no further user interaction.

[1]This menu title used to be labeled "Desk" or contain the fuji logo. With the advent of **MultiTOS**, however, placing the application name here makes it possible for the user to easily determine the application which has the input focus.

The File Menu

The “File” menu should consist of the following items (presented in order):

- New
- Open...
- Recall (optional – has cascading menu attached with most-recently used file list)
- Save
- Save as...
- Save all (optional)
- Any other document closing commands as required.

Separator

- Import (if applicable)
- Export (if applicable)
- Any other file operations as required[2].

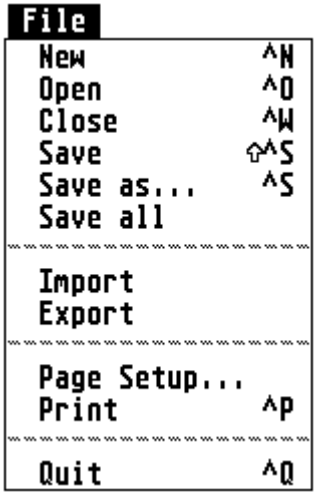
Separator

- Page Setup... (if applicable)
- Print (if applicable)
- Any other printing commands as required.

Separator

- Quit

Following is an example “File” menu:



[2]This does not refer to operations such as ‘Delete File’ or ‘Rename File’. These commands should not be supported in applications because they are available from the Desktop running under **MultiTOS** or from disk utility CPX’s and accessories.

The Edit Menu

The next menu, “Edit”, usually contains the following items:

- Undo (if supported)
- Redo (if supported[3])

Separator

- Cut
- Copy
- Paste
- Delete

Separator

- Select All (optional)

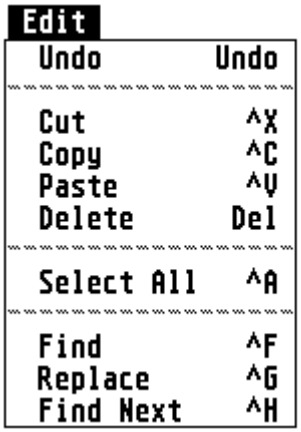
Separator

- Find... (optional)
- Replace... (optional)
- Find Next (optional)

Separator

- Any other editing/searching commands.

An example “Edit” menu follows:



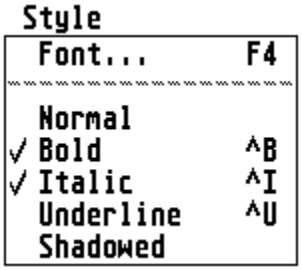
Dual-State Menu Items

Menu selections can be designed to represent toggles. There are two methods of accomplishing this as follows:

- Apply a checkmark to the item to indicate an enabled state.
- Alter the text. For example, when “Hide Toolbar” is clicked, change the text to “Show Toolbar”.

[3] ‘Redo’ is used when multiple levels of ‘Undo’ are to be provided.

In addition, some menu item groups may provide a choice between more than two options as shown in the following example:



Again, checkmarks can be used to indicate the selection.

Here are some other general pointers about using menus:

- Menu items such as “Preferences...” or “Save Preferences” belong in the “Options” menu.
- Menu items for text styles (like bold, italic) can be made **G_USERDEF** objects and made to reflect their actual state.
- If you add a “Window” menu, items such as “New Window” which opens a new window for the current document, “Arrange All”, “Tile All”, “Cascade All”, which positions windows can optionally be included. Followed by a separator, a generic item “Window” can be attached to a cascading menu which contains an updated list of all document windows so that the user can use the menu bar to ‘top’ a window.
- If you add a “Help” menu, different options can provide different levels of help such as “Contents” or “Index”. Don’t list help items for each possible dialog box or mode, instead provide context sensitive help that is activated through a “Help” button or by pressing the HELP key.

Popup Menus

Popup menus are menus which can appear anywhere on screen at the request of the user. A common use of popup menus is for object-specific options which are called upon when an object is right-clicked on with the mouse.

Popup menus can also be placed in dialog boxes as shown below. Dialog objects which lead to popup menus should be **TOUCHEXIT** and **SHADOWED**. If text describing the popup appears at the left of the button, it should be inverted when the popup is displayed and until it is closed.

When a popup menu contains a list of exclusive options, the option currently selected should be properly identified to the **menu_popup()** command so that it is aligned with the object in addition to having a checkmark. Popups with no selected option should always start at the first selection.

Popup menus may contain objects other than text (like fill styles or bitmaps) but will be unable to scroll.

Drop-Down List Boxes

Drop-down list boxes are handled in the same manner as popup menus with the following exceptions:

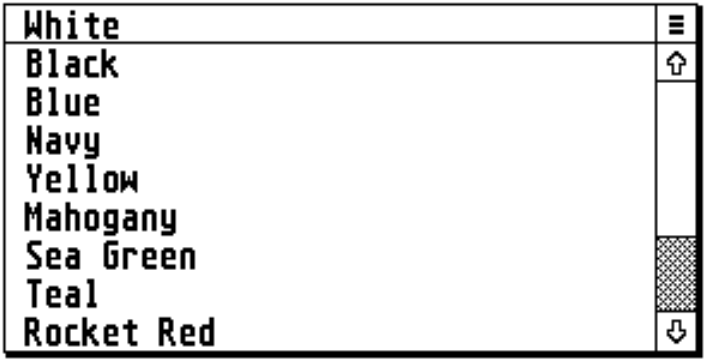
An ‘equivalence’ character (ASCII 240) in a **BOXCHAR** object should be displayed immediately to the right of the box leading to the drop-down list and should also be **TOUCHEXIT** and **SHADOWED**. A click on this object is the same as clicking on the main object.

No checkmark should be displayed next to the current selection.

The **TOUCHEXIT** box leading to a drop-down list may be editable, if appropriate, to allow the user to add items to those currently in the list.

The following illustrations show examples of both a ‘closed’ (prior to being selected) and ‘open’ (during selection) drop-down list:

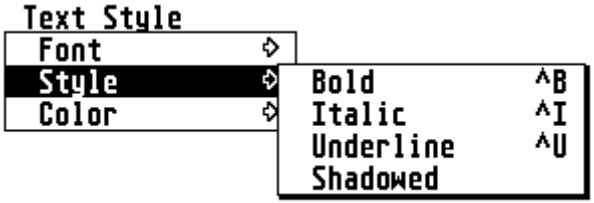
Drop-Down List Box (closed)



Drop-Down List Box (open)

Hierarchical Menus

Hierarchical menus (or sub-menus) are menus attached to either a main menu item or a popup menu item. These menus can be nested several levels deep but it is recommended that this feature not be used because your menu bar, in general, should never be this complex. An example of a hierarchical menu follows:



Keyboard Equivalents

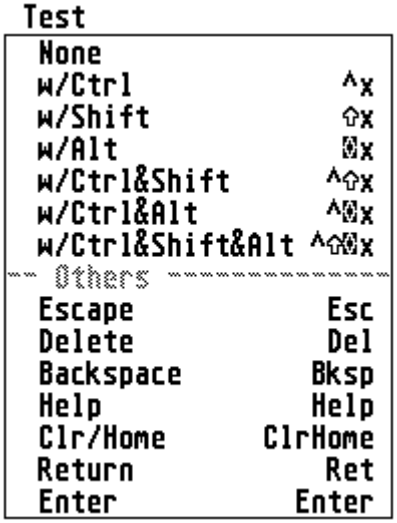
Some users prefer to do their program interaction via the mouse while others prefer the keyboard. Those users who prefer keyboard interaction are often frustrated by a lack of consistency among programs concerning keyboard equivalents.

The following keyboard equivalents are universal among many platforms (including Atari) and should be enabled in all cases where a counterpart option exists in an application. Other keyboard equivalents may be assigned as long as they do not conflict with one of those already predefined. The use of the ALTERNATE key as a modifier in a keyboard equivalent is discouraged because international users use the ALTERNATE key to access special keyboard characters.

Menus

Menu keyboard equivalents should be notated next the menu item and flush right (excepting one space) with the menu. The CONTROL key should be notated by the caret, the ALTERNATE key should be notated by the window closer character, and the SHIFT key should be notated by the up arrow character. Function keys are notated “Fnn” and other keys are notated as, for example, “Del”, “Bksp”, “Help”, etc.

Menu items with a sub-menu attachment should not have a keyboard equivalent. An example menu with keyboard equivalents shown correctly follows:



Following is a list of defined keyboard equivalents:

Key Equivalent	Operation
CTRL–N	New
CTRL-O	Open
CTRL-W	Close
CTRL-S	Save as...
CTRL-SHIFT-S	Save
CTRL-P	Print
CTRL-SHIFT-P	Page Setup
CTRL-Q	Quit
CTRL-X	Cut
CTRL-C	Copy
CTRL-V	Paste
CTRL-A	Select all
CTRL-F	Find
CTRL-R	Replace
HELP	Access help
SHIFT-HELP	Engage context sensitive help. Pointer should change to arrow/question mark and help should be provided for any object clicked on.
UNDO	Undo last operation

Windows

When working with text-oriented applications, the following list of keyboard equivalents apply. Keep in mind that CTRL is generally a character-based modifier while SHIFT is line-based.

Key Equivalent	Operation
CTRL-B	Bold
CTRL-I	Italic

CTRL-U	Underline
CTRL-BACKSPACE	Delete word to left.
CTRL-DELETE	Delete word to right.
CTRL-ARROW	Move to the left/right one word.
CTRL-CLRHOME	Move cursor to start of document.
SHIFT-LEFT-ARROW	Move to the beginning of current line.
SHIFT-RIGHT-ARROW	Move to the end of current line.
SHIFT-UP-ARROW	Move up one page.
SHIFT-DOWN-ARROW	Move down one page.
SHIFT-DELETE	Delete line.
SHIFT-CLRHOME	Move cursor to end of document.
ARROW	Move one character left/right.
CLRHOME	Move cursor to top of window.
BACKSPACE	Delete character to left of cursor.
DELETE	Delete character to the right of cursor.

When working with object-oriented applications, the following keyboard equivalents are suggested:

Key Equivalent	Operation
ARROW	Deselect current object(s), select previous/next object.
BACKSPACE	Delete selected object.
DELETE	Delete selected object.
TAB	Deselect current object, select next object.

Disjoint/Group Selection

When in the context of a text-editing application, SHIFT-clicking on a point should select the text from the cursor position to the point clicked or add that region to a current selection (if one exists). In an object-oriented application, SHIFT-clicking should allow the user to select and deselect multiple objects.

Device Independence

Programming for compatibility on the Atari is a simple task. Here are some basic tips:

- A **GEM** program should use the **VDI** for all graphical/screen output. Never use **GEMDOS**, **BIOS,** or **XBIOS** functions to output to the screen or manipulate the palette.
- Don't make assumptions about the type of display based on any call such as **Getrez()**, **EsetShift()**, or **Vsetmode()**. Only look at the values returned by the **VDI v_opnvwk()** call.
- For printing, always support **GDOS**. It is the only way to ensure that a user has a printer driver and fonts for the attached printer and that output is consistent among different printers. As with the screen, never make assumptions about the printer based on criteria like driver name, etc.

- Never write directly to hardware unless it's the documented way to accomplish a task. This is an almost sure sign that your program will break in future hardware releases.
- Avoid using interrupt vectors. If you must use them, use **Setexc()**.

Globalization

One of the most effective ways a software marketer can increase his product's sales is by ensuring its usability in foreign countries. Programmers can make their software more portable through the following methods:

- Store all language-dependent strings in the application's resource file. Porting to other languages may then be accomplished by the modification of the resource file only.
- When creating resource files. Allow at least 50% more space than that is required for English text. The English language tends to require fewer characters than most others.
- Use the '_IDT' and '_AKP' cookie to globalize references to dates, times, and currencies. If your application does not have a resource file, you may also use the '_AKP' cookie to select among language specific strings embedded within your code. When the '_AKP' cookie is not present you can check for language information embedded in the program header.

Colors

An application's proper use of color can greatly enhance its effectiveness. Likewise, improper use of color can thoroughly confuse a user. Below are some basic rules about the use of color:

- Never alter the first 16 colors in modes with 256 colors or more. Only change system colors in other cases when absolutely necessary. These are system colors which should be controlled exclusively by the user.
- When providing a custom 3D effect to complement the OS under **TOS** 4.0 and above, use **objc_sysvar()** to interrogate color settings to allow your objects to match.
- Make dialogs **FL3DBAK** objects to allow the user's selected dialog color to come through.
- Don't use colors to decorate, use them to emphasize or draw attention to an important screen element. Use colors to display choices relating to color or when a user expects it in the document.
- When using color as a choice indicator, use green as a positive, red as a negative.

Sound

As with color, the proper use of sound can help or hinder an application program. The system bell should be used as a polite reminder to the user when an operation is being attempted that is beyond the capabilities of the application (ex: scrolling past the last line in a document). It is also useful to alert the user to the end of a long operation (during which the user might have stepped away).

In general, applications should restrict their use of sounds to the system bell. Beyond that, applications can support sounds through the use of the accessory "System Audio Manager" (supplied with the Falcon030) or have their custom sounds provided they may be enabled selectively by the user.

Application Software

Application software programmers writing for the Atari line of computers should follow the following suggestions:

- Provide an installation program on the distribution floppy called 'INSTALL.PRG'. See below for details.
- Use the '_IDT' cookie to determine the proper method of displaying dates and times. Use the '_AKP' cookie to determine the country's currency character.
- Provide help in as many places as possible. Provide context-sensitive help if possible.
- Your application file, its resource file(s), and any 'readme' files should be together in one directory. Any other application data files should be kept in a child directory of the application directory.

Installation Software

Every disk distributed for end-user use should have an installation program called 'INSTALL.PRG' on the root directory of the floppy or CD-ROM diskette. Even disks containing only data files should be installable in this manner. Basic guidelines for installation programs follow:

- The installation program should allow the user to specify a location for the files to be installed and create a new directory for them if necessary.

- The installation program may (if desired by the user) add icons for the application itself and data files to the DESKICON.RSC or DESKCICN.RSC file as appropriate. If the application

requires special GDOS drivers or fonts, the installation should (if desired by the user) modify the ASSIGN.SYS or EXTEND.SYS files appropriately.

- The installation program may (if desired) modify the system DESKTOP.INF or NEWDESK.INF, as appropriate, to create references to added icons and to install the application to the system (creating associated file types, startup directory, etc.). Be careful not to override existing document associations without the user's permission.

- If your installation program modifies any system files, *always* make a backup prior to the changes and inform the user where the backups will be located.

- The installation program should visually update the user as to the progress of the installation procedure.

- If changes to system files were made, inform the user on exit that the system will need a reboot for these changes to become effective.

- If removing your application completely from the system involves more than deleting a single directory's contents or if relocating the application will cause it to no longer function properly, provide an additional application that will remove or move your application as desired by the user.

Entertainment Software

Entertainment software written for Atari computers should follow these minimum standards.

- Allow the user to install your software on the hard drive using an 'INSTALL.PRG'.
- Don't force the user to change resolutions prior to running your software.
- The path to your application should not contain data files, place those in a folder.
- Allow the user to return to the desktop in the same resolution he left.
- If possible, allow the game to be run in a window.
- Use device-independent graphics paired with the **VDI** call **vr_trnfm()** to translate your graphics upon loading to be compatible with the installed video shifter.
- Support the enhanced analog joystick rather than CX-40 style controls on machines which have the ports to support them (like the STe and Falcon030). Use the CX-40 controls if four-player play is desired.

— APPENDIX A —

FUNCTIONS BY OPCODE

GEMDOS Functions by Opcode

Dec	Hex	Function	Summary	Page
0	0x00	**PtermØ()**	Exit process with a return code of 0.	2.122
1	0x01	**Cconin()**	Fetch a character from the console device and echo it.	2.41
2	0x02	**Cconout()**	Output a character to the console device processing any special keys.	2.43
3	0x03	**Cauxin()**	Fetch character from the auxiliary device.	2.39
4	0x04	**Cauxout()**	Output a character to the auxiliary device.	2.41
5	0x05	**Cprnout()**	Output a character to the printer device.	2.47
6	0x06	**Crawio()**	Perform input and output on the console device.	2.49
7	0x07	**Crawcin()**	Output a character to the console device.	2.48
8	0x08	**Cnecin()**	Fetch a character from the console device.	2.46
9	0x09	**Cconws()**	Write a string to the console device.	2.45
10	0x0A	**Cconrs()**	Read a string from the console device.	2.44
11	0x0B	**Cconis()**	Determine if a character is waiting to be received from the console device.	2.42
14	0x0E	**Dsetdrv()**	Set the default drive.	2.62
16	0x10	**Cconos()**	Determine if a character may be sent to the console device.	2.43
17	0x11	**Cprnos()**	Determine if a character may be sent to the printer device.	2.46
18	0x12	**Cauxis()**	Determine if a character is waiting to be received from the auxiliary device.	2.39
19	0x13	**Cauxos()**	Determine if a character may be sent to the auxiliary device.	2.40
20	0x14	**Maddalt()**	Notify **GEMDOS** of additional memory.	2.97
25	0x19	**Dgetdrv()**	Return the default drive.	2.56
26	0x1A	**Fsetdta()**	Set the address of the **DTA**.	2.91
32	0x20	**Super()**	Modify user/supervisor status.	2.128
42	0x2A	**Tgetdate()**	Get the current date.	2.132
43	0x2B	**Tsetdate()**	Set the current date.	2.133
44	0x2C	**Tgettime()**	Get the current time.	2.132
45	0x2D	**Tsettime()**	Set the current time.	2.133
47	0x2F	**Fgetdta()**	Return a pointer to the **DTA**.	2.79
48	0x30	**Sversion()**	Obtain the current **GEMDOS** version.	2.129
49	0x31	**Ptermres()**	Exit process leaving some data intact.	2.123
54	0x36	**Dfree()**	Determine the free space on a drive.	2.54
57	0x39	**Dcreate()**	Create a directory.	2.53
58	0x3A	**Ddelete()**	Delete a directory.	2.54
59	0x3B	**Dsetpath()**	Set the default path.	2.63
60	0x3C	**Fcreate()**	Create a file.	2.74
61	0x3D	**Fopen()**	Open a file.	2.84
62	0x3E	**Fclose()**	Close a file.	2.66
63	0x3F	**Fread()**	Read binary data from a file.	2.87
64	0x40	**Fwrite()**	Write binary data to a file.	2.95
65	0x41	**Fdelete()**	Delete a file.	2.76
66	0x42	**Fseek()**	Move a file pointer.	2.89
67	0x43	**Fattrib()**	Get or set the attributes of a file.	2.64
68	0x44	**Mxalloc()**	Allocate memory with preference.	2.100
69	0x45	**Fdup()**	Duplicate a file handle.	2.76

A.4 – Functions by Opcode

Dec	Hex	Function	Summary	Page
70	0x46	**Fforce()**	Redirect one handle to another.	2.77
71	0x47	**Dgetpath()**	Return the default path.	2.57
72	0x48	**Malloc()**	Allocate memory.	2.98
73	0x49	**Mfree()**	Free allocated memory.	2.99
74	0x4A	**Mshrink()**	Shrink or expand a block of memory.	2.99
75	0x4B	**Pexec()**	Execute another process.	2.103
76	0x4C	**Pterm()**	Exit process with the specified return code.	2.121
78	0x4E	**Fsfirst()**	Find a file with the specified mask.	2.92
79	0x4F	**Fsnext()**	Find subsequent files with the specified mask.	2.93
86	0x56	**Frename()**	Rename a file or directory.	2.89
87	0x57	**Fdatime()**	Get or set the time/date flags of a file.	2.75
92	0x5C	**Flock()**	Set or remove a file lock.	2.82
255	0xFF	**Syield()**	Surrender the remaining portion of the processes timeslice.	2.130
256	0x100	**Fpipe()**	Establish a communication pipeline between processes.	2.86
260	0x104	**Fcntl()**	Perform a file-system specific file operation.	2.67
261	0x105	**Finstat()**	Determine the input status of a file.	2.80
262	0x106	**Foutstat()**	Determine the output status of a file.	2.85
263	0x107	**Fgetchar()**	Get a character from a file.	2.79
264	0x108	**Fputchar()**	Output a character to a file.	2.86
265	0x109	**Pwait()**	Determine the exit code of a stopped or terminated child process.	2.125
266	0x10A	**Pnice()**	Alter the process priority of the calling process.	2.111
267	0x10B	**Pgetpid()**	Obtain the process ID of the calling process.	2.107
268	0x10C	**Pgetppid()**	Obtain the process ID of the processes' parent.	2.108
269	0x10D	**Pgetpgrp()**	Obtain the process group ID of the calling process.	2.107
270	0x10E	**Psetpgrp()**	Set the process group ID for the calling process.	2.115
271	0x10F	**Pgetuid()**	Obtain the user ID of the calling process.	2.108
272	0x110	**Psetuid()**	Set the user ID for the calling process.	2.116
273	0x111	**Pkill()**	Send a signal to one or more processes.	2.109
274	0x112	**Psignal()**	Determine the action to take when a signal is received.	2.118
275	0x113	**Pvfork()**	Create a duplicate of the current process which shares address and data space with its parent.	2.124
276	0x114	**Pgetgid()**	Obtain the group ID of the calling process.	2.107
277	0x115	**Psetgid()**	Set the group ID of the calling process.	2.114
278	0x116	**Psigblock()**	Block selected signals from delivery.	2.118
279	0x117	**Psigsetmask()**	Specifies which signals should be blocked and which should be received.	2.121
280	0x118	**Pusrval()**	Get or set the user-defined value associated with a process.	2.124
281	0x119	**Pdomain()**	Get or set the processes execution domain.	2.102
282	0x11A	**Psigreturn()**	Clean up from a signal handler.	2.120
283	0x11B	**Pfork()**	Create a copy of the current process.	2.105
284	0x11C	**Pwait3()**	Determine the exit code of stopped or terminated child processes.	2.126
285	0x11D	**Fselect()**	Enumerate file descriptors which are ready for reading/writing.	2.90
286	0x11E	**Prusage()**	Return resource usage information on the calling process.	2.112
287	0x11F	**Psetlimit()**	Read or modify resource usage limits for a process.	2.114
288	0x120	**Talarm()**	Read or set an alarm for the current process.	2.131

Dec	Hex	Function	Summary	Page
289	0x121	**Pause()**	Suspend the process until a signal is received.	2.101
290	0x122	**Sysconf()**	Return information regarding current capabilities and limitations of processes running under **MiNT**.	2.130
291	0x123	**Psigpending()**	Determines which signals have been sent but not yet received to the calling process.	2.120
292	0x124	**Dpathconf()**	Return information regarding limitations and capabilities of a file system.	2.59
293	0x125	**Pmsg()**	Send or receive a message.	2.109
294	0x126	**Fmidipipe()**	Change the file handles which refer to MIDI input and output.	2.83
295	0x127	**Prenice()**	Alter the process priority of the specified process.	2.111
296	0x128	**Dopendir()**	Open a directory.	2.58
297	0x129	**Dreaddir()**	Read a directory entry.	2.61
298	0x12A	**Drewinddir()**	Reset the directory pointer.	2.62
299	0x12B	**Dclosedir()**	Close a directory.	2.50
300	0x12C	**Fxattr()**	Return extended attribute information for a file.	2.95
301	0x12D	**Flink()**	Create a file link.	2.81
302	0x12E	**Fsymlink()**	Establish a symbolic link to a file.	2.94
303	0x12F	**Freadlink()**	Determine the actual file to which a link refers.	2.88
304	0x130	**Dcntl()**	Perform a file-system specific device operation.	2.50
305	0x131	**Fchown()**	Modify the ownership of a file.	2.66
306	0x132	**Fchmod()**	Modify the access permission flags of a file.	2.65
307	0x133	**Pumask()**	Determines the minimum file and/or directory creation access permission masks.	2.123
308	0x134	**Psemaphore()**	Create a semaphore.	2.113
309	0x135	**Dlock()**	Lock or unlock a **BIOS** disk device.	2.57
310	0x136	**Psigpause()**	Suspends the process until a specified signal (or signals) is received.	2.119
311	0x137	**Psigaction()**	Changes the way a signal is handled.	2.116
312	0x138	**Pgeteuid()**	Returns the effective user ID of the caller.	2.106
313	0x139	**Pgetegid()**	Returns the effective group ID of the caller.	2.106
314	0x13A	**Pwaitpid()**	Attempts to determine the exit code of a particular process.	2.127
315	0x13B	**Dgetcwd()**	Returns the current **GEMDOS** working directory for the process on the specified drive.	2.56
316	0x13C	**Salert()**	Sends an alert to the alert pipe 'U:\PIPE\ALERT'.	2.128

BIOS Functions by Opcode

Dec	Hex	Function	Summary	Page
0	0x00	**Getmpb()**	Return the address of the **MPB** (Memory Parameter Block) structure.	3.31
1	0x01	**Bconstat()**	Determine if a character is waiting from a device.	3.28
2	0x02	**Bconin()**	Input a character from a device.	3.27
3	0x03	**Bconout()**	Output a character from a device.	3.28
4	0x04	**Rwabs()**	Read/write sectors to a device.	3.34
5	0x05	**Setexc()**	Set or read a system exception vector.	3.35
6	0x06	**Tickcal()**	Return the current system timer calibration.	3.36
7	0x07	**Getbpb()**	Return the address of the **BPB** (**BIOS** Parameter Block).	3.30
8	0x08	**Bcostat()**	Determine if a device is ready to receive a character.	3.29
9	0x09	**Mediach()**	Determine if a drive's media has been changed.	3.33
10	0x0A	**Drvmap()**	Return a bitmap of mounted drives.	3.30
11	0x0B	**Kbshift()**	Return the state of the keyboard shift keys.	3.32

XBIOS Functions by Opcode

Dec	Hex	Function	Summary	Page
0	0x00	**Initmous()**	Initialize the mouse handler.	4.73
1	0x01	**Ssbrk()**	Reserve memory at the top of RAM.	4.102
2	0x02	**Physbase()**	Return the address of the physical screen.	4.85
3	0x03	**Logbase()**	Return the address of the logical screen.	4.80
4	0x04	**Getrez()**	Return the current screen resolution code.	4.68
5	0x05	**Setscreen()** and **VsetScreen()**	Set the current screen address and mode.	4.97 4.108
6	0x06	**Setpalette()**	Set entries in the ST compatible palette.	4.95
7	0x07	**Setcolor()**	Set an entry in the ST compatible palette.	4.93
8	0x08	**Floprd()**	Read a sector from a floppy disk.	4.66
9	0x09	**Flopwr()**	Write a sector to a floppy disk.	4.67
10	0x0A	**Flopfmt()**	Format a sector on a floppy disk.	4.63
11	0x0B	**Dbmsg()**	Send a debugging message to the resident debugger.	4.28
12	0x0C	**Midiws()**	Write a string to the MIDI port.	4.82
13	0x0D	**Mfpint()**	Define an MFP interrupt.	4.81
14	0x0E	**Iorec()**	Return the address of the system **IOREC** structure.	4.75
15	0x0F	**Rsconf()**	Configure the currently mapped RS-232 port.	4.89
16	0x10	**Keytbl()**	Return the addresses of the current key mapping tables.	4.78
17	0x11	**Random()**	Return a random number.	4.89
18	0x12	**Protobt()**	Prototype a floppy boot sector.	4.86
19	0x13	**Flopver()**	Verify a sector on a floppy disk.	4.66
20	0x14	**Scrdump()**	Execute the built-in screen dump code.	4.91
21	0x15	**Cursconf()**	Configure the **TOS** cursor.	4.27
22	0x16	**Settime()**	Set the time of day and current date.	4.98
23	0x17	**Gettime()**	Get the time of day and current date.	4.69
24	0x18	**Bioskeys()**	Reset the keyboard mapping tables to default.	4.24
25	0x19	**Ikbdws()**	Write a string to the intelligent keyboard controller.	4.72
26	0x1A	**Jdisint()**	Disable an MFP interrupt.	4.76
27	0x1B	**Jenabint()**	Enable an MFP interrupt.	4.76
28	0x1C	**Giaccess()**	Modify or set a register on the PSG.	4.70
29	0x1D	**Offgibit()**	Toggle bits of the PSG Port A off.	4.84
30	0x1E	**Ongibit()**	Toggle bits of the PSG Port A on.	4.84
31	0x1F	**Xbtimer()**	Set an interrupt on the 68901.	4.113
32	0x20	**Dosound()**	Start an interrupt driven sound routine.	4.33
33	0x21	**Setprt()**	Set or read the printer configuration bits.	4.96
34	0x22	**Kbdvbase()**	Return the address of the current IKBD interrupt table.	4.77
35	0x23	**Kbrate()**	Set or read the keyboard repeat rate.	4.78
36	0x24	**Prtblk()**	Print a block of memory using the built-in screen dump routines.	4.87
37	0x25	**Vsync()**	Hold the process until the next vertical blank.	4.110
38	0x26	**Supexec()**	Execute a routine in supervisor mode.	4.103
39	0x27	**Puntaes()**	Discard the **AES**.	4.88

A.10 – Functions by Opcode

Dec	Hex	Function	Summary	Page
41	0x29	**Floprate()**	Set the floppy drive seek rates.	4.65
42	0x2A	**DMAread()**	Read sectors from a DMA/SCSI device.	4.31
43	0x2B	**DMAwrite()**	Write sectors to a DMA/SCSI device.	4.32
44	0x2C	**Bconmap()**	Modify the **BIOS** device mapping table.	4.23
46	0x2E	**NVMaccess()**	Access non-volatile RAM.	4.83
48	0x30	**Metainit()**	Initialize **MetaDOS**.	4.80
64	0x40	**Blitmode()**	Get or set the state of the BLiTTER chip.	4.25
80	0x50	**EsetShift()**	Set the TT030 shift mode registers.	4.61
81	0x51	**EgetShift()**	Get the TT030 shift mode registers.	4.57
82	0x52	**EsetBank()**	Set the current TT030 color bank.	4.58
83	0x53	**EsetColor()**	Get or set a color in the TT030 palette.	4.59
84	0x54	**EsetPalette()**	Set the TT030 palette.	4.60
85	0x55	**EgetPalette()**	Get the TT030 palette.	4.56
86	0x56	**EsetGray()**	Set the TT030 gray mode register.	4.60
87	0x57	**EsetSmear()**	Set the TT030 smear mode register.	4.62
88	0x58	**VsetMode()**	Set the Falcon030 video mode.	4.107
89	0x59	**VgetMonitor()**	Identify the kind of monitor attached to the Falcon030.	4.104
90	0x5A	**VsetSync()**	Set the Falcon030 sync mode.	4.109
91	0x5B	**VgetSize()**	Get the size of screen memory in bytes.	4.105
92	0x5C	**VsetMask()**	Set the mask assigned to each true color plotted.	4.106
93	0x5D	**VsetRGB()**	Set the Falcon030 palette using RGB data.	4.108
94	0x5E	**VgetRGB()**	Get the Falcon030 palette using RGB data.	4.104
96	0x60	**Dsp_DoBlock()**	Transfer bytewise packed data to/from the DSP.	4.38
97	0x61	**Dsp_BlkHandshake()**	Handshakes bytewise packed data to/from the DSP.	4.35
98	0x62	**Dsp_BlkUnpacked()**	Transfers data stored in a longword array to/from the DSP.	4.36
99	0x63	**Dsp_InStream()**	Transfers data to the DSP via an interrupt handler.	4.45
100	0x64	**Dsp_OutStream()**	Transfers data from the DSP via an interrupt handler.	4.51
101	0x65	**Dsp_IOStream()**	Transfers data to/from the DSP via concurrent interrupt handlers.	4.46
102	0x66	**Dsp_RemoveInterrupts()**	Disable the generation of DSP interrupts.	4.51
103	0x67	**Dsp_GetWordSize()**	Get the current size of a DSP word.	4.41
104	0x68	**Dsp_Lock()**	Lock the DSP system.	4.48
105	0x69	**Dsp_Unlock()**	Unlock the DSP system.	4.55
106	0x6A	**Dsp_Available()**	Determines the amount of free X and Y memory available in the DSP.	4.34
107	0x6B	**Dsp_Reserve()**	Reserves a portion of DSP memory for a user program	4.53
108	0x6C	**Dsp_LoadProg()**	Loads a '.LOD' file from disk, transmits it to the DSP, and executes it.	4.47
109	0x6D	**Dsp_ExecProg()**	Transfers a DSP program in memory to the DSP and executes it.	4.39
110	0x6E	**Dsp_ExecBoot()**	Resets the DSP and loads a new bootstrap program into the first 512 words of DSP memory.	4.39

Dec	Hex	Function	Summary	Page
111	0x6F	**Dsp_LodToBinary()**	Converts a '.LOD' file to binary format.	4.49
112	0x70	**Dsp_TriggerHC()**	Causes a host command set aside for DSP programs to execute.	4.55
113	0x71	**Dsp_RequestUniqueAbility()**	Requests a unique DSP ability identifier.	4.52
114	0x72	**Dsp_GetProgAbility()**	Returns the ability code for the program residing in DSP memory.	4.40
115	0x73	**Dsp_FlushSubroutines()**	Removes all DSP subroutines from memory.	4.40
116	0x74	**Dsp_LoadSubroutine()**	Loads a DSP subroutine into memory.	4.48
117	0x75	**Dsp_InqSubrAbility()**	Determines if a subroutine with the specified ability code is currently loaded into the DSP.	4.44
118	0x76	**Dsp_RunSubroutine()**	Begins execution of the specified subroutine.	4.53
119	0x77	**Dsp_Hf0()**	Reads/writes bit #3 of the HSR.	4.41
120	0x78	**Dsp_Hf1()**	Reads/writes bit #4 of the HSR.	4.42
121	0x79	**Dsp_Hf2()**	Reads bit #5 of the HSR.	4.43
122	0x7A	**Dsp_Hf3()**	Reads bit #6 of the HSR.	4.43
123	0x7B	**Dsp_BlkWords()**	Transfers an array of **WORD**s to/from the DSP.	4.37
124	0x7C	**Dsp_BlkBytes()**	Transfers an array of bytes to/from the DSP.	4.34
125	0x7D	**Dsp_Hstat()**	Returns the value of the DSP's ICR register.	4.44
126	0x7E	**Dsp_SetVectors()**	Defines interrupt handlers to be called when DSP data is ready to be sent or received.	4.54
127	0x7F	**Dsp_MultBlocks()**	Transmits multiple blocks to/from the DSP.	4.50
128	0x80	**Locksnd()**	Lock the sound system.	4.79
129	0x81	**Unlocksnd()**	Unlock the sound system.	4.103
130	0x82	**Soundcmd()**	Execute a sound system specific function.	4.100
131	0x83	**Setbuffer()**	Set the record and playback buffers.	4.92
132	0x84	**Setmode()**	Set the playback/record mode.	4.94
133	0x85	**Settracks()**	Set the playback/record tracks.	4.99
134	0x86	**Setmontracks()**	Set the track to be output over the speaker/headphone.	4.95
135	0x87	**Setinterrupt()**	Set the sound system interrupts.	4.93
136	0x88	**Buffoper()**	Enable or disable playback/recording.	4.25
137	0x89	**Dsptristate()**	Connect or disconnect the DSP from the connection matrix.	4.56
138	0x8A	**Gpio()**	Read or write data over the general purpose pins on the DSP port.	4.72
139	0x8B	**Devconnect()**	Connect devices in the connection matrix.	4.29
140	0x8C	**Sndstatus()**	Obtain the status of the sound system.	4.99
141	0x8D	**Buffptr()**	Return the current position of the record or playback buffer pointers.	4.26
165	0xA5	**WavePlay()**	Playback a DMA sample.	4.110

AES Functions by Opcode

Dec	Hex	Function	Summary	Page
10	0x0A	**appl_init()**	Initializes a **GEM** application.	6.53
11	0x0B	**appl_read()**	Reads data from the message pipe.	6.54
12	0x0C	**appl_write()**	Writes data to the message pipe.	6.58
13	0x0D	**appl_find()**	Locates a system process.	6.47
14	0x0E	**appl_tplay()**	Plays back recorded events.	6.56
15	0x0F	**appl_trecord()**	Records keyboard and mouse events.	6.57
18	0x12	**appl_search()**	Enumerates system processes.	6.55
19	0x13	**appl_exit()**	Prepares a **GEM** application for termination.	6.47
20	0x14	**evnt_keybd()**	Waits for a keyboard event.	6.63
21	0x15	**evnt_button()**	Waits for a mouse button event.	6.61
22	0x16	**evnt_mouse()**	Waits for a mouse rectangle event.	6.70
23	0x17	**evnt_mesag()**	Waits for an application message.	6.64
24	0x18	**evnt_timer()**	Waits for a timer event.	6.73
25	0x19	**evnt_multi()**	Waits for multiple events.	6.71
26	0x1A	**evnt_dclick()**	Sets the mouse double-click rate.	6.62
30	0x1E	**menu_bar()**	Displays/removes a menu bar.	6.105
31	0x1F	**menu_icheck()**	Places a checkmark beside a menu item.	6.106
32	0x20	**menu_ienable()**	Enables/disables a menu item.	6.106
33	0x21	**menu_tnormal()**	Selects/deselects a menu item or title.	6.111
34	0x22	**menu_text()**	Changes menu item/title text.	6.111
35	0x23	**menu_register()**	Registers applications in the menu bar.	6.109
36	0x24	**menu_popup()**	Manages a floating popup menu.	6.108
37	0x25	**menu_attach()**	Attaches a sub-menu to a menu item.	6.103
38	0x26	**menu_istart()**	Defines the initial selection of a sub-menu.	6.107
39	0x27	**menu_settings()**	Modifies popup menu settings.	6.110
40	0x28	**objc_add()**	Adds an object to an object tree.	6.115
41	0x29	**objc_delete()**	Deletes an object from an object tree.	6.116
42	0x2A	**objc_draw()**	Draws an object tree.	6.117
43	0x2B	**objc_find()**	Locates an object based on screen coordinates.	6.119
44	0x2C	**objc_offset()**	Determines the offset of child objects in an object tree.	6.120
45	0x2D	**objc_order()**	Reorders objects within an object tree.	6.121
46	0x2E	**objc_edit()**	Manipulates an editable object.	6.118
47	0x2F	**objc_change()**	Changes the state of an object.	6.115
48	0x30	**objc_sysvar()**	Reads/modifies the system defaults for 3D effects.	6.121
50	0x32	**form_do()**	Manages a user-defined form.	6.81
51	0x33	**form_dial()**	Reserves/releases screen space for forms.	6.80
52	0x34	**form_alert()**	Manages a generic alert.	6.77
53	0x35	**form_error()**	Manages a generic error alert.	6.82
54	0x36	**form_center()**	Centers an object tree on screen.	6.79
55	0x37	**form_keybd()**	Provides a system-level editable field handler.	6.83
56	0x38	**form_button()**	Provides a system-level button handler.	6.78
70	0x46	**graf_rubberbox()**	Controls the shrinking/enlarging of a box outline.	6.97
71	0x47	**graf_dragbox()**	Controls the moving of a box outline.	6.91
72	0x48	**graf_movebox()**	Draws a moving box.	6.96
73	0x49	**graf_growbox()**	Draws an expanding box.	6.92

A.14 – Functions by Opcode

Dec	Hex	Function	Summary	Page
74	0x50	**graf_shrinkbox()**	Draws a shrinking box.	6.98
75	0x51	**graf_watchbox()**	Selects/draws an object depending on the position of the mouse.	6.100
76	0x52	**graf_slidebox()**	Controls a slider outline.	6.99
77	0x53	**graf_handle()**	Obtains **AES** workstation attributes.	6.92
78	0x54	**graf_mouse()**	Defines the mouse form.	6.94
79	0x55	**graf_mkstate()**	Provides information about the mouse state.	6.93
80	0x56	**scrp_read()**	Determines the system scrap directory.	6.135
81	0x57	**scrp_write()**	Sets the system scrap directory.	6.136
90	0x58	**fsel_input()**	Manages the file selector.	6.88
91	0x59	**fsel_exinput()**	Manages the extended file selector.	6.87
100	0x64	**wind_create()**	Creates a window.	6.150
101	0x65	**wind_open()**	Opens a window.	6.158
102	0x66	**wind_close()**	Closes a window.	6.150
103	0x67	**wind_delete()**	Deletes a window.	6.152
104	0x68	**wind_get()**	Returns window attributes.	6.153
105	0x69	**wind_set()**	Sets a window attribute.	6.158
106	0x6A	**wind_find()**	Determines the window at given pixel coordinates.	6.152
107	0x6B	**wind_update()**	Manages the window update semaphore.	6.161
108	0x6C	**wind_calc()**	Calculates window extents.	6.149
109	0x6D	**wind_new()**	Removes all windows.	6.157
110	0x6E	**rsrc_load()**	Loads a disk-based resource file.	6.128
111	0x6F	**rsrc_free()**	Releases a resource file from memory.	6.127
112	0x70	**rsrc_gaddr()**	Calculates the address of a resource element.	6.127
113	0x71	**rsrc_saddr()**	Sets the address of a resource element.	6.130
114	0x72	**rsrc_obfix()**	Changes the coordinates of an object from character-based to pixel-based.	6.129
115	0x73	**rsrc_rcfix()**	Changes the coordinates of a resource file from character-based to pixel-based.	6.130
120	0x78	**shel_read()**	Determine's the processes parent and command tail.	6.141
121	0x79	**shel_write()**	Manages process loading and control.	6.142
122	0x7A	**shel_get()**	Copies data from the system's shell buffer.	6.140
123	0x7B	**shel_put()**	Stores data in the system's shell buffer.	6.141
124	0x7C	**shel_find()**	Searches the **AES**'s path for a file.	6.139
125	0x7D	**shel_envrn()**	Searches the system environment string.	6.139
130	0x82	**appl_getinfo()**	Returns information about the **AES**.	6.48

VDI Functions by Opcode

Opcode, Subopcode(s) (if required)	Function	Summary	Page
N/A	**vq_gdos()**	Test for presence of **GDOS**.	7.92
-1, 6	**v_set_app_buff()**	Reserve bezier workspace.	7.77
1	**v_opnwk()**	Open physical workstation.	7.66
2	**v_clswk()**	Close a physical workstation.	7.35
3	**v_clrwk()**	Close a physical workstation.	7.34
4	**v_updwk()**	Update workstation.	7.78
5, 1	**vq_chcells()**	Return alpha screen size.	7.87
5, 2	**v_exit_cur()**	Exit text mode.	7.46
5, 3	**v_enter_cur()**	Enter text mode.	7.45
5, 4	**v_curup()**	Move text cursor up one row.	7.40
5, 5	**v_curdown()**	Move text cursor down one row.	7.37
5, 6	**v_curright()**	Move text cursor right one row.	7.38
5, 7	**v_curleft()**	Move text cursor up one row.	7.38
5, 8	**v_curhome()**	Home text cursor.	7.37
5, 9	**v_eeos()**	Erase to end of screen.	7.42
5, 10	**v_eeol()**	Erase to end of line.	7.41
5, 11	**vs_curaddress()**	Position text cursor.	7.126
5, 12	**v_curtext()**	Output text (alpha mode).	7.39
5, 13	**v_rvon()**	Reverse text on (alpha mode).	7.75
5, 14	**v_rvoff()**	Reverse text off (alpha mode).	7.75
5, 15	**vq_curaddress()**	Inquire text cursor location.	7.89
5, 16	**vq_tabstatus()**	Get availability of tablet.	7.95
5, 17	**v_hardcopy()**	Output screen to printer.	7.57
5, 18	**v_dspcur()**	Display text cursor.	7.40
5, 19	**v_rmcur()**	Remove text cursor.	7.74
5, 20	**v_form_adv()**	Advance printer page.	7.48
5, 21	**v_output_window()**	Output window of page to printer.	7.68
5, 22	**v_clear_disp_list()**	Clear display list.	7.34
5, 23	**v_bit_image()**	Render bit-image file.	7.31
5, 24	**vq_scan()**	Return printer scan heights.	7.94
5, 25	**v_alpha_text()**	Output printer text (alpha mode).	7.23
5, 60	**vs_palette()**	Set color palette.	7.127
5, 81	**vt_resolution()**	Set tablet resolution.	7.165
5, 82	**vt_axis()**	Set tablet axis resolution.	7.164
5, 83	**vt_origin()**	Set tablet origin.	7.164
5, 84	**vq_tdimensions()**	Return tablet X and Y dimensions.	7.96
5, 85	**vt_alignment()**	Set tablet alignment.	7.163
5, 91	**vqp_films()**	Return camera film types.	7.101
5, 92	**vqp_state()**	Return camera driver state.	7.101
5, 93	**vsp_state()**	Set camera driver state.	7.145
5, 94	**vsp_save()**	Save camera driver state.	7.145
5, 95	**vsp_message()**	Supress camera screen messages.	7.144
5, 96	**vqp_error()**	Return camera error status.	7.100
5, 98	**v_meta_extents()**	Specify metafile bounding box.	7.60

A.16 – Functions by Opcode

Opcode, Subopcode(s) (if required)	Function	Summary	Page
5, 99†	**v_write_meta()**	Write metafile item.	7.79
5, 99, 0†	**vm_pagesize()**	Set metafile page size.	7.85
5, 99, 1†	**vm_coords()**	Set metafile coordinate system.	7.83
5, 99, 32, 1†	**v_bez_qual()**	Set bezier quality.	7.30
5, 100	**vm_filename()**	Set metafile filename.	7.84
5, 102	**v_fontinit()**	Select a new system font.	7.48
5, 2000	**v_pgcount()**	Specify laser printer copies.	7.69
6	**v_pline()**	Draw a polyline.	7.71
6, 13	**v_bez()**	Draw a bezier curve.	7.26
7	**v_pmarker()**	Draw polymarkers.	7.72
8	**v_gtext()**	Output graphic text.	7.56
9	**v_fillarea()**	Draw a filled polygon.	7.46
9, 13	**v_bez_fill()**	Draw a filled bezier curve.	7.27
10	**v_cellarray()**	Draw a cell array.	7.32
11, 1	**v_bar()**	Draw a rectangle.	7.25
11, 2	**v_arc()**	Draw an arc.	7.24
11, 3	**v_pieslice()**	Draw a pieslice.	7.70
11, 4	**v_circle()**	Draw a circle.	7.33
11, 5	**v_ellipse()**	Draw an ellipse	7.43
11, 6	**v_ellarc()**	Draw an elliptical arc.	7.42
11, 7	**v_ellpie()**	Draw an elliptical pie segment.	7.44
11, 8	**v_rbox()**	Draw a rounded-rectangle.	7.72
11, 9	**v_rfbox()**	Draw a filled rounded-rectangle.	7.73
11, 10	**v_justified()**	Output justified text.	7.58
11, 13†	**v_bez_off()**	Disable bezier drawing.	7.28
11, 13†	**v_bez_on()**	Enable bezier drawing.	7.29
12	**vst_height()**	Set graphic text height (in pixels).	7.153
13	**vst_rotation()**	Set graphic text rotation.	7.156
14	**vs_color()**	Set color palette index.	7.126
15	**vsl_type()**	Set line type.	7.135
16	**vsl_width()**	Set line width.	7.137
17	**vsl_color()**	Set line color.	7.134
18	**vsm_type()**	Set marker type.	7.142
19	**vsm_height()**	Set marker height.	7.139
20	**vsm_color()**	Set marker color.	7.138
21	**vst_font()**	Set graphic text font.	7.152
22	**vst_color()**	Set graphic text color.	7.150
23	**vsf_interior()**	Set fill interior type.	7.129
24	**vsf_style()**	Set fill style type.	7.131
25	**vsf_color()**	Set fill color.	7.129
26	**vq_color()**	Inquire palette index.	7.88
27	**vq_cellarray()**	Inquire cell array.	7.86
28†	**vrq_locator()**	Poll for mouse/keyboard input.	7.121
28†	**vsm_locator()**	Sample mouse/keyboard input.	7.140
29†	**vrq_valuator()**	Poll for ‘valuator’ input.	7.123
29†	**vsm_valuator()**	Sample ‘valuator’ input.	7.143
30†	**vrq_choice()**	Poll for ‘choice’ input.	7.121
30†	**vsm_choice()**	Sample input from ‘choice’ device.	7.138

Opcode, Subopcode(s) (if required)	Function	Summary	Page
31†	**vrq_string()**	Poll for keyboard string input.	7.122
31†	**vsm_string()**	Sample keyboard string input.	7.141
32	**vswr_mode()**	Set writing mode.	7.162
33	**vsin_mode()**	Set input mode.	7.133
35	**vql_attributes()**	Return line attributes.	7.98
36	**vqm_attributes()**	Return marker attributes.	7.99
37	**vqf_attributes()**	Return fill area attributes.	7.96
38	**vqt_attributes()**	Return text attributes.	7.104
39	**vst_alignment()**	Set graphic text alignment.	7.146
100	**v_opnvwk()**	Open virtual workstation.	7.61
101	**v_clsvwk()**	Close a virtual workstation.	7.35
102	**vq_extnd()**	Inquire workstation attributes.	7.89
103	**v_contourfill()**	Fill an irregularly shaped region.	7.36
104	**vsf_perimeter()**	Set fill perimeter visibility.	7.130
105	**v_get_pixel()**	Read screen pixel value.	7.55
106	**vst_effects()**	Set graphic text effects.	7.150
107	**vst_point()**	Set graphic text height (by point).	7.155
108	**vsl_ends()**	Set line end style.	7.134
109	**vro_cpyfm()**	Copy raster (opaque mode).	7.119
110	**vr_trnfm()**	Transform raster form.	7.117
111	**vsc_form()**	Set mouse form.	7.128
112	**vsf_udpat()**	Set user defined fill pattern	7.132
113	**vsl_udsty()**	Set user-defined line style.	7.136
114	**vr_recfl()**	Output filled rectangle.	7.117
115	**vqin_mode()**	Return input mode for device.	7.97
116	**vqt_extent()**	Return graphic text extent.	7.107
117	**vqt_width()**	Return graphic character width.	7.115
118	**vex_timv()**	Install timer tick routine.	7.83
119	**vst_load_fonts()**	Load fonts from disk.	7.154
120	**vst_unload_fonts()**	Unload fonts.	7.160
121	**vrt_cpyfm()**	Copy raster (transparent mode).	7.124
122	**v_show_c()**	Show mouse cursor.	7.77
123	**v_hide_c()**	Hide mouse cursor.	7.57
124	**vq_mouse()**	Get mouse position and state.	7.93
125	**vex_butv()**	Install mouse button routine.	7.80
126	**vex_motv()**	Install mouse movement routine.	7.82
127	**vex_curv()**	Install mouse rendering routine.	7.81
128	**vq_key_s()**	Get shift key status.	7.93
129	**vs_clip()**	Set clipping rectangle.	7.125
130	**vqt_name()**	Return font name and index.	7.113
131	**vqt_fontinfo()**	Return font size information.	7.111
232	**vqt_fontheader()**	Copy the Speedo font header into a user defined buffer.	7.110
234	**vqt_trackkern()**	Inquire about current track kerning.	7.114
235	**vqt_pairkern()**	Inquire about current pair kerning.	7.115
236	**vst_charmap()**	Set ASCII/Speedo index interpretation mode.	7.149
237	**vst_kern()**	Set kerning modes.	7.154
239	**v_getbitmap_info()**	Return Speedo font bitmap extents.	7.53
240†	**vqt_f_extent()**	Return outline text extent.	7.108

A.18 – Functions by Opcode

Opcode, Subopcode(s) (if required)	Function	Summary	Page
240†	**vqt_f_extent16()**	Return 16-bit outline text extent.	7.109
241†	**v_ftext()**	Output outlined text.	7.49
241†	**v_ftext16()**	Output 16-bit outlined text.	7.50
241†	**v_ftext_offset()**	Output outlined text with individual character offsets.	7.51
241†	**v_ftext_offset16()**	Output 16-bit outlined text with individual character offsets.	7.52
242	**v_killoutline()**	Free character outline (no longer used with **SpeedoGDOS**).	7.59
243	**v_getoutline()**	Return character outline.	7.54
244	**vst_scratch()**	Set outline scratch buffer.	7.157
245	**vst_error()**	Set **GDOS** error reporting mode.	7.151
246†	**vst_arbpt()**	Set outline text point size.	7.147
246†	**vst_arbpt32()**	Set outline text point size to a fix31 value.	7.148
247	**vqt_advance()**	Return character advance vector.	7.102
247	**vqt_advance32()**	Return character advance vector as a fix31 value.	7.103
248	**vqt_devinfo()**	Return device information.	7.106
249	**v_savecache()**	Save bitmap cache to disk.	7.76
250	**v_loadcache()**	Load bitmap cache from disk.	7.59
251	**v_flushcache()**	Flush outline font cache.	7.47
252†	**vst_setsize()**	Set outline text proportion.	7.158
252†	**vst_setsize32()**	Set outline text proportion to a fix31 value.	7.159
253	**vst_skew()**	Set outline text skew factor.	7.160
254	**vqt_get_table()**	Return character mappings.	7.112
255	**vqt_cachesize()**	Return bitmap cache size	7.105

† These functions share an opcode and sub-opcode.

— APPENDIX B —

MEMORY MAP

Usage

The information in this appendix provides a useful reference to the memory locations of the Atari computer series. While most documented locations have stayed backwardly compatible, some have changed in meaning. Software programmers directly accessing these locations should carefully consider the possibility that a location may move or not even exist in a newer version of the OS. For this reason many OS functions exist to manipulate system variables, vectors, interrupts, and devices. These should always be used, if possible, as an alternative to directly accessing hardware registers, vectors, interrupts, and variables.

WARNING!

In addition to those considerations mentioned above, directly accessing hardware registers can cause damage to hardware if not done correctly. In particular, improper use of the Falcon030 video registers could damage an attached monitor. Likewise, use of the floppy and hard drive registers can cause data loss and drive damage. For these reasons, it is strongly recommended that you avoid using hardware registers when possible, and when otherwise unavoidable, they should be used with extreme care.

Memory Map Conventions

For each Atari computer that a specific hardware location is valid for, the appropriate box will be shaded. Following is a key to several abbreviations and concepts used in this guide:

BYTE	Occupies one byte (8 bits).
WORD	Occupies one **WORD** (16 bits).
LONG	Occupies one longword (32 bits).
OW	Occupies the odd **WORD** of a **LONG**.
EW	Occupies the even **WORD** of a **LONG**.
OB	Occupies the odd **BYTE** of a **WORD**.
EB	Occupies the even **BYTE** of the **WORD**.
ROM	Location is Read-Only Memory
RAM	Location is Read-Write Memory
I/O	Location is hardware-mapped
VME	Location addresses VME address space
N/A	Not applicable
RO	Read-only location
WO	Write-only location
RW	Read-write location
RSVD	Reserved
Unassigned	Either not assigned or undocumented (hardware developers should always consult Atari before mapping a third-party device to a hardware location).

B.4 – Memory Map

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
System Boot Variables									
0x00000000	**LONG**							ROM	Reset: Supervisor Stack Pointer
0x00000004	**LONG**							ROM	Reset: Program Counter
68x00 Exception Vectors									
0x00000008	**LONG**							RAM	Bus Error Vector
0x0000000C	**LONG**							RAM	Address Error Vector
0x00000010	**LONG**							RAM	Illegal Instruction Error Vector
0x00000014	**LONG**							RAM	Divide by 0 Error Vector
0x00000018	**LONG**							RAM	CHK Instruction Exception Vector
0x0000001C	**LONG**							RAM	TRAPV, FTRAPcc, TRAPcc, cpTRAPcc Instruction Exception Vector
0x00000020	**LONG**							RAM	Privilege Violation Exception Vector
0x00000024	**LONG**							RAM	Trace Exception Vector
0x00000028	**LONG**							RAM	Line-A Exception Vector
0x0000002C	**LONG**							RAM	Line-F Exception Vector
0x00000030	**LONG**							RAM	Reserved by Motorola
0x00000034	**LONG**							RAM	Coprocessor Protocol Violation Vector
0x00000038	**LONG**							RAM	Format Error Vector
0x0000003C	**LONG**							RAM	Uninitialized Interrupt Vector
0x00000040 – 0x0000005C	**LONG**							RAM	Reserved by Motorola
0x00000060	**LONG**							RAM	Spurious Interrupt Vector (taken when an interrupt occurs during Bus Error handling)
Auto-Vector Interrupts									
0x00000064	**LONG**							RAM	Level 1 Auto-Vector Interrupt (used if Hblank is enabled)
0x00000068	**LONG**							RAM	Level 2 Auto-Vector Interrupt (Hblank)
0x0000006C	**LONG**							RAM	Level 3 Auto-Vector Interrupt (Normal processor interrupt level)
0x00000070	**LONG**							RAM	Level 4 Auto-Vector Interrupt (Vblank)
0x00000074	**LONG**							RAM	Level 5 Auto-Vector Interrupt (currently unused)
0x00000078	**LONG**							RAM	Level 6 Auto-Vector Interrupt (MFP Interrupts)
0x0000007C	**LONG**							RAM	Level 7 Auto-Vector Interrupt (Non-maskable)
TRAP Exception Vectors									
0x00000080	**LONG**							RAM	TRAP #0 Handler (Currently Unused)
0x00000084	**LONG**							RAM	TRAP #1 Handler (**GEMDOS**)
0x00000088	**LONG**							RAM	TRAP #2 Handler (**AES** and **VDI**)

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x0000008C	**LONG**							RAM	TRAP #3 Handler (Currently Unused)
0x00000090	**LONG**							RAM	TRAP #4 Handler (Currently Unused)
0x00000094	**LONG**							RAM	TRAP #5 Handler (Currently Unused)
0x00000098	**LONG**							RAM	TRAP #6 Handler (Currently Unused)
0x0000009C	**LONG**							RAM	TRAP #7 Handler (Currently Unused)
0x000000A0	**LONG**							RAM	TRAP #8 Handler (Currently Unused)
0x000000A4	**LONG**							RAM	TRAP #9 Handler (Currently Unused)
0x000000A8	**LONG**							RAM	TRAP #10 Handler (Currently Unused)
0x000000AC	**LONG**							RAM	TRAP #11 Handler (Currently Unused)
0x000000B0	**LONG**							RAM	TRAP #12 Handler (Currently Unused)
0x000000B4	**LONG**							RAM	TRAP #13 Handler (**BIOS**)
0x000000B8	**LONG**							RAM	TRAP #14 Handler (**XBIOS**)
0x000000BC	**LONG**							RAM	TRAP #15 Handler (Currently Unused)
68881 Co-processor Exception Vectors									
0x000000C0	**LONG**							RAM	FPCP Branch or Set on Unordered Condition Vector
0x000000C4	**LONG**							RAM	FPCP Inexact Result Vector
0x000000C8	**LONG**							RAM	FPCP Floating-Point Divide by Zero Vector
0x000000CC	**LONG**							RAM	FPCP Underflow Vector
0x000000D0	**LONG**							RAM	FPCP Operand Error Vector
0x000000D4	**LONG**							RAM	FPCP Overflow Vector
0x000000D8	**LONG**							RAM	FPCP Signaling NAN Vector
0x000000DC	**LONG**							RAM	Unassigned
68851 MMU Exception Vectors									
0x000000E0	**LONG**							RAM	MMU Configuration Error Vector
0x000000E4	**LONG**							RAM	MMU Illegal Operation Vector
0x000000E8	**LONG**							RAM	MMU Access Violation Vector
0x000000EC – 0x000000FC	**LONG**							RAM	Reserved by Motorola
Multi-Function Peripheral Port Vectors									
0x00000100	**LONG**							RAM	MFP #0: Parallel-Port Interrupt Vector
0x00000104	**LONG**							RAM	MFP #1: RS-232 Carrier Detect Vector (On a Falcon030, this MFP interrupt is connected to the parallel port 'Acknowledge' signal, not the RS-232 port.)
0x00000108	**LONG**							RAM	MFP #2: RS-232 Clear to Send Vector
0x0000010C	**LONG**							RAM	MFP #3: BLiTTER Operation Complete (when hardware BLiTTER is present)

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00000110	**LONG**							RAM	Timer D: RS-232 Baud Rate Generator
0x00000114	**LONG**							RAM	Timer C: 200 Hz System Clock
0x00000118	**LONG**							RAM	MFP #4: Keyboard/MIDI (6850 processor)
0x0000011C	**LONG**							RAM	MFP #5: Floppy/Hard Disk Controller
0x00000120	**LONG**							RAM	Timer B: Horizontal Blank Counter
0x00000124	**LONG**							RAM	RS-232 Transmit Error Interrupt
0x00000128	**LONG**							RAM	RS-232 Transmit Buffer Error Interrupt
0x0000012C	**LONG**							RAM	RS-232 Receive Error Interrupt
0x00000130	**LONG**							RAM	RS-232 Receive Buffer Full Interrupt
0x00000134	**LONG**							RAM	Timer A: DMA Sound Complete
0x00000138	**LONG**							RAM	MFP #6: RS-232 Ring Indicator (On a Falcon030, this is the only Serial port vector that remains part of the MFP. All other Serial port functions have been transferred to the SCC.)
0x0000013C	**LONG**							RAM	MFP #7: Monochrome Monitor Detect
Multi-Function Peripheral Port Vectors (TT)									
0x00000140	**LONG**							RAM	MFP #0: General Purpose I/O Pin
0x00000144	**LONG**							RAM	MFP #1: General Purpose I/O Pin
0x00000148	**LONG**							RAM	MFP #2: SCC DMAC Interrupt
0x0000014C	**LONG**							RAM	MFP #3: RS-232 Ring Indicator
0x00000150	**LONG**							RAM	Timer D: RS-232 Baud Rate Generator
0x00000154	**LONG**							RAM	Timer C: SCC TRxCB
0x00000158	**LONG**							RAM	MFP #4: Reserved
0x0000015C	**LONG**							RAM	MFP #5: SCSI DMAC Interrupt
0x00000160	**LONG**							RAM	Timer B: Unassigned
0x00000164	**LONG**							RAM	RS-232 Transmit Error Interrupt
0x00000168	**LONG**							RAM	RS-232 Transmit Buffer Error Interrupt
0x0000016C	**LONG**							RAM	RS-232 Receive Error Interrupt
0x00000170	**LONG**							RAM	RS-232 Receive Buffer Error Interrupt
0x00000174	**LONG**							RAM	Timer A: Reserved
0x00000178	**LONG**							RAM	MFP #6: RTC IRQ
0x0000017C	**LONG**							RAM	MFP #7: SCSI Controller IRQ
Zilog 85C30 (SCC) Interrupt Vectors									
0x00000180	**LONG**							RAM	SCC Port B Transmit Buffer Empty Vector
0x00000184	**LONG**							RAM	Unused
0x00000188	**LONG**							RAM	SCC Port B External Status Change Vector
0x0000018C	**LONG**							RAM	Unused

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00000190	**LONG**							RAM	SCC Port B Receive Character Available Vector
0x00000194	**LONG**							RAM	Unused
0x00000198	**LONG**							RAM	SCC Port B Special Receive Condition Vector
0x0000019C	**LONG**							RAM	Unused
0x000001A0	**LONG**							RAM	SCC Port A Transmit Buffer Empty Vector
0x000001A4	**LONG**							RAM	Unused
0x000001A8	**LONG**							RAM	SCC Port A External Status Change Vector
0x000001AC	**LONG**							RAM	Unused
0x000001B0	**LONG**							RAM	SCC Port A Receive Character Available Vector
0x000001B4	**LONG**							RAM	Unused
0x000001B8	**LONG**							RAM	SCC Port A Special Receive Condition Vector
0x000001BC	**LONG**							RAM	Unused
0x000001C0 – 0x0000037F	**N/A**							RAM	Undefined
Processor State Save Area									
0x00000380	**LONG**							RAM	*proc_lives*: If, after a system failure, the operating system is able to save the processor state in the following variables, this value will be 0x12345678.
0x00000384	**LONG**							RAM	*proc_dregs*: The contents of registers D0 through D7 are stored here.
0x000003A4	**LONG**							RAM	*proc_aregs*: The contents of registers A0 through A7 are stored here.
0x000003C4	**LONG**							RAM	*proc_pc*: The first byte of this longword indicates the exception number that occurred.
0x000003C8	**LONG**							RAM	*proc_usp*: The user stack pointer (USP) is saved here.
0x000003CC– 0x000003EA	**WORD**							RAM	*proc_stk*: The top 16 **WORD**s of the supervisor stack are saved here.
0x000003EC – 0x000003FF	**N/A**							RAM	Unassigned
System Vectors									
0x00000400	**LONG**							RAM	*etv_timer*: System Timer Handoff Vector (see **GEMDOS**)
0x00000404	**LONG**							RAM	*etv_critic*: Critical Error Handoff Vector (see **GEMDOS**)
0x00000408	**LONG**							RAM	*etv_term*: Process Termination Handler (see **GEMDOS**)
0x0000040C – 0x0000041C	**LONG**							RAM	Reserved for future vectors.

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
System Variables									
0x00000420	**LONG**							RAM	*memvalid*: If this variable is equal to $752019F3 and the value at *memval2* ($43A) is also correct, then the last coldstart was successful and *memcntlr* ($424) is valid. As of **TOS** 1.02 memval3 ($51A) must also be correct.
0x00000424	**WORD**							RAM	*memcntlr*: Bits 11–8 of this **WORD** contains the memory controller state.
0x00000426	**LONG**							RAM	*resvalid:* If this location contains the magic number $31415926 then the system will jump through *resvector* (below) on a system reset.
0x0000042A	**LONG**							RAM	*resvector*: If the magic number in *resvalid* is set properly, this vector will be jumped through on a system reset with the return address placed in A6.
0x0000042E	**LONG**							RAM	*phystop*: Physical top of ST compatible RAM.
0x00000432	**LONG**							RAM	*_membot*: This value points to the lowest memory location available for the system heap. This value is used to initialize **GEMDOS** free memory.
0x00000436	**LONG**							RAM	*_memtop*: This value points to the highest memory location available for the system heap. This value is used to initialize **GEMDOS** free memory.
0x0000043A	**LONG**							RAM	*memval2*: This value will equal $237698AA if coldstart was successful. See *memvalid* ($420).
0x0000043E	**WORD**							RAM	*flock*: This variable should be set to non-zero prior to accessing the DMA registers to prevent the system or other processes from attempting DMA concurrently.
0x00000440	**WORD**							RAM	*seekrate*: This variable sets the floppy drive seek rate for both floppy drives as follows: **Value** — **Seek Rate** 0 — 6 ms 1 — 12 ms 2 — 2 ms 3 — 3 ms (default)
0x00000442	**WORD**							RAM	*_timr_ms*: This value indicates the time between system timer ticks in milliseconds. Current machines have the value of 20 (0x14) equating to 50 timer updates per second. This value is returned by the **BIOS** function **Tickcal()** and is placed on the stack prior to jumping through the timer handoff vector ($400).

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00000444	**WORD**							RAM	*_fverify*: When non-zero, all floppy writes are verified, otherwise, no verification is done.
0x00000446	**WORD**							RAM	*_bootdev*: This value represents the device from which the system was booted (0 = A:, 1 = B:, etc.)
0x00000448	**WORD**							RAM	*palmode*: A value of 0 indicates that NTSC video is being used, otherwise, PAL is being is used.
0x0000044A	**WORD**							RAM	*defshftmd*: This value indicates the default video shifter mode.
0x0000044C	**WORD**							RAM	*sshiftmd*: This value is a copy of the hardware register at 0x00FF8260 which indicates the current ST shifter mode.
0x0000044E	**LONG**							RAM	*_v_bas_ad*: This indicates the starting address of the logical screen. Prior to **TOS** 1.06, this address needed to be aligned on a 256 byte boundary. As of **TOS** 1.06, it may be **WORD** aligned.
0x00000452	**WORD**							RAM	*vblsem*: A value of 0 here disables all vertical blank processing while a value of 1 enables it.
0x00000454	**WORD**							RAM	*nvbls*: This value indicates the number of slots in the deferred vertical blank handler list. If all table slots are full and your application needs to install a handler, it may allocate a new, larger list, update this value and the pointer below.
0x00000456	**LONG**							RAM	*_vblqueue*: This is a pointer to a list of pointers to the deferred vertical blank handlers. Each pointer in the list pointed to by this variable which contains a value other than 0 is 'JSR'ed' through at each vertical blank. This occurs 50 times per second on PAL color monitors, 60 times per second on NTSC color monitors and 70 times per second on all monochrome monitors.
0x0000045A	**LONG**							RAM	*colorptr*: If this value is non-zero then at the next vertical blank, the 16 color registers pointed to by this value will be loaded into the hardware registers.
0x0000045E	**LONG**							RAM	*screenpt*: If this value is non-zero then at the next vertical blank, the value stored here will be loaded into the hardware register which points to the base of the physical screen.
0x00000462	**LONG**							RAM	*_vbclock*: This value indicates the number of vertical blanks that have been processed since the last reset.

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00000466	**LONG**							RAM	*_frlock*: This value indicates the number of vertical blanks regardless of whether they were processed or not (blocked by *vblsem*).
0x0000046A	**LONG**							RAM	*hdv_init*: This value points the hard disk initialization routine or is 0 to indicate that no hard disk is installed.
0x0000046E	**LONG**							RAM	*swv_vec*: The vector pointed to by this routine is called when the system detects a change in monitors (normally this points to the reset handler).
0x00000472	**LONG**							RAM	*hdv_bpb*: This vector is used when **Getbpb()** is called. A value of 0 indicates that no hard disk is attached. Applications installing themselves here should expect parameters to be located on the stack as they would be for the actual function call beginning at 4(sp). If the installed process services the call it should RTS, otherwise, leaving the stack intact, should JMP through the old vector value.
0x00000476	**LONG**							RAM	*hdv_rw*: This vector is used when **Rwabs()** is called. A value of 0 here indicates that no hard disk is attached. Applications installing themselves here should expect parameters to be located on the stack as they would be for the actual function call beginning at 4(sp). If the installed process services the call it should RTS, otherwise, leaving the stack intact, should JMP through the old vector value.
0x0000047A	**LONG**							RAM	*hdv_boot*: This vector is JSR'ed through to boot from the hard disk. A value of 0 here indicates that no hard disk is attached. If the installed process services the call it should RTS, otherwise, leaving the stack intact, should JMP through the old vector value.
0x0000047E	**LONG**							RAM	*hdv_mediach*: This vector is used when **Mediach()** is called. A value of 0 here indicates that no hard disk is attached. Applications installing themselves here should expect parameters to be located on the stack as they would be for the actual function call beginning at 4(sp). If the installed process services the call it should RTS, otherwise, leaving the stack intact, should JMP through the old vector value.

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00000482	**WORD**							RAM	*_cmdload*: During boot if this location contains a non-zero value, the system will attempt to load "COMMAND.PRG" from the boot device rather than initializing the **GEM** Desktop.
0x00000484	**BYTE**							RAM	*conterm*: This location contains a bit array which determine several system attributes as follows: **Bit** — **Meaning if Set** 0 — Enable key-click 1 — Enable key repeat 2 — Enable system bell 3 — Cause **Bconin**() to return shift status
0x00000485	**BYTE**							RAM	Reserved
0x00000486	**LONG**							RAM	*trp14ret*: This value is used by Trap #14 OS code to store the return address.
0x0000048A	**LONG**							RAM	*criticret*: This value is used by *etv_critic* handling code to store the return address.
0x0000048E – 0x0000049D	**BYTE**							RAM	*themd*: This is the **MD** (Memory Descriptor structure) initialized by the **BIOS** at boot and returned by **Getmpb()**.
0x0000049E	**LONG**							RAM	*_md*: This is a pointer to additional **MD** structures.
0x000004A2	**LONG**							RAM	*savptr*: This is a pointer to the buffer which the **BIOS** uses to save internal registers.
0x000004A6	**WORD**							RAM	*_nflops*: This value indicates the number of floppy drives currently connected to the system.
0x000004A8	**LONG**							RAM	*con_state*: This is a vector to internal console output routines which is set to various VT-52 ESC functions.
0x000004AC	**WORD**							RAM	*save_row*: This value contains the row number of the cursor temporarily when using the ESC-Y VT-52 sequence.
0x000004AE	**LONG**							RAM	*sav_contxt*: This points to a temporary buffer where the processor context is saved.
0x000004B2 – 0x000004B6	**LONG**							RAM	*_bufl*: The first longword here points to a **BCB** (Buffer Control Block) used to store data sectors. The second longword points to a **BCB** which is used to store FAT and directory sectors.
0x000004BA	**LONG**							RAM	*_hz_200*: This value is an ongoing counter for the internal 200Hz clock. It is used as a seed value for the **Random()** function.

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x000004BE	**LONG**							RAM	*the_env*: This longword is the default environment string (four zeros).
0x000004C2	**LONG**							RAM	*_drvbits*: Each of 32 bits in this longword represents a drive connected to the system. Bit #0 is A, Bit #1 is B and so on. If at least one floppy is connected to the system, both floppy bits will always be set because of virtual swapping.
0x000004C6	**LONG**							RAM	*_dskbufp*: This variable points to a 1K disk operation buffer and is also used by some graphics functions.
0x000004CA	**LONG**							RAM	*_autopath*: This variable points to the **GEMDOS** path specification of the directory to load '\AUTO' folder programs from (may be **NULL** to indicate default).
0x000004CE – 0x000004EA	**LONG**							RAM	*_vbl_list*: This area is used by the system for the initial deferred vertical blank list.
0x000004EE	**WORD**							RAM	*_prt_cnt*: This value is used by the ALT-HELP screen dump code and is initialized to 0xFFFF. Each time ALT-HELP is pressed, this value is incremented. Custom screen dump code should check this value on entry and if 0 begin a screen dump, otherwise, abort the dump, reset the value to 0xFFFF and return.
0x000004F0	**WORD**							RAM	*_prtabt*: Flag is set to abort printing because of a timeout.

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning

0x000004F2	**LONG**							RAM	*_sysbase*: This value points to the beginning of the **TOS** operating system. The beginning of the OS contains a structure as follows:
									
									`typedef struct _osheader`
									`{`
									`/* BRA to Reset Code */`
									`UWORD os_entry;`
									`/* TOS Version */`
									`UWORD os_version;`
									`/* Reset Code */`
									`VOID *reseth;`
									`/* Pointer to OSBASE */`
									`struct _osheader *os_beg;`
									`/* Pointer to OS end*/`
									`VOID *os_end;`
									`/* Reserved */`
									`LONG os_rsv1;`
									`/* Memory Usage PB */`
									`GEM_MUPB *os_magic;`
									`/* OS Date $YYYYMMDD */`
									`LONG os_date;`
									`/* OS Conf. Bits */`
									`UWORD os_conf;`
									`/* DOS OS Date */`
									`UWORD os_dosdate;`
									
									`/* As of TOS 1.2 */`
									
									`/* Base of OS Pool */`
									`char **p_root;`
									`/* Key. Shift State */`
									`char **pkbshift;`
									`/* Current process */`
									`BASEPAGE **p_run;`
									`/* Reserved */`
									`char *p_rsv2;`
									`} OSHEADER;`

0x000004F6	**LONG**							RAM	*_shell_p*: Normally not utilized, this vector allows a shell process to be installed which expects to be called with a pointer to a CLI-type command to be at 4(sp). If a command handler does not exist, this value will be **NULL**.
0x000004FA	**LONG**							RAM	*end_os*: This value points to the end of RAM utilized by **TOS** (copied into *membot*).

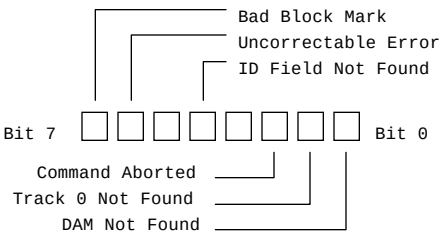
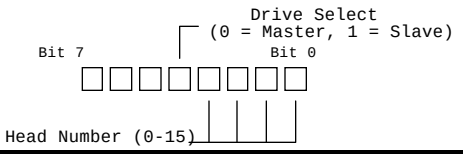
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x000004FE	**LONG**							RAM	*exec_os*: This vector is jumped through when operating system initialization is complete (normally points to the Desktop/**AES** startup code).
0x00000502	**LONG**							RAM	*scr_dump*: The routine pointed to by this value is called each time the user pressed ALT-HELP.
0x00000506	**LONG**							RAM	*prv_lsto*: This vector is called to check the status of the 'PRN:' output device by the **Prtblk()** routine.
0x0000050A	**LONG**							RAM	*prv_lst*: This vector is called to output a byte to the 'PRN:' device by the **Prtblk()** routine..
0x0000050E	**LONG**							RAM	*prv_auxo*: This vector is called to check the status of the 'AUX:' output device by the **Prtblk()** routine.
0x00000512	**LONG**							RAM	*prv_aux*: This vector is called to output a byte to the 'AUX:' device by the **Prtblk()** routine.

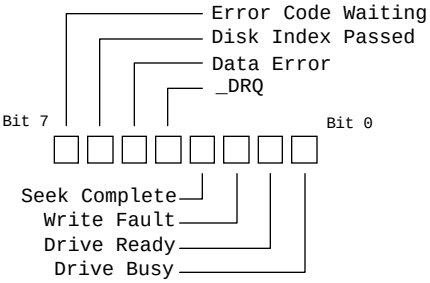
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning

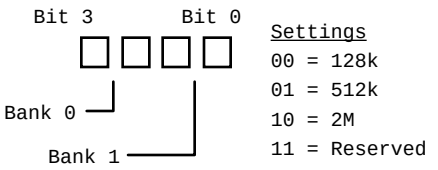
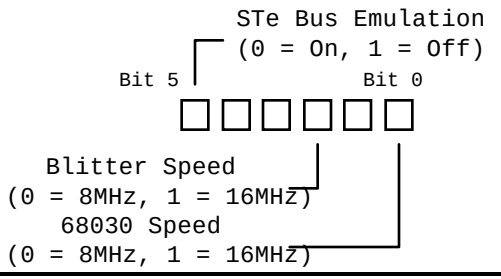
0x00000516	**LONG**							RAM	*pun_ptr*: This points to a structure used by AHDI as follows:
									
									`/* # supported drives */`
									
									`#define MAXUNITS 16`
									
									`typedef struct`
									`{`
									`  /* Maximum # of drives`
									`   * supported by system,`
									`   * including floppies.`
									`   */`
									`  WORD puns;`
									`  /* Bit 0-2 indicates`
									`   * the physical ACSI unit`
									`   * it resides on.`
									`   * Bit 7 = 0 indicates`
									`   * that the drive exists`
									`   */`
									`  BYTE pun[MAXUNITS];`
									`  /* Indicates offset in`
									`   * physical sectors (512`
									`   * bytes) to the start of`
									`   * partition.`
									`   */`
									`  LONG prt_start[MAXUNITS];`
									
									`  /* The following are`
									`   * only present as of`
									`   * AHDI 3.0. */`
									
									`  /* Cookie is $41484449 */`
									`  LONG P_cookie;`
									`  /* Points to P_cookie */`
									`  LONG *P_cookptr;`
									`  /* Version of AHDI */`
									`  UWORD P_version;`
									`  /* Size of the largest`
									`   * logical sector. */`
									`  UWORD P_max_sector;`
									`  /* Reserved */`
									`  LONG reserved[MAXUNITS];`
									`} PUN_INFO;`

0x0000051A	**LONG**							RAM	*memval3*: Will equal $5555AAAA if coldstart was successful. See *memvalid* ($420).

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x0000051E – 0x0000053A	**LONG**							RAM	*xconstat*: This location contains eight pointers to the **BIOS Bconstat()** functions for eight **BIOS** devices.
0x0000053E – 0x0000055A	**LONG**							RAM	*xconin*: This location contains eight pointers to the **BIOS Bconin()** functions for eight **BIOS** devices.
0x0000055E – 0x0000056A	**LONG**							RAM	*xcostat*: This location contains eight pointers to the **BIOS Bcostat()** functions for eight **BIOS** devices.
0x0000057E – 0x0000059A	**LONG**							RAM	*xconout*: This location contains eight pointers to the **BIOS Bconout()** functions for eight **BIOS** devices.
0x0000059E	**WORD**							RAM	*_longframe*: If this value is 0 then the processor uses short stack frames, otherwise it uses long stack frames. This value is of interest to applications which intercept TRAP handlers. When using short stack frames, the first parameter will be found at 6(sp), otherwise at 8(sp).
0x000005A0	**LONG**							RAM	*_p_cookies*: This is a pointer to the system Cookie Jar.
0x000005A4	**LONG**							RAM	*ramtop*: If *ramvalid* is correct, this is a pointer to the end of alternative RAM.
0x000005A8	**LONG**							RAM	*ramvalid*: This value should be $1357BD13 to indicate that *ramtop* is correct.
0x000005AC	**LONG**							RAM	*bell_hook*: This vector is jumped through to sound the system bell.
0x000005B0	**LONG**							RAM	*kcl_hook*: This vector is jumped through to sound system key clicks. The scancode of the current character is placed in the low byte of D0.
System RAM / Expansion									
0x000005B4 – 0x009FFFFF	**BYTE**							RAM/ ROM	This area contains whatever remaining ST compatible RAM is available. Additional space at this location is utilized by the operating system. Memory locations below 0x00E00000 on a machine other than the Mega STe or below 0x00A00000 on a Mega STe that are not part of this RAM may be utilized by hardware developers.
0x00A00000 – 0x00DEFFFF	**BYTE**							VME/ RAM	On a Mega STe, this area is mapped to VME A24:D16 address space, otherwise it may be mapped to additional ST compatible RAM or I/O space. Falcon030 computers use this address space for RAM.

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00DF0000 – 0x00DFFFFF	**BYTE**							VME/ RAM	On a Mega STe, this area is mapped to VME A16:D16 address space, otherwise it may be mapped to additional ST compatible RAM or I/O space. Falcon030 computers use this address space for RAM.
0x00E00000 – 0x00EFFFFF	**BYTE**							ROM	Operating system ROM's as of **TOS** 1.06.
IDE Controller									
0x00F00000	**OW**							I/O	Data Register
0x00F00004	**OB**							I/O	Error Register as follows: 
0x00F00006	**N/A**								Unused
0x00F00008	**OB**							I/O	Sector Count Register
0x00F0000A	**N/A**							I/O	Unused
0x00F0000C	**OB**							I/O	Sector Number Register
0x00F0000E	**N/A**							I/O	Unused
0x00F00010	**OB**							I/O	Cylinder Low Register (this register is written with the low eight bits of the ten bit cylinder number).
0x00F00012	**N/A**							I/O	Unused
0x00F00014	**OB**							I/O	Cylinder High Register (this register is written with the high two bits of the ten bit cylinder number).
0x00F00016	**N/A**							I/O	Unused
0x00F00018	**OB**							I/O	Drive Head Register as follows: 

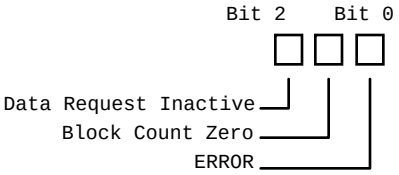
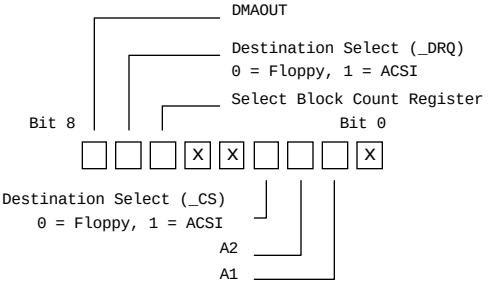
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00F0001A – 0x00F0001D	**N/A**							I/O	Unused
0x00F0001E	**OB**							I/O	Status Register (on read) as follows:  Command Register (on write). The IDE registers must be completely setup prior to writing the command byte here.
0x00F00020 – 0x00F00036	**N/A**							I/O	Unused
0x00F00038	**OB**							I/O	Alternate Status Register (on read) Alternate Command Register (on write)
0x00F00040 – 0x00F9FFFF	**N/A**							N/A	Unassigned
ROM/Reserved Hardware Space									
0x00FA0000 – 0x00FBFFFF	**BYTE**							ROM	Cartridge ROM
0x00FC0000 – 0x00FEFFFF	**BYTE**							ROM	On pre **TOS** 2.00 machines, this location marked the beginning of the operating system ROM's.
0x00FF0000 – 0x00FF7FFF	**N/A**							N/A	Unassigned

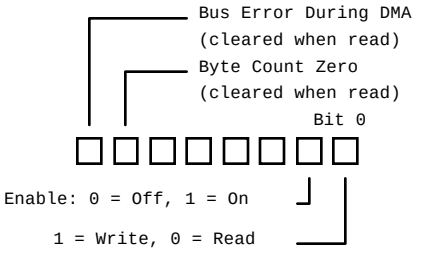
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
Memory Management Unit/Falcon Processor Control									
0x00FF8000	**OB**							I/O	Memory Controller Configuration as follows: 
0x00FF8002 – 0x00FF8004	**N/A**							I/O	Unassigned
0x00FF8006	**BYTE**							I/O	Connected Monitor Type as follows: **Value** **Monitor** 0 Atari Monochrome 1 Atari Color 2 VGA Color 3 Television
0x00FF8007	**BYTE**							I/O	Falcon Processor Control as follows: 
0x00FF8008 – 0x00FF81FF	**N/A**							I/O	Unassigned
Video Registers									
0x00FF8200	**OB**							I/O	Video Base Address High
0x00FF8202	**OB**							I/O	Video Base Address Mid
0x00FF8204	**OB**							I/O	Video Address Counter High (R/O)
0x00FF8206	**OB**							I/O	Video Address Counter Mid (R/O)
0x00FF8208	**OB**							I/O	Video Address Counter Low (R/O)

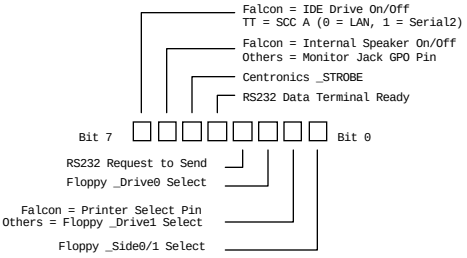
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF820A	**BYTE**							I/O	Video Shifter Sync Mode as follows: Bit 7 Bit 0 1= 60 Hz, 0 = 50 Hz 1 = External, 0 = Internal Sync
0x00FF820C	**OB**							I/O	Video Base Address Low
0x00FF820E	**OB**							I/O	Line Width Register (width of scanline in **WORD**s - 1). On a Falcon030, this is a **WORD** value.
0x00FF8210	**WORD**							I/O	Falcon030 Line Width Register (width of scanline in **WORD**s)
0x00FF8212 – 0x00FF823F	**N/A**							I/O	Unassigned
0x00FF8240	**WORD**							I/O	ST/e Compatible Palette Register #0: ST layout is as follows: XXXX XRRR XGGG XBBB STe layout is as follows: XXXX RRRR GGGG BBBB For compatibility, STe bit arrangement per nibble is 0-3-2-1. These registers are simulated for compatibility on newer model machines.
0x00FF8242	**WORD**							I/O	ST/e Compatible Palette Register #1
0x00FF8244	**WORD**							I/O	ST/e Compatible Palette Register #2
0x00FF8246	**WORD**							I/O	ST/e Compatible Palette Register #3
0x00FF8248	**WORD**							I/O	ST/e Compatible Palette Register #4
0x00FF824A	**WORD**							I/O	ST/e Compatible Palette Register #5
0x00FF824C	**WORD**							I/O	ST/e Compatible Palette Register #6
0x00FF824E	**WORD**							I/O	ST/e Compatible Palette Register #7
0x00FF8250	**WORD**							I/O	ST/e Compatible Palette Register #8
0x00FF8252	**WORD**							I/O	ST/e Compatible Palette Register #9
0x00FF8254	**WORD**							I/O	ST/e Compatible Palette Register #10
0x00FF8256	**WORD**							I/O	ST/e Compatible Palette Register #11
0x00FF8258	**WORD**							I/O	ST/e Compatible Palette Register #12
0x00FF825A	**WORD**							I/O	ST/e Compatible Palette Register #13

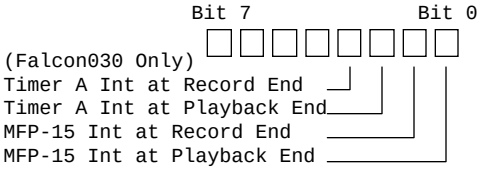
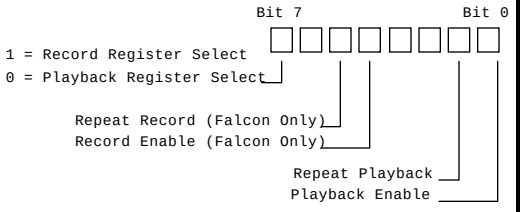
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF825C	**WORD**							I/O	ST/e Compatible Palette Register #14
0x00FF825E	**WORD**							I/O	ST/e Compatible Palette Register #15
0x00FF8260	**EB**							I/O	ST Video Shifter Mode as follows: Bit 7 ☐☐☐☐☐☐☐☐ Bit 0 00 = 320x200, 4 plane 01 = 640x200, 2 plane 10 = 640x400, 1 plane 11 = Reserved
0x00FF8262	**EB**							I/O	TT030 Video Shifter Mode as follows: Smear Mode Hyper Mono Mode Bit 15 ☐☐☐☐☐☐☐☐ Bit 8 000 = 320x200, 4 plane 001 = 640x200, 2 plane 010 = 640x400, 1 plane 100 = 640x480, 4 plane 110 = 1280x960, 1 plane 111 = 320x480, 8 plane Bit 7 ☐☐☐☐☐☐☐☐ Bit 0 ST Palette Bank
0x00FF8264	**OB**							I/O	Horizontal Scroll Register
0x00FF8266	**WORD**							I/O	SPSHIFT Control Register as follows: **Bit** — **Meaning When Set** 4 — Enable Bitplane Mode 5 — Use External VSYNC 6 — Use External HSYNC 8 — Enable Truecolor Mode 10 — Enable 2-Color Mode
0x00FF8268 – 0x00FF827D	**N/A**								Unassigned

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF827E	**EB**							I/O	STACY Display State as follows: Bit 7 Bit 0 1 = Backlight Off 1 = Display Off
0x00FF8280	**WORD**							I/O	Horizontal Hold Counter
0x00FF8282	**WORD**							I/O	Horizontal Hold Timer
0x00FF8284	**WORD**							I/O	Horizontal Border Begin
0x00FF8286	**WORD**							I/O	Horizontal Border End
0x00FF8288	**WORD**							I/O	Horizontal Display Begin
0x00FF828A	**WORD**							I/O	Horizontal Display End
0x00FF828C	**WORD**							I/O	HSS
0x00FF828E	**WORD**							I/O	HFS
0x00FF8290	**WORD**							I/O	HEE
0x00FF8292 – 0x00FF829F	**N/A**								Unassigned
0x00FF82A0	**WORD**							I/O	Vertical Frequency Counter
0x00FF82A2	**WORD**							I/O	Vertical Frequency Timer
0x00FF82A4	**WORD**							I/O	Vertical Border Begin
0x00FF82A6	**WORD**							I/O	Vertical Border End (in half lines)
0x00FF82A8	**WORD**							I/O	Vertical Display Begin
0x00FF82AA	**WORD**							I/O	Vertical Display End
0x00FF82AC	**WORD**							I/O	VSS
0x00FF82AE – 0x00FF82C1	**N/A**								Unassigned
0x00FF82C2	**WORD**							I/O	VCO - Video Control as follows: Bit 3 Bit 0 Quarter Pixel Width Halve Pixel Width Interlace Mode Line Doubling

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF82C4 – 0x00FF83FF	**N/A**							I/O	Unassigned
0x00FF8400 – 0x00FF85FE	**WORD**							I/O	TT030 Palette Registers #0 – #255: Each palette register is a longword which is arranged as follows: XXXX RRRR GGGG BBBB Unlike the ST registers, each nibble is properly formatted in the manner 3–2–1–0.
ACSI DMA and Floppy Disk Controller									
0x00FF8600 – 0x00FF8602	**WORD**							I/O	Reserved
0x00FF8604	**WORD**							I/O	DMA Sector Count (on write) DMA Data Register (on read)
0x00FF8606	**WORD**							I/O	DMA Status (on read) as follows:  DMA Mode Control (on write) as follows: 
0x00FF8608	**OB**							I/O	DMA Pointer High
0x00FF860A	**OB**							I/O	DMA Pointer Mid
0x00FF860C	**OB**							I/O	DMA Pointer Low
0x00FF860E – 0x00FF86FF	**N/A**							I/O	Unassigned

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
SCSI DMA Control									
0x00FF8700	**OB**							I/O	SCSI DMA Pointer Upper
0x00FF8702	**OB**							I/O	SCSI DMA Pointer Upper-Middle
0x00FF8704	**OB**							I/O	SCSI DMA Pointer Lower-Middle
0x00FF8706	**OB**							I/O	SCSI DMA Pointer Lower
0x00FF8708	**OB**							I/O	Byte Count Upper
0x00FF870A	**OB**							I/O	Byte Count Upper-Middle
0x00FF870C	**OB**							I/O	Byte Count Lower-Middle
0x00FF870E	**OB**							I/O	Byte Count Lower
0x00FF8710	**WORD**							I/O	SCSI DMA Data Residue Register High
0x00FF8712	**WORD**							I/O	SCSI DMA Data Residue Register Low
0x00FF8714	**OB**							I/O	SCSI DMA Control Register as follows: 
0x00FF8716 – 0x00FF877F	**N/A**							I/O	Unassigned
SCSI Controller Registers									
0x00FF8780	**OB**							I/O	SCSI Controller Data Register
0x00FF8782	**OB**							I/O	SCSI Controller Initiator Command Register
0x00FF8784	**OB**							I/O	SCSI Controller Mode Register
0x00FF8786	**OB**							I/O	SCSI Controller Target Command Register
0x00FF8788	**OB**							I/O	SCSI Controller ID Select/Control Register
0x00FF878A	**OB**							I/O	SCSI Controller DMA Start/DMA Status
0x00FF878C	**OB**							I/O	SCSI Controller DMA Target Receive/Input Data
0x00FF878E	**OB**							I/O	SCSI Controller DMA Initiator Receive/Reset
0x00FF8790 – 0x00FF879F	**N/A**							I/O	Unassigned

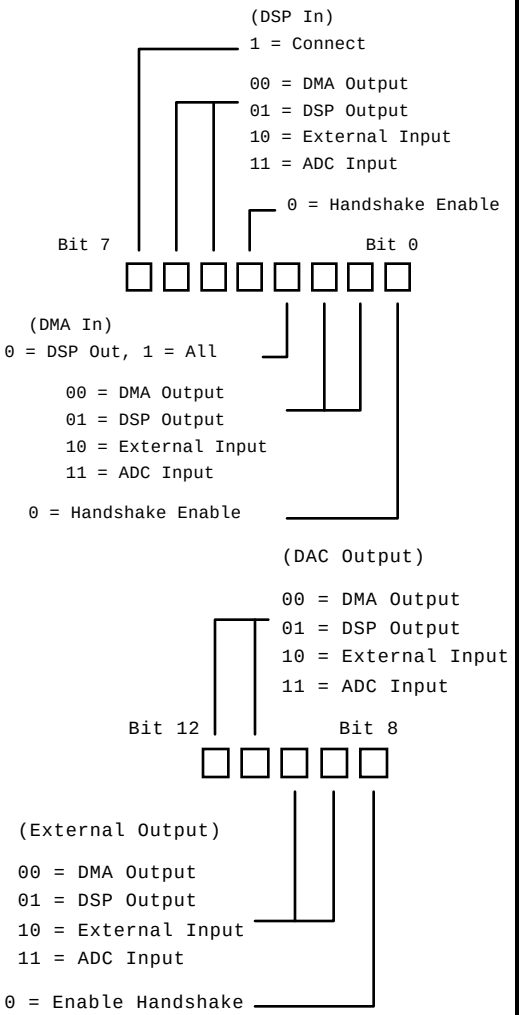
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
Programmable Sound Generator (YM-2149)									
0x00FF8800	**EB**							I/O	PSG Read (Read only on I/O port B) / PSG Register Select (WO). Reading this location yields data from the parallel interface. Writing to bits 0–3 of this location selects a PSG register to address as follows: **Value** **Register** 0000 Channel A Fine Tune 0001 Channel A Coarse Tune 0010 Channel B Fine Tune 0011 Channel B Coarse Tune 0100 Channel C Fine Tune 0101 Channel C Coarse Tune 0110 Noise Generator Control 0111 Mixer Control – I/O Enable 1000 Channel A Amplitude 1001 Channel B Amplitude 1010 Channel C Amplitude 1011 Envelope Period Fine Tune 1100 Envelope Period Coarse Tune 1110 I/O Port A Select (Write only) 1111 I/O Port B Select
0x00FF8802	**EB**							I/O	When I/O Port A is selected, this location contains the PSG Write Data (WO) register as follows:  When I/O Port B is selected, this locations accesses the Parallel Port Data Register (WO).
0x00FF8804 – 0x00FF88FF	**N/A**							I/O	Unassigned

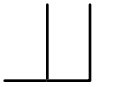
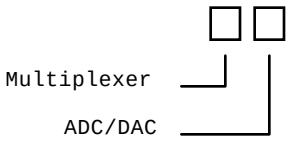
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
DMA Sound System									
0x00FF8900	**BYTE**							I/O	Sound DMA Control as follows: 
0x00FF8901	**BYTE**							I/O	Additional sound DMA control as follows: 
0x00FF8902	**OB**							I/O	Frame Base Address High
0x00FF8904	**OB**							I/O	Frame Base Address Mid
0x00FF8906	**OB**							I/O	Frame Base Address Low
0x00FF8908	**OB**							I/O	Frame Address Counter High
0x00FF890A	**OB**							I/O	Frame Address Counter Mid
0x00FF890C	**OB**							I/O	Frame Address Counter Low
0x00FF890E	**OB**							I/O	Frame End Address High
0x00FF8910	**OB**							I/O	Frame End Address Mid
0x00FF8912	**OB**							I/O	Frame End Address Low
0x00FF8914 – 0x00FF8919	**N/A**							I/O	Unassigned

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF8920	**BYTE**							I/O	Sound mode control as follows: 00 = Monitor Track 0 01 = Monitor Track 1 10 = Monitor Track 2 11 = Monitor Track 3 Bit 7 … Bit 0 00 = Play 1 Track 01 = Play 2 Tracks 10 = Play 3 Tracks 11 = Play 4 Tracks
0x00FF8921	**BYTE**							I/O	Additional sound mode control as follows: 00 = 8-bit Stereo 01 = 16-bit Stereo (Falcon) 10 = 8-bit Mono Bit 7 … Bit 0 00 = 6258 Hz 01 = 12517 Hz 10 = 25033 Hz 11 = 50066 Hz
MICROWIRE									
0x00FF8922	**WORD**							I/O	MICROWIRE Data Register
0x00FF8924	**WORD**							I/O	MICROWIRE Mask Register
0x00FF8926 – 0x00FF8929	**N/A**							I/O	Unassigned

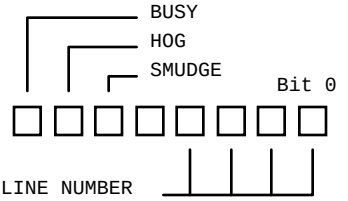
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
Falcon030 DSP/DMA Controller									
0x00FF8930	**WORD**							I/O	DMA Crossbar Output Select Controller as follows: (DSP Out) 1 = Connect 00 = 25.175 MHz Clock 01 = External Clock 10 = 32 MHz Clock 0 = Handshake Enable Bit 7 … Bit 0 (DMA Out) 0 = DMA In, 1 = All 00 = 25.175MHz Clock 01 = External Clock 10 = 32 MHz Clock 0 = Handshake Enable (ADC Input) 0 = Internal Sync 1 = External Sync Bit 12 … Bit 8 (External Input) 00 = 25.175 MHz Clock 01 = External Clock 10 = 32 MHz Clock 0 = Enable Handshake

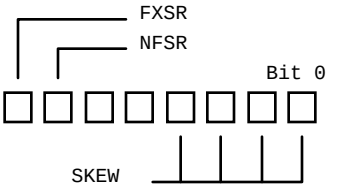
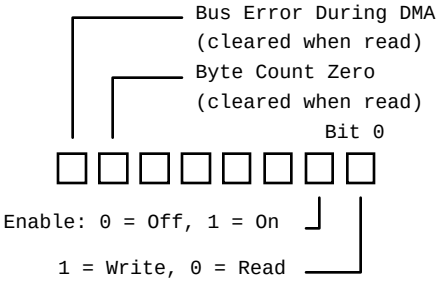
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF8932	**WORD**							I/O	DMA Crossbar Input Select Controller as follows:



Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF8934	**BYTE**							I/O	Frequency Divider External Sync (0 = STe/TT030 Compatible Prescaler, 1-15 = Divide by 256 and then the value given)
0x00FF8935	**BYTE**							I/O	Frequency Divider Internal Sync as follows: **Value** – **Meaning** 0 – STe Compatible Mode 1 – 49170 Hz 2 – 32780 Hz 3 – 24585 Hz 4 – 19668 Hz 5 – 16390 Hz 6 – 14049 Hz 7 – 12292 Hz 8 – 10927 Hz 9 – 9834 Hz 10 – 8940 Hz 11 – 8195 Hz 12 – 7565 Hz 13 – 7024 Hz 14 – 6556 Hz 15 – 6146 Hz
0x00FF8936	**BYTE**							I/O	Record Tracks Select as follows: Bit 1/0  00 = Record 1 Track 01 = Record 2 Tracks 10 = Record 3 Tracks 11 = Record 4 Tracks
0x00FF8937	**BYTE**							I/O	CODEC Input Source as follows: Bit 1/0  Multiplexer ADC/DAC

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF8938	**BYTE**							I/O	CODEC ADC Input as follows: Bit 1/0 0 = Left Channel Mic 1 = Left Channel PSG 0 = Right Channel Mic 1 = Right Channel PSG
0x00FF8939	**BYTE**							I/O	Gain settings (0–15 per channel) as follows: Bit 7 … Bit 0 L L L L R R R R
0x00FF893A	**BYTE**							I/O	Attenuation settings (0–15 per channel) as follows: Bit 7 … Bit 0 L L L L R R R R
0x00FF8940	**OB**							I/O	GPIO Data direction as follows: Bit 2 Bit 0 0 = Read 1 = Write
0x00FF8942	**OB**							I/O	GPIO Data (low three bits). Read or write by setting direction bits above.
0x00FF8944 – 0x00FF895F	**N/A**							I/O	Unassigned
Real Time Clock (146818A)									
0x00FF8960	**OB**							I/O	Real Time Clock Address Register
0x00FF8962	**OB**							I/O	Real Time Clock Data Register
0x00FF8964 – 0x00FF89FF	**N/A**							I/O	Unassigned

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
BLiTTER Bit-Block Transfer Processor									
0x00FF8A00 – 0x00FF8A1E	**WORD**							I/O	BLiTTER Halftone RAM
0x00FF8A20	**WORD**							I/O	BLiTTER Source X Increment
0x00FF8A22	**WORD**							I/O	BLiTTER Source Y Increment
0x00FF8A24	**WORD**							I/O	BLiTTER Source Address (bits 7–0 are bits 23–16 of address)
0x00FF8A26	**WORD**							I/O	BLiTTER Source Address (bits 15–1 are bits 15–1 of address, bit 0 must be 0)
0x00FF8A28	**WORD**							I/O	BLiTTER Endmask 1
0x00FF8A2A	**WORD**							I/O	BLiTTER Endmask 2
0x00FF8A2C	**WORD**							I/O	BLiTTER Endmask 3
0x00FF8A2E	**WORD**							I/O	BLiTTER Destination X Increment
0x00FF8A30	**WORD**							I/O	BLiTTER Destination Y Increment
0x00FF8A32	**WORD**							I/O	BLiTTER Destination (bits 7–0 are bits 23–16 of address)
0x00FF8A34	**WORD**							I/O	BLiTTER Destination (bits 15–1 are bits 15–1 of address, bit 0 must be 0)
0x00FF8A36	**WORD**							I/O	BLiTTER X Count
0x00FF8A38	**WORD**							I/O	BLiTTER Y Count
0x00FF8A3A	**BYTE**							I/O	BLiTTER HOP
0x00FF8A3B	**BYTE**							I/O	BLiTTER OP
0x00FF8A3C	**BYTE**							I/O	BLiTTER Configuration as follows: 

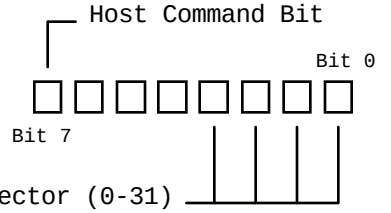
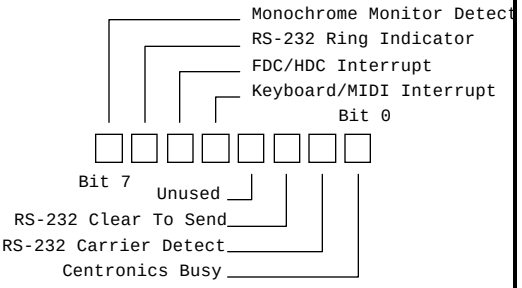
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF8A3D	**BYTE**							I/O	BLiTTER Configuration as follows: 
0x00FF8A3E– 0x00FF8BFF	**N/A**							I/O	Unassigned
SCC DMA Registers									
0x00FF8C00	**OB**							I/O	SCC DMA Pointer Upper
0x00FF8C02	**OB**							I/O	SCC DMA Pointer Upper-Middle
0x00FF8C04	**OB**							I/O	SCC DMA Pointer Lower-Middle
0x00FF8C06	**OB**							I/O	SCC DMA Pointer Lower
0x00FF8C08	**OB**							I/O	SCC Byte Count Upper
0x00FF8C0A	**OB**							I/O	SCC Byte Count Upper-Middle
0x00FF8C0C	**OB**							I/O	SCC Byte Count Lower-Middle
0x00FF8C0E	**OB**							I/O	SCC Byte Count Lower
0x00FF8C10	**WORD**							I/O	SCC Data Residue Register High (RO)
0x00FF8C12	**WORD**							I/O	SCC Data Residue Register Low (RO)
0x00FF8C14	**OB**							I/O	SCC DMA Control Register as follows: 
0x00FF8C16 – 0x00FF8C7E	**N/A**							I/O	Unassigned

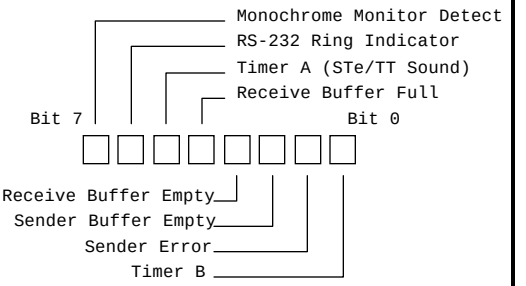
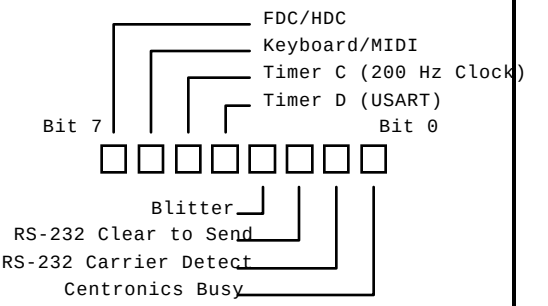
B.34 – Memory Map

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
SCC Ports (85C30)									
0x00FF8C80	**OB**							I/O	SCC A Control
0x00FF8C82	**OB**							I/O	SCC A Data
0x00FF8C84	**OB**							I/O	SCC B Control
0x00FF8C86	**OB**							I/O	SCC B Data
0x00FF8C88 – 0x00FF8DFF	**N/A**							I/O	Unassigned
System Control Unit									
0x00FF8E00	**OB**							I/O	SCU System Interrupt Mask
0x00FF8E02	**OB**							I/O	SCU System Interrupt State (RO)
0x00FF8E04	**OB**							I/O	SCU System Interrupter: Set Bit #0 to generate VME interrupt IRQ1.
0x00FF8E06	**OB**							I/O	VME Interrupter: Set Bit #0 to generate VME interrupt IRQ3.
0x00FF8E08	**OB**							I/O	SCU General Purpose Register 1
0x00FF8E0A	**OB**							I/O	SCU General Purpose Register 2
0x00FF8E0C	**OB**							I/O	VME Interrupt Mask
0x00FF8E0E	**OB**							I/O	VME Interrupt State (RO)
0x00FF8E10 – 0x00FF8E1F	**N/A**								Unassigned
Mega STe Cache/Processor Control									
0x00FF8E20	**OB**							I/O	Mega STe Cache/Processor Control Register as follows: **Value** — **Meaning** 0xFF — 16 MHz w/Cache 0xFE — 16 MHz 0xF4 — 8 MHz
0x00FF8E22 – 0x00FF8EFF	**N/A**								Unassigned
Extended Joystick/Paddle/Light Gun Ports									
0x00FF9200	**WORD**							I/O	Joystick Fire Button Matrix Register
0x00FF9202	**WORD**							I/O	Joystick Direction Matrix Register
0x00FF9204 – 0x00FF920F	**N/A**							I/O	Unassigned
0x00FF9210	**WORD**							I/O	Paddle 0 X Direction
0x00FF9212	**WORD**							I/O	Paddle 0 Y Direction
0x00FF9214	**WORD**							I/O	Paddle 1 X Direction
0x00FF9216	**WORD**							I/O	Paddle 1 Y Direction

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FF9218 – 0x00FF921F	**N/A**							I/O	Unassigned
0x00FF9220	**WORD**							I/O	Light Gun/Pen X Position
0x00FF9222	**WORD**							I/O	Light Gun/Pen Y Position
0x00FF9224 – 0x00FF97FF	**N/A**								Unassigned
Falcon030 VIDEL Palette Registers									
0x00FF9800 – 0x00FF9BFC	**LONG**							I/O	Falcon030 Palette Registers 0-255 as follows: `RRRRRR-- GGGGGG-- -------- BBBBBB--`
0x00FF9C00 – 0x00FFA1FF	**N/A**							I/O	Unassigned

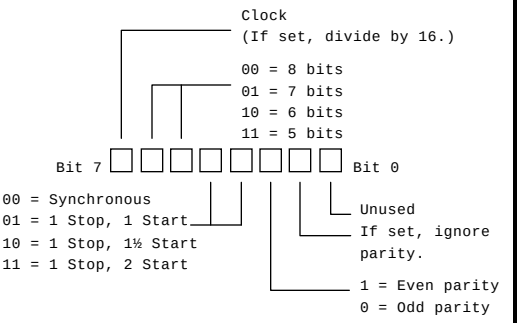
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
DSP Host Interface									
0x00FFA200	**BYTE**							I/O	Interrupt Control Register (DSP X:$FFE9) as follows: **Bit #7** INIT – Setting this bit forces initialization of the host interface. **Bits #6–5** DMA Mode Control as follows: **Value** **Meaning** %00 Interrupt Mode (DMA Off) %01 24-bit DMA Mode %10 16-bit DMA Mode %11 8-bit DMA Mode **Bit #4–3** Host Flags 1 & 0 respectively (HF1 & HF0) **Bit #2** Unused **Bits #1–0** Data Transfer Mode as follows: **Value** **Meaning in Interrupt Mode** %00 No Interrupts %01 Enable Receiver Full Interrupts %10 Enable Transmitter Empty Interrupts %11 Enable Both Interrupts **Value** **Meaning in DMA Mode** %00 No DMA %01 DSP to Host Request %10 Host to DSP Request

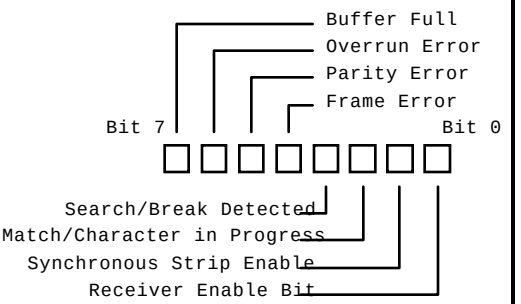
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FFA201	**BYTE**							I/O	Command Vector Register (DSP X:$FFE9) as follows: 
0x00FFA202	**BYTE**							I/O	Interrupt Status Register (DSP X:$FFE8) as follows:
0x00FFA203	**BYTE**							I/O	Interrupt Vector Register (This register contains the 680x0 exception vector used for DSP exceptions).
0x00FFA204	**BYTE**							I/O	Unused
0x00FFA205	**BYTE**							I/O	DSP **WORD** High (DSP X:$FFEB)
0x00FFA206	**BYTE**							I/O	DSP **WORD** Middle (DSP X:$FFEB)
0x00FFA207	**BYTE**							I/O	DSP **WORD** Low (DSP X:$FFEB)
0x00FFA208 – 0x00FFF9FF	**N/A**							N/A	Undefined
ST Multi-Function Peripheral Port (68901)									
0x00FFFA00	**OB**							I/O	MFP-ST General Purpose Pins (Parallel port data register on Atari machines).
0x00FFFA02	**OB**							I/O	MFP-ST Active Edge Register as follows:  On a Falcon030, the MFP is not actually used for serial communcations.
0x00FFFA04	**OB**							I/O	MFP-ST Data Direction Register. Each bit is individually programmed (0 = input, 1 = output).

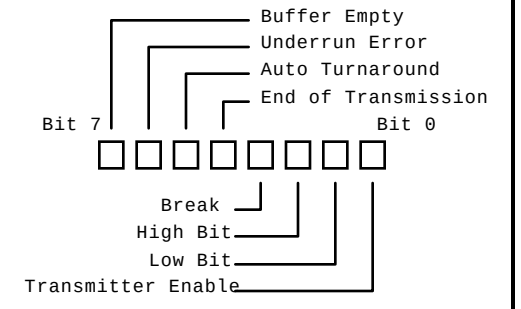
Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FFFA06	**OB**							I/O	MFP-ST Interrupt Enable Register A as follows:  On a Falcon030, the MFP is not actually used for serial communcations.
0x00FFFA08	**OB**							I/O	MFP-ST Interrupt Enable Register B as follows: 
0x00FFFA0A	**OB**							I/O	MFP-ST Interrupt Pending Register A (see mapping at 0x00FFFA06).
0x00FFFA0C	**OB**							I/O	MFP-ST Interrupt Pending Register B (see mapping at 0x00FFFA08).
0x00FFFA0E	**OB**							I/O	MFP-ST Interrupt In-Service Register A (see mapping at 0x00FFFA06).
0x00FFFA10	**OB**							I/O	MFP-ST Interrupt In-Service Register B (see mapping at 0x00FFFA08).
0x00FFFA12	**OB**							I/O	MFP-ST Interrupt Mask Register A (see mapping at 0x00FFFA06).
0x00FFFA14	**OB**							I/O	MFP-ST Interrupt Mask Register B (see mapping at 0x00FFFA08).

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FFFA16	**OB**							I/O	MFP-ST Vector Register. Bit 3 is set to 1 to indicate software End-of-Interrupt mode and 0 to indicate automatic End-of-Interrupt mode.
0x00FFFA18	**OB**							I/O	MFP-ST Timer A Control Register. Interpret bits 3-0 as follows: **Value Meaning** 0000 Timer stop. 0001 Delay mode, divide by 4. 0010 Delay mode, divide by 10. 0011 Delay mode, divide by 16. 0100 Delay mode, divide by 50. 0101 Delay mode, divide by 64. 0110 Delay mode, divide by 100. 0111 Delay mode, divide by 200. 1000 Event count mode. 1xxx Pulse extension mode (as above).
0x00FFFA1A	**OB**							I/O	MFP-ST Timer B Control Register (see Timer A).
0x00FFFA1C	**OB**							I/O	MFP-ST Timer C & D Control Register. Interpret bits 6-4 for Timer C and bits 2-0 for Timer D as follows: **Value Meaning** 000 Timer stop. 001 Delay mode, divide by 4. 010 Delay mode, divide by 10. 011 Delay mode, divide by 16. 100 Delay mode, divide by 50. 101 Delay mode, divide by 64. 110 Delay mode, divide by 100. 111 Delay mode, divide by 200.
0x00FFFA1E	**OB**							I/O	MFP-ST Timer A Data Register.
0x00FFFA20	**OB**							I/O	MFP-ST Timer B Data Register.
0x00FFFA22	**OB**							I/O	MFP-ST Timer C Data Register.
0x00FFFA24	**OB**							I/O	MFP-ST Timer D Data Register.
0x00FFFA26	**OB**							I/O	MFP-ST Sync Character Register.

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FFFA28	**OB**							I/O	MFP-ST USART Control Register as follows:
0x00FFFA2A	**OB**							I/O	MFP-ST Receiver Status Register as follows:
0x00FFFA2C	**OB**							I/O	MFP-ST Transmitter Status Register as follows:



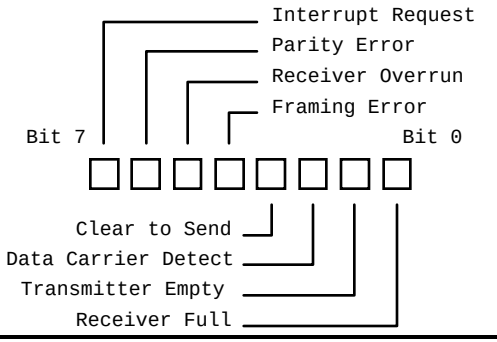


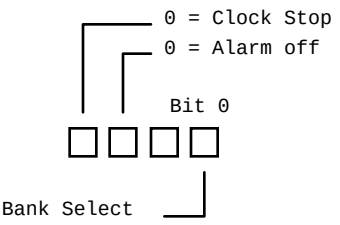


Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FFFA2E	**OB**							I/O	MFP-ST USART Data Register.
0x00FFFA30 – 0x00FFFA3F	**N/A**							I/O	Unassigned
68881 Math Co-Processor in Peripheral Mode									
0x00FFFA40	**WORD**							I/O	FPCIR Status Register (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA42	**WORD**							I/O	FPCTL Control Register (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA44	**WORD**							I/O	FPSAV Save Register (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA46	**WORD**							I/O	FPREST Restore Register (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA48	**WORD**							I/O	FPOPR Operation Word Register (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA4A	**WORD**							I/O	FPCMD Command Register (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA4C	**WORD**							I/O	FPRES Reserved (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA4E	**WORD**							I/O	FPCCR Condition Code Register (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA50	**LONG**							I/O	FPOP Operand Register (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA54	**WORD**							I/O	FPSLCT Register Select (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA56	**WORD**							I/O	Reserved
0x00FFFA58	**LONG**							I/O	FPIADR Instruction Address (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA5C	**LONG**							I/O	FPOADR Operand Address (available as a Mega Bus card accessed in 68881 peripheral mode)
0x00FFFA54 – 0x00FFFA7F	**N/A**							I/O	Unassigned
TT030 Multi-Function Peripheral Port (68901)									
0x00FFFA80	**OB**							I/O	MFP-TT030 GPIP (see 0x00FFFA00).
0x00FFFA82	**OB**							I/O	MFP-TT030 AER (see 0x00FFFA02).
0x00FFFA84	**OB**							I/O	MFP-TT030 DDR (see 0x00FFFA04).
0x00FFFA86	**OB**							I/O	MFP-TT030 IERA (see 0x00FFFA06).
0x00FFFA88	**OB**							I/O	MFP-TT030 IERB (see 0x00FFFA08).
0x00FFFA8A	**OB**							I/O	MFP-TT030 IPRA (see 0x00FFFA0A).
0x00FFFA8C	**OB**							I/O	MFP-TT030 IPRB (see 0x00FFFA0C).

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FFFA8E	**OB**							I/O	MFP-TT030 ISRA (see 0x00FFFA0E).
0x00FFFA90	**OB**							I/O	MFP-TT030 ISRB (see 0x00FFFA10).
0x00FFFA92	**OB**							I/O	MFP-TT030 IMRA (see 0x00FFFA12).
0x00FFFA94	**OB**							I/O	MFP-TT030 IMRB (see 0x00FFFA14).
0x00FFFA96	**OB**							I/O	MFP-TT030 VR (see 0x00FFFA16).
0x00FFFA98	**OB**							I/O	MFP-TT030 TACR (see 0x00FFFA18).
0x00FFFA9A	**OB**							I/O	MFP-TT030 TBCR (see 0x00FFFA1A).
0x00FFFA9C	**OB**							I/O	MFP-TT030 TCDCR (see 0x00FFFA1C).
0x00FFFA9E	**OB**							I/O	MFP-TT030 TADR (see 0x00FFFA1E).
0x00FFFAA0	**OB**							I/O	MFP-TT030 TBDR (see 0x00FFFA20).
0x00FFFAA2	**OB**							I/O	MFP-TT030 TCDR (see 0x00FFFA22).
0x00FFFAA4	**OB**							I/O	MFP-TT030 TDDR (see 0x00FFFA24).
0x00FFFAA6	**OB**							I/O	MFP-TT030 SCR (see 0x00FFFA26).
0x00FFFAA8	**OB**							I/O	MFP-TT030 UCR (see 0x00FFFA28).
0x00FFFAAA	**OB**							I/O	MFP-TT030 RSR (see 0x00FFFA2A).
0x00FFFAAC	**OB**							I/O	MFP-TT030 TSR (see 0x00FFFA2C).
0x00FFFAAE	**OB**							I/O	MFP-TT030 UDR (see 0x00FFFA2E).
0x00FFFAB0–0x00FFFBFF	**N/A**							I/O	Undefined

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
Keyboard ACIA (6850)									
0x00FFFC00	**EB**							I/O	Keyboard ACIA Control (when written) as follows: **Bit #7** Enables receive interrupts **Bits #6–5** Configures transmitter interrupts as follows: **Value** – **Meaning** %00 – RTS low, Disable Interrupts %01 – RTS low, Enable Interrupts %10 – RTS high, Disable Interrupts %11 – RTS low, Disable Interrupts Send a break on Interrupt **Bits #4–2** Configure Port Settings as follows: **Value** – **Data Bits–Parity–Stop Bits** %000 – 7-E-2 %001 – 7-O-2 %010 – 7-E-1 %011 – 7-O-1 %100 – 8-N-2 %101 – 8-N-1 %110 – 8-E-1 %111 – 8-O-1 **Bits #1–0** Set Clock Divisor as follows: **Value** – **Meaning** %00 – Normal %01 – Divide by 16 %10 – Divide by 256 %11 – Master Reset

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
									Keyboard ACIA Control (when read) as follows: 
0x00FFFC02	**EB**							I/O	Keyboard ACIA Data
MIDI ACIA (6850)									
0x00FFFC04	**EB**							I/O	MIDI ACIA Control (see keyboard ACIA control register for details)
0x00FFFC06	**EB**							I/O	MIDI ACIA Data
Mega ST Real Time Clock (RP5C15)									
0x00FFFC20	**OB**							I/O	Bank 0: Seconds-Ones (0–9) Bank 1: Clock output frequency as follows: **Value** — **Meaning** 0 — Open-Collector "CLKOUT" 1 — 16384 Hz 2 — 1024 Hz 3 — 128 Hz 4 — 16 Hz 5 — 1 Hz 6 — 1/60 Hz 7 — Open-Collector "CLKOUT"
0x00FFFC22	**OB**							I/O	Bank 0: Seconds-Tens (0–5) Bank 1: Setting bit #0 will reset the seconds register to the 0 and, if the seconds register is currently between 30–59, increment the minutes register.
0x00FFFC24	**OB**							I/O	Bank 0: Minutes-Ones (0–9) Bank 1: Alarm Minutes-Ones (0–9)

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FFFC26	**OB**							I/O	Bank 0: Minutes–Tens (0–5) Bank 1: Alarm Minutes-Tens (0–5)
0x00FFFC28	**OB**							I/O	Bank 0: Hour-Ones (0–9) Bank 1: Alarm Hour-Ones (0–9)
0x00FFFC2A	**OB**							I/O	Bank 0: Hour-Tens (0–2), in 24 hour mode, otherwise (0–1) in 12 hour mode with Bit 1 being set for PM, cleared for AM. Bank 1: Alarm Hour-Tens (as in bank 0)
0x00FFFC2C	**OB**							I/O	Bank 0: Day of Week (0–6), 0 = Sunday Bank 1: Alarm Day of Week (0–6), 0 = Sunday
0x00FFFC2E	**OB**							I/O	Bank 0: Date-Ones (0–9) Bank 1: Alarm Date-Ones (0–9)
0x00FFFC30	**OB**							I/O	Bank 0: Date-Tens (0–3) Bank 1: Alarm Date-Tens (0–3)
0x00FFFC32	**OB**							I/O	Bank 0: Month-Ones (0–9) Bank 1: Not Used
0x00FFFC34	**OB**							I/O	Bank 0: Month-Tens (0–1) Bank 1: If Bit #1 is set then clock is in 24 hour mode, otherwise, it is in 12 hour mode.
0x00FFFC36	**OB**							I/O	Bank 0: Year-Ones (0–9). The value for Year represents the (Year - 1980). Bank 1: Leap Year Register (0–3), 0 = Leap Year
0x00FFFC38	**OB**							I/O	Bank 0: Year-Tens (0–9) Bank 1: Not Used
0x00FFFC3A	**OB**							I/O	Mode Register as follows: 
0x00FFFC3C	**OB**							I/O	Test Register (lower nibble must equal zero to show confirm proper functioning)

Location(s)	Size	ST	Mega ST	STe	Mega STe	TT030	Falcon030	Type	Meaning
0x00FFFC3E	**OB**							I/O	Reset Register as follows: 0 = 1 Hz Alarm Pulse 0 = 16 Hz Alarm Pulse Bit 0 1 = Clock Reset 1 = Alarm Reset
0x00FFFC40– 0x00FFFFFF	**N/A**							I/O	Undefined
Expansion Area									
0x01000000 – 0x01FFFFFF	**N/A**							RAM	TT030 Fast Ram (Unsuitable for direct DMA and Video Shifter transfers)
0x02000000 – 0xFDFFFFFF	**N/A**							RSVD	Reserved
0xFE000000 – 0xFEFEFFFF	**N/A**							VME	VME A24:D16 Addressable Area
0xFEFF0000 – 0xFEFFFFFF	**N/A**							VME	VME A16:D16 Addressable Area
Shadow Image									
0xFF000000 – 0xFFFFFFFF	**N/A**							Image	This area is a 'shadow' image of 0x00000000 – 0x00FFFFFF to remain compatible with the ST.

– APPENDIX C –

NATIVE FILE FORMATS

The .GEM File Format

Files ending in '.GEM' are graphic metafiles created by **GDOS**. They are usually used to represent vector graphics but may also be used to store links to bitmap images and textual information.

Two primary versions of **GEM** files exist. Version 1 files are guaranteed not to contain bezier curves whereas version 3 files may. Version 3.xx files are also commonly referred to as **GEM/3** files.

The Metafile Header

GEM metafiles begin with a header as follows:

WORD	Contents
0	Magic number (0xFFFF).
1	Header length in **WORD**s.
2	Version number (major * 100 + minor).
3	NDC Flag as follows: **Value** **Meaning** 0 (0, 0) in lower-left corner (NDC) 2 (0, 0) in upper-left corner (RC)
4	Minimum X extent.
5	Minimum Y extent.
6	Maximum X extent.
7	Maximum Y extent.
8	Page width in tenths of millimeters.
9	Page height in tenths of millimeters.
10	Lower Left X value of coordinate system.
11	Lower Left Y value of coordinate system.
12	Upper Right X value of coordinate system.
13	Upper Right Y value of coordinate system.
...	Other information may appear in the header following which is currently undefined. Use **WORD** #1 to skip any unknown information.

The definition of **WORD**s 4–13 is defined by the creator of the file using three metafile commands. **WORD**s 4–7 are set with the **v_meta_extents()** function. **WORD**s 8–9 are defined with the **vm_pagesize()** function. **WORD**s 10–13 are defined with **vm_coords()**. If the creator fails to specify defaults for any of these values, the appropriate values will be set to 0 in the header. If zeros appear for **WORD**s 10–13, the default NDC coordinate system should be assumed.

Metafile Records

Following the header will appear a list of records of varying length which, when translated, can be 'played back' on the destination **VDI** device. Each record is formatted as follows:

WORD	Meaning
0	Opcode of **VDI** function.
1	Number of *PTSIN* elements.
2	Number of *INTIN* elements.
3	Function sub-ID.
4...	*PTSIN* elements.
...	*INTIN* elements.

The list of records is terminated with an opcode of 0xFFFF (this record is written when a **v_clswk()** call is made by the creator).

When playing back **GEM** files, the application must translate all coordinates from the metafile coordinate system to that of the destination device. In addition, text metrics should be appropriately converted. If an unknown opcode is discovered it should be played after any elements of the *PTSIN* array are translated (making the assumption that they should be).

Metafile Sub-Opcodes

GEM metafiles support the use of special sub-opcodes for implementing reserved and user-defined functions. **GEM** metafile translators should ignore sub-opcodes they don't understand. Each sub-opcode can be identified with the primary opcode of 5, function ID of 99 and the first (required) member of *INTIN* being the sub-opcode ID. The currently defined sub-opcodes are as follows:

INTIN[0]	Meaning
10	Start Group.
11	End Group.
49	Set No Line Style.
50	Set Attribute Shadow On.
51	Set Attribute Shadow Off.
80	Start Draw Area Type Primitive.
81	End Draw Area Type Primitive.

None of the pre-defined sub-opcodes use additional *INTIN* or *PTSIN* elements though user-defined sub-opcodes may.

Opcodes from 0–100 are reserved for use by Atari. Sub-opcodes from 101-65535 are available for use by developers but should be registered with Atari to avoid possible conflicts.

The .IMG File Format

The IMG file format was designed to support raster images with a varying number of planes. In practice, almost all IMG files currently available are simple black and white single plane images because the original file format did not specify a method of storing palette information with the file. To fill this need, several unofficial extensions to the format were put into use (some of which were incorrectly implemented by applications supporting them). The color extension which will be discussed here to cover color images is the 'XIMG' format.

The IMG Header

Image headers consist of at least 8 **WORD**s as follows:

WORD	Meaning
0	Image file version (Usually 0x0001).
1	Header length in **WORD**s.
2	Number of planes.
3	Pattern definition length.
4	Source device pixel width (in microns).
5	Source device pixel height (in microns).
6	Scan line width (in pixels).
7	Number of scan lines.

Some IMG files will have additional header information which should be skipped or interpreted as discussed below.

Interpreting Extra Palette Information

If **WORD** #2 is set to 1, then the image data consists of one plane (i.e. monochrome) and any extra header information should be ignored.

If **WORD** #2 is set to 16 or 24 then the image data consists of that many planes of high color or true color data and any extra header information should be ignored. In a high color image, planes appear in the order RRRRR GGGGGG BBBBB. In a true-color image, planes appear in the order RRRRRRRR GGGGGGGG BBBBBBBB.

If **WORD** #2 is set to 2, 4, or 8, the image consists of palette based color image data. If no extra header information is given then the creator did not specify palette data for this image. If extra header **WORD**s appears they may be useful in determining the color palette. The two primary extensions to the IMG format are 'XIMG' and 'STTT'. 'STTT' will not be discussed here as it does not serve well as a machine or device independent format. The 'XIMG' header extension is as follows:

WORD	Meaning
8 & 9	ASCII 'XIMG'
10	Color format (Almost always 0 – RGB).
11...	RGB **WORD** triplets. Three **WORD**s appear for each pen. There are (2 ^ *numplanes*) pens. Each word contains a value from 0 to 1000 for direct passage to **vs_color()**.

Image Data Format

Each scanline contains data in **VDI** device independent format which must be converted using the **VDI** call **vr_trnfm()**. Each scanline is padded to the nearest byte. Every plane for each scanline should appear prior to the beginning of data for the next scanline. This allows interpreters to decompress and transform the image data a scanline at a time to conserve on time and memory. A sample ordering for a four-plane image is listed below:

Scanline #0 – Plane #0
Scanline #0 – Plane #1
Scanline #0 – Plane #2
Scanline #0 – Plane #3
Scanline #1 – Plane #0
Scanline #1 – Plane #1
Scanline #1 – Plane #2
Scanline #1 – Plane #3
etc.

Image Compression

Each scanline is individually compressed. This means that compression codes should not transgress over scanline boundaries. This enables decompression routines to work scanline by scanline.

Scanline data should consist of two components, a vertical replication count and encoded scanline data. In practice, however, some older .IMG files may not contain a vertical replication count for each scan line.

The vertical replication count specifies the number of times the following scanline data should be used to replicate an image row. It is formatted as follows:

BYTE	Contents
0	0x00
1	0x00
2	0xFF
3	Replication Count

Immediately following the vertical replication count is the encoded scanline data. This run-length encoding can by looking for three separate flag **BYTE**s. A 0x80 **BYTE** indicates the beginning of a bit-string item. A bit-string item is formatted as follows:

BYTE	Contents
0	0x80
1	Byte count 'n'.
2...	'n' **BYTE**s of unencoded data.

A pattern-run item begins with a **BYTE** of 0x00. It specifies a fixed number of times that the pattern which follows it should be repeated. It is formatted as follows:

BYTE	Contents
0	0x00
1	Length of run.
2...	Pattern bytes (length of pattern is determined by header **WORD** #3).

Finally, a solid-run item begins with any other **BYTE** code. If the high order bit is set then this indicates a run of black pixels, otherwise it indicates a run of white pixels. The lower 7 bits of the byte indicates the length of the run in bytes. For example a **BYTE** code of 0x83 indicates a run of 24 black pixels (3 bytes).

The .FNT File Format

Filenames ending with the extension '.FNT' represent bitmap font files. These files may be utilized by loading them through any version of **GDOS**. FNT files are composed of a file header, font data, a character offset table, and (optionally) a horizontal offset table.

The FNT Header

Font files begin with a header 88 **BYTE**s long. **WORD** and **LONG** format entries in the header must be byte-swapped as they appear in Intel ('Little Endian') format. The font header is formatted as follows:

BYTE(s)	Contents	Related VDI Call
0 – 1	Face ID (must be unique).	**vqt_name()**
2 – 3	Face size (in points).	**vst_point()**
4 – 35	Face name.	**vqt_name()**
36 – 37	Lowest character index in face (usually 32 for disk-loaded fonts).	**vqt_fontinfo()**
38 – 39	Highest character index in face.	**vqt_fontinfo()**
40 – 41	Top line distance expressed as a positive offset from baseline.	**vqt_fontinfo()**
42 – 43	Ascent line distance expressed as a positive offset from baseline.	**vqt_fontinfo()**
44 – 45	Half line distance expressed as a positive offset from baseline.	**vqt_fontinfo()**
46 – 47	Descent line distance expressed as a positive offset from baseline.	**vqt_fontinfo()**

48 – 49	Bottom line distance expressed as a positive offset from baseline.	**vqt_fontinfo()**
50 – 51	Width of the widest character.	N/A
52 – 53	Width of the widest character cell.	**vqt_fontinfo()**
54 – 55	Left offset.	**vqt_fontinfo()**
56 – 57	Right offset.	**vqt_fontinfo()**
58 – 59	Thickening size (in pixels).	**vqt_fontinfo()**
60 – 61	Underline size (in pixels).	**vqt_fontinfo()**
62 – 63	Lightening mask (used to eliminate pixels, usually 0x5555).	N/A
64 – 65	Skewing mask (rotated to determine when to perform additional rotation on a character when skewing, usually 0x5555).	N/A
66 – 67	Font flags as follows: **Bit** **Meaning (if Set)** 0 Contains System Font 1 Horizontal Offset Tables should be used. 2 Font data need not be byte-swapped. 3 Font is mono-spaced.	N/A
68 – 71	Offset from start of file to horizontal offset table.	**vqt_width()**
72 – 75	Offset from start of file to character offset table.	**vqt_width()**
76 – 79	Offset from start of file to font data.	N/A
80 – 81	Form width (in bytes).	N/A
82 – 83	Form height (in scanlines).	N/A
84 – 87	Pointer to the next font (set by **GDOS** after loading).	N/A

Font Data

The binary font data is arranged on a single raster form. The raster's height is the same as the font's height. The raster's width is the sum of the character width's padded to end on a **WORD** boundary.

There is no padding between characters. Each character may overlap **BYTE** boundaries. Only the last character in a font is padded to make the width of the form end on an even **WORD** boundary.

If bit #2 of the font flags header item is cleared, each **WORD** in the font data must be byte-swapped.

Character Offset Table

The Character Offset Table is an array of **WORD**s which specifies the distance (in pixels) from the previous character to the next. The first entry is the distance from the start of the raster form to the left side of the first character. One succeeding entry follows for each character in the font yielding (number of characters + 1) entries in the table. Each entry must be byte-swapped as it appears in Intel ('Little Endian') format.

Horizontal Offset Table

The Horizontal Offset Table is an optional array of positive or negative **WORD** values which when added to the values in the character offset table yield the true spacing information for each character. One entry appears in the table for each character. This table is not often used.

The .RSC File Format

Resource files contain application specific data which is generally loaded at run-time. RSC files contain **OBJECT** trees (see the discussion of the **OBJECT** structure in *Chapter 6: **AES***), strings, and images.

Two resource file formats are currently supported. **TOS** versions less than 4.0 support the original RSC format while **TOS** 4.0 and greater will now support the older format and a new extensible format. The original format will be discussed first followed by an explanation of the changes incurred by the newer format.

The RSC Header

Resource files begin with an 18 **WORD** header as follows:

WORD	Field Name	Contents
0	*rsh_vrsn*	Contains the version number of the resource file. This value is 0x0000 or 0x0001 in old format RSC files and has the third bit set (i.e. 0x0004) in the new file format.
1	*rsh_object*	Contains an offset from the beginning of the file to the **OBJECT** structures.
2	*rsh_tedinfo*	Contains an offset from the beginning of the file to the **TEDINFO** structures.
3	*rsh_iconblk*	Contains an offset from the beginning of the file to the **ICONBLK** structures.
4	*rsh_bitblk*	Contains an offset from the beginning of the file to the **BITBLK** structures.
5	*rsh_frstr*	Contains an offset from the beginning of the file to the string pointer table.
6	*rsh_string*	Contains an offset from the beginning of the file to the string data.
7	*rsh_imdata*	Contains an offset from the beginning of the file to the image data.
8	*rsh_frimg*	Contains an offset from the beginning of the file to the image pointer table.

9	*rsh_trindex*	Contains an offset from the beginning of the file to the tree pointer table.
10	*rsh_nobs*	Number of **OBJECT**s in the file.
11	*rsh_ntree*	Number of object trees in the file.
12	*rsh_nted*	Number of **TEDINFO**s in the file.
13	*rsh_nib*	Number of **ICONBLK**s in the file.
14	*rsh_nbb*	Number of **BITBLK**s in the file.
15	*rsh_nstring*	Number of free strings in the file.
16	*rsh_nimages*	Number of free images in the file.
17	*rsh_rssize*	Size of the resource file (in bytes). Note that this is the size of the old format resource file. If the newer format file is being used then this value can be used as an offset to the extension array.

Many of the header entries represent offsets from the beginning of the file. These offsets are expressed as positive unsigned **WORD**s making the standard file a maximum size of 64k bytes.

Object Trees

Each RSC file may contain a number of object trees. *rsh_object* contains an offset from the beginning of the file to the object trees (stored consecutively). The **LONG** array pointed to by *rsh_trindex* can be used to separate the object trees in the list. There are *rsh_ntree* **LONG**s in this array. Each array entry can be used as an array index to a different object tree. After being loaded in memory by **rsrc_load()**, the members at *rsh_trindex* are filled in with the absolute pointers to their respective trees.

Each individual **OBJECT** is stored differently on disk then in memory. In the file, pointers to **TEDINFO**s, **BITBLK**s, and **ICONBLK**s are stored as absolute indexes into the arrays of these members stored in the file. Therefore a **G_TEXT OBJECT** whose *ob_spec* field would normally point a **TEDINFO** in memory would contain the value 0 if that **TEDINFO** were the first **TEDINFO** contained in the file.

String pointers are represented on disk by their absolute offset from the beginning of the file. Image pointers in **BITBLK** and **ICONBLK** structures are likewise pointed to through absolute file offsets, not indexes.

Free Strings and Images

rsh_frstr points to a table of **LONG**s which each specify an offset from the start of the RSC file to a free string. *rsh_frimg* points to a table of **LONG**s which each specify an offset from the start of the file to a **BITBLK** structure.

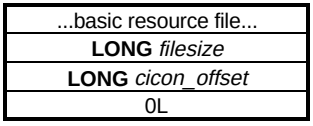
AES 3.30 Resource Format

Beginning with **AES** 3.30, the resource file format was altered to allow for new **OBJECT** types. The only **OBJECT** which currently takes advantage of this format is **G_CICON**. **G_CICON**s can only be stored in files of the new format. The new format can be identified by the third bit of *rsh_vrsn* being set.

The Extension Array

Immediately following the old resource data (using *rsh_rssize* as an offset) an extension array is added. The first entry in this array is a **LONG** containing the true size of the RSC file. Notice that values such as these are now stored as **LONG**s to allow the size of RSC files to exceed 64k. Due to the method in which some older resource elements were stored many components of RSC files will still be constrained to 64k.

Following the file size is a **LONG** word for each extension present followed by a 0L which terminates the array. Currently only one extension exists (**CICONBLK**) and it *always* occupies the first extension slot. As additional extensions are added, a value of -1L for any entry will indicate that there are no resource elements of that type in the file. For example an extension array that does contain **CICONBLK**s would look like this.



The CICONBLK Extension

The **G_CICON** object type adds the ability to display color icons from the **AES**. The *ob_spec* of the object indexes a **CICONBLK** structure stored in the extension area. Each **CICONBLK** must contain a monochrome icon and a color icon for as many different resolutions as desired. When drawn, the **AES** will pick the icon that is the closest match for the current screen display. If there is no color icon present which the **AES** is able to convert, the monochrome icon is displayed.

The *cicon_offset* pointer gives an offset from the beginning of the resource file to a file segment which contains the **CICON** data. This segment contains a **CICONBLK** pointer table followed by the actual **CICONBLK**s.

The **CICONBLK** pointer table is simply a longword 0L for each **CICONBLK** present in the file. These pointers are filled in by the **AES** when loaded. The list is terminated by a -1L.

Immediately following the pointer table is one of the following variable length structures for each **CICONBLK**:

```
ICONBLK monoicon;     /* This is the standard monochrome resource. */
LONG n_cicons;        /* Number of CICONs of different resolutions. */
WORD mono_data[x];    /* Monochrome bitmap data. */
WORD mono_mask[x];    /* Monochrome bitmap mask. */
CHAR icon_text[12];   /* Icon text (maximum of 12 characters). */

/* for each resolution supported (n_cicons) include the following structure */

WORD num_planes;      /* Number of planes this icon was intended for */
LONG col_data;        /* Placeholder (calculated upon loading). */
LONG col_mask;        /* Placeholder (calculated upon loading). */
LONG sel_data;        /* Placeholder (must be non-zero if 'selected' data exists */
LONG sel_mask;        /* Placeholder (calculated upon loadind). */
LONG next_res;        /* 1L = more icons follow */
WORD color_data[n];   /* n WORDs of image data (n is num_planes*WORDs in mono
       icon).*/
WORD color_mask[n];   /* n WORDs of image mask. */
WORD select_data[n];  /* Only present if sel_data is non-zero. */
WORD select_mask[n];  /* Only present if sel_data is non-zero. */
```

CICON Images

All color image data is stored in **VDI** device independent format on disk and is automatically converted by **vr_trnfm()** upon **rsrc_load()**[1].

[1]Due to a bug in some versions of the **VDI** the seventh **WORD** of color icon image data may not contain the value 0x0001. If it does, the **VDI** may incorrectly display the icon.

– APPENDIX D –

ERROR CODES

GEMDOS/BIOS Errors

Upon return from most **GEMDOS** and **BIOS** functions, register D0 contains a longword error code describing the failure or success of an operation. The **BIOS** uses error codes -1 to -31 while **GEMDOS** uses error codes -32 and lower. A return value of 0 always indicates success. The error codes and their meanings are as follows:

Name	BIOS #	Meaning
E_OK	0	No error
ERROR	-1	Generic error
EDRVNR	-2	Drive not ready
EUNCMD	-3	Unknown command
E_CRC	-4	CRC error
EBADRQ	-5	Bad request
E_SEEK	-6	Seek error
EMEDIA	-7	Unknown media
ESECNF	-8	Sector not found
EPAPER	-9	Out of paper
EWRITF	-10	Write fault
EREADF	-11	Read fault
EWRPRO	-12	Device is write protected
E_CHNG	-14	Media change detected
EUNDEV	-15	Unknown device
EBADSF	-16	Bad sectors on format
EOTHER	-17	Insert other disk (request)

Name	GEMDOS #	Meaning
EINVFN	-32	Invalid function
EFILNF	-33	File not found
EPTHNF	-34	Path not found
ENHNDL	-35	No more handles
EACCDN	-36	Access denied
EIHNDL	-37	Invalid handle
ENSMEM	-39	Insufficient memory
EIMBA	-40	Invalid memory block address
EDRIVE	-46	Invalid drive specification
ENSAME	-48	Cross device rename
ENMFIL	-49	No more files
ELOCKED	-58	Record is already locked
ENSLOCK	-59	Invalid lock removal request
ERANGE or **ENAMETOOLONG**	-64	Range error
EINTRN	-65	Internal error
EPLFMT	-66	Invalid program load format
EGSBF	-67	Memory block growth failure
ELOOP	-80	Too many symbolic links
EMOUNT	-200	Mount point crossed (indicator)

– APPENDIX E –

ATARI ASCII TABLE

Atari ASCII Table

All Atari operating system calls use the Atari ASCII character set as the default method for encoding text strings. Strings encoded in this manner are composed of unsigned bytes representing a uniquely defined character as the following table specifies. Unless otherwise noted, a **NULL** character (ASCII 0) is used to indicate the end of string.

Dec	Hex	Char
0	0x00	
1	0x01	
2	0x02	
3	0x03	
4	0x04	
5	0x05	
6	0x06	
7	0x07	
8	0x08	
9	0x09	
10	0x0A	
11	0x0B	
12	0x0C	
13	0x0D	
14	0x0E	
15	0x0F	
16	0x10	
17	0x11	
18	0x12	
19	0x13	
20	0x14	
21	0x15	
22	0x16	
23	0x17	
24	0x18	
25	0x19	
26	0x1A	
27	0x1B	
28	0x1C	
29	0x1D	
30	0x1E	
31	0x1F	
32	0x20	
33	0x21	!

Dec	Hex	Char
34	0x22	"
35	0x23	#
36	0x24	$
37	0x25	%
38	0x26	&
39	0x27	'
40	0x28	(
41	0x29	)
42	0x2A	*
43	0x2B	+
44	0x2C	,
45	0x2D	-
46	0x2E	.
47	0x2F	/
48	0x30	0
49	0x31	1
50	0x32	2
51	0x33	3
52	0x34	4
53	0x35	5
54	0x36	6
55	0x37	7
56	0x38	8
57	0x39	9
58	0x3A	:
59	0x3B	;
60	0x3C	<
61	0x3D	=
62	0x3E	>
63	0x3F	?
64	0x40	@
65	0x41	A
66	0x42	B
67	0x43	C

Dec	Hex	Char
68	0x44	D
69	0x45	E
70	0x46	F
71	0x47	G
72	0x48	H
73	0x49	I
74	0x4A	J
75	0x4B	K
76	0x4C	L
77	0x4D	M
78	0x4E	N
79	0x4F	O
80	0x50	P
81	0x51	Q
82	0x52	R
83	0x53	S
84	0x54	T
85	0x55	U
86	0x56	V
87	0x57	W
88	0x58	X
89	0x59	Y
90	0x5A	Z
91	0x5B	[
92	0x5C	\
93	0x5D	]
94	0x5E	^
95	0x5F	_
96	0x60	`
97	0x61	a
98	0x62	b
99	0x63	c
100	0x64	d
101	0x65	e

E.4 – Atari ASCII Table

Dec	Hex	Char
102	0x66	f
103	0x67	g
104	0x68	h
105	0x69	i
106	0x6A	j
107	0x6B	k
108	0x6C	l
109	0x6D	m
110	0x6E	n
111	0x6F	o
112	0x70	p
113	0x71	q
114	0x72	r
115	0x73	s
116	0x74	t
117	0x75	u
118	0x76	v
119	0x77	w
120	0x78	x
121	0x79	y
122	0x7A	z
123	0x7B	{
124	0x7C	|
125	0x7D	}
126	0x7E	~
127	0x7F	△
128	0x80	Ç
129	0x81	ü
130	0x82	é
131	0x83	â
132	0x84	ä
133	0x85	à
134	0x86	å
135	0x87	ç
136	0x88	ê
137	0x89	ë
138	0x8A	è
139	0x8B	ï
140	0x8C	î
141	0x8D	ì
142	0x8E	Ä

Dec	Hex	Char
143	0x8F	Å
144	0x90	É
145	0x91	æ
146	0x92	Æ
147	0x93	ô
148	0x94	ö
149	0x95	ò
150	0x96	û
151	0x97	ù
152	0x98	ÿ
153	0x99	Ö
154	0x9A	Ü
155	0x9B	¢
156	0x9C	£
157	0x9D	¥
158	0x9E	ß
159	0x9F	ƒ
160	0xA0	á
161	0xA1	í
162	0xA2	ó
163	0xA3	ú
164	0xA4	ñ
165	0xA5	Ñ
166	0xA6	ª
167	0xA7	º
168	0xA8	¿
169	0xA9	⌐
170	0xAA	¬
171	0xAB	½
172	0xAC	¼
173	0xAD	¡
174	0xAE	«
175	0xAF	»
176	0xB0	ã
177	0xB1	õ
178	0xB2	Ø
179	0xB3	ø
180	0xB4	œ
181	0xB5	Œ
182	0xB6	À
183	0xB7	Ã

Dec	Hex	Char
184	0xB8	Õ
185	0xB9	¨
186	0xBA	´
187	0xBB	†
188	0xBC	¶
189	0xBD	©
190	0xBE	®
191	0xBF	™
192	0xC0	ij
193	0xC1	IJ
194	0xC2	א
195	0xC3	ב
196	0xC4	ג
197	0xC5	ד
198	0xC6	ה
199	0xC7	ו
200	0xC8	ז
201	0xC9	ח
202	0xCA	ט
203	0xCB	י
204	0xCC	כ
205	0xCD	ל
206	0xCE	מ
207	0xCF	נ
208	0xD0	ס
209	0xD1	ע
210	0xD2	פ
211	0xD3	צ
212	0xD4	ק
213	0xD5	ר
214	0xD6	ש
215	0xD7	ת
216	0xD8	ן
217	0xD9	ך
218	0xDA	ם
219	0xDB	ף
220	0xDC	ץ
221	0xDD	₪

Dec	Hex	Char
222	0xDE	∧
223	0xDF	∞
224	0xE0	α
225	0xE1	ß
226	0xE2	Γ
227	0xE3	π
228	0xE4	Σ
229	0xE5	σ
230	0xE6	µ
231	0xE7	τ
232	0xE8	Φ
233	0xE9	Θ
234	0xEA	Ω
235	0xEB	δ
236	0xEC	∅
237	0xED	φ
238	0xEE	∈
239	0xEF	∩
240	0xF0	≡
241	0xF1	±
242	0xF2	≥
243	0xF3	≤
244	0xF4	⌠
245	0xF5	⌡
246	0xF6	÷
247	0xF7	≈
248	0xF8	°
249	0xF9	∙
250	0xFA	·
251	0xFB	√
252	0xFC	ⁿ
253	0xFD	²
254	0xFE	³
255	0xFF	

– APPENDIX F –

IKBD SCAN CODES

IKBD Scan Codes

The **AES**, **VDI**, and **BIOS**, all contain functions which return scan codes from the Intelligent Keyboard Controller (**IKBD**). These scan codes can be used to determine exactly which key was struck (not simply the ASCII value).

One thing that must be considered when relying on scan codes is that they identify a physical vector on the keyboard, not a key definition. The scancode for a letter on an American keyboard, for instance, may be different than the scancode for the same letter on a German keyboard. The **XBIOS** function **Keytbl()** can be used to look up the ASCII value assigned to a scancode to ensure that keystrokes are correctly processed.

Scancodes for keyboard modifiers (SHIFT, ALT, etc.) are never returned by an OS call. However, when handling the IKBD directly, the following scancodes may be encountered:

Key	Scancode
Left-Shift	42 (0x2A)
Right-Shift	54 (0x36)
Control	29 (0x1D)
Alternate	56 (0x38)
Caps Lock	58 (0x3A)

The values shown in the following table contain the **IKBD** scancode of each keyboard key in the high **BYTE** and the ASCII code in the low **BYTE**. Keys with no corresponding ASCII value will always have zero as the low byte. These values are valid for all Atari computers with US keyboards:

Key	Unshifted	Key	Shifted	w/CTRL	w/ALT
a	0x1E61	A	0x1E41	0x1E01	0x1E00
b	0x3062	B	0x3042	0x3002	0x3000
c	0x2E63	C	0x2E43	0x2E03	0x2E00
d	0x2064	D	0x2044	0x2004	0x2000
e	0x1265	E	0x1245	0x1205	0x1200
f	0x2166	F	0x2146	0x2106	0x2100
g	0x2267	G	0x2247	0x2207	0x2200
h	0x2368	H	0x2348	0x2308	0x2300
i	0x1769	I	0x1749	0x1709	0x1700
j	0x246A	J	0x244A	0x240A	0x2400
k	0x256B	K	0x254B	0x250B	0x2500
l	0x266C	L	0x264C	0x260C	0x2600
m	0x326D	M	0x324D	0x320D	0x3200
n	0x316E	N	0x314E	0x310E	0x3100
o	0x186F	O	0x184F	0x180F	0x1800
p	0x1970	P	0x1950	0x1910	0x1900
q	0x1071	Q	0x1051	0x1011	0x1000
r	0x1372	R	0x1352	0x1312	0x1300
s	0x1F73	S	0x1F53	0x1F13	0x1F00
t	0x1474	T	0x1454	0x1414	0x1400

Key	Unshifted	Key	Shifted	w/CTRL	w/ALT
u	0x1675	U	0x1655	0x1615	0x1600
v	0x2F76	V	0x2F56	0x2F16	0x2F00
w	0x1177	W	0x1157	0x1117	0x1100
x	0x2D78	X	0x2D58	0x2D18	0x2D00
y	0x1579	Y	0x1559	0x1519	0x1500
z	0x2C7A	Z	0x2C5A	0x2C1A	0x2C00
1	0x0231	!	0x0221	0x0211	0x7800
2	0x0332	@	0x0340	0x0300	0x7900
3	0x0433	#	0x0423	0x0413	0x7A00
4	0x0534	$	0x0524	0x0514	0x7B00
5	0x0635	%	0x0625	0x0615	0x7C00
6	0x0736	^	0x075E	0x071E	0x7D00
7	0x0837	&	0x0826	0x0817	0x7E00
8	0x0938	*	0x092A	0x0918	0x7F00
9	0x0A39	(	0x0A28	0x0A19	0x8000
0	0x0B30	)	0x0B29	0x0B10	0x8100
-	0x0C2D		0x0C5F	0x0C1F	0x8200
=	0x0D3D	+	0x0D2B	0x0D1D	0x8300
`	0x2960	~	0x297E	0x2900	0x2960
\	0x2B5C	|	0x2B7C	0x2B1C	0x2B5C
[	0x1A5B	{	0x1A7B	0x1A1B	0x1A5B
]	0x1B5D	}	0x1B7D	0x1B1D	0x1B5D
;	0x273B	:	0x273A	0x271B	0x273B
'	0x2827	"	0x2822	0x2807	0x2827
,	0x332C	<	0x333C	0x330C	0x332C
.	0x342E	>	0x343E	0x340E	0x342E
/	0x352F	?	0x353F	0x250F	0x352E
SPACE	0x3920		0x3920	0x3900	0x3920
ESC	0x011B		0x011B	0x011B	0x011B
BKSP	0x0E08		0x0E08	0x0E08	0x0E08
DEL	0x537F		0x537F	0x531F	0x537F
RETURN	0x1C0D		0x1C0D	0x1C0A	0x1C0D
TAB	0x0F09		0x0F09	0x0F09	0x0F09
Nmpad (	0x6328		0x6328	0x6308	0x6328
Nmpad)	0x6429		0x6429	0x6409	0x6429
Nmpad /	0x652F		0x652F	0x650F	0x652F
Nmpad *	0x662A		0x662A	0x660A	0x662A
Nmpad	0x4A2D		0x4A2D	0x4A1F	0x4A2D
Nmpad +	0x4E2B		0x4E2B	0x3E0B	0x4E2B
Nmpad .	0x712E		0x712E	0x710E	0x712E
Nmpad ENTER	0x720D		0x720D	0x720A	0x720D
Nmpad 0	0x7030		0x7030	0x7010	0x7030[1]
Nmpad 1	0x6D31		0x6D31	0x6D11	0x6D31[1]
Nmpad 2	0x6E32		0x6E32	0x6E00	0x6E32[1]
Nmpad 3	0x6F33		0x6F33	0x6F13	0x6F33[1]
Nmpad 4	0x6A34		0x6A34	0x6A14	0x6A34[1]
Nmpad 5	0x6B35		0x6B35	0x6B15	0x6B35[1]
Nmpad 6	0x6C36		0x6C36	0x6C1E	0x6C36[1]

[1] Atari computers with **TOS** 2.0 or higher do not generate scancodes for the ALT-Numeric Keypad numbers. Instead they allow the user to enter any key by holding ALT while typing the ASCII code number and then releasing ALT to generate the keypress.

Key	Unshifted	Key	Shifted	w/CTRL	w/ALT
Nmpad 7	0x6737		0x6737	0x6717	0x6737[1]
Nmpad 8	0x6838		0x6838	0x6818	0x6838[1]
Nmpad 9	0x6939		0x6939	0x6919	0x6939[1]
HELP	0x6200		0x6200	0x6200	Alt-Help[2]
UNDO	0x6100		0x6100	0x6100	0x6100
INSERT	0x5200		0x5230	0x5200	Left Mouse Button[3]
CLR/ HOME	0x4700		0x4737	0x7700	Right Mouse Button[3]
UP-ARROW	0x4800		0x4838	0x4800	Mouse Up[3]
DOWN-ARROW	0x5000		0x5032	0x5000	Mouse Down[3]
LEFT-ARROW	0x4B00		0x4B34	0x7300	Mouse Left[3]
RIGHT-ARROW	0x4D00		0x4D36	0x7400	Mouse Right[3]
F1	0x3B00	F11	0x5400	0x3B00	0x3B00
F2	0x3C00	F12	0x5500	0x3C00	0x3C00
F3	0x3D00	F13	0x5600	0x3D00	0x3D00
F4	0x3E00	F14	0x5700	0x3E00	0x3E00
F5	0x3F00	F15	0x5800	0x3F00	0x3F00
F6	0x4000	F16	0x5900	0x4000	0x4000
F7	0x4100	F17	0x5A00	0x4100	0x4100
F8	0x4200	F18	0x5B00	0x4200	0x4200
F9	0x4300	F19	0x5C00	0x4300	0x4300
F10	0x4400	F20	0x5D00	0x4400	0x4400

[2]This key does not generate a keycode, rather it triggers the screen dump interrupt.

[3] Keycodes marked by an asterisk are mouse-equivalent keys and generate mouse events rather than keycodes.

– APPENDIX G –

Speedo Fonts

The Speedo Font Header

This section provides detailed information about the contents of the buffer returned by the **vqt_fontheader()** call. First, here are some general notes about the values you will be using:

Character strings are only NULL terminated if they do not completely fill their assigned field.

All integers are signed (unless otherwise noted) and in Big-Endian format (most significant byte first).

Outline Resolution Units (ORUs) are the basic unit of measurement for Speedo characters. There are usually 1000 ORUs per Em square (width of the letter 'M') though you can check this value in the font header itself.

6-byte Transformation Parameters consist of a WORD Y offset (expressed in ORUs) followed by a UWORD X-scaling factor (expressed in units of 1/4096) and a similar UWORD Y-scaling factor (also expressed in units of 1/4096).

The following table details the information returned by the **vqt_fontheader()** function call:

Offset	Field	Meaning
0	Format Identifier	An 8-byte character string consisting of "D1.0" CR LF NULL NULL
8	Font Size	A LONG specifying the size of the font file in bytes.
12	Minimum Font Buffer Size	A LONG specifying the minimum size buffer required to load the non-image data of the font.
16	Minimum Character Buffer Size	A WORD specifying the minimum size buffer required to hold the largest character in the font.
18	Header Size	A WORD specifying the size of the font header.
20	Font ID	A WORD containing the Bitstream font ID number.
22	Font Version Number	A WORD containing the font revision number.
24	Font Full Name	A 70-byte character string containing the full name of the font.
94	Manufacturing Date	A 10-byte character string containing the manufacturing date of the font as DD Mon YY.
104	Character Set Name	A 66-byte character string containing the name of the character set used for the font (ex: "Bitstream International Character Set").
170		

Vendor ID A 2-byte character string identifying the manufacturer of the font. This is usually the first two characters in the font filename. Bitstream fonts use 'BX'.
172
Character Set ID A 2-byte character string identifying the character set used for this font. This is usually the second 2 characters in the font filename. The Bitstream International Character Set is '00'.
174
Copyright Notice A 78-byte character string containing the copyright notice for the font.
252
Number of Character Indexes in Character Set A WORD specifying the number of character indexes available in the font's character set. This does not necessarily mean that every index is actually used.
254
Total Number of Character Indexes in Font A WORD indicating the number of character indexes available in the font's character set in addition to any supplementary characters needed to create compound characters.
256
Index of First Character A WORD containing the first available character in a font.
258
Number of Kerning Tracks A WORD specifying the total number of kerning tracks.
260
Number of Kerning Pairs A WORD specifying the total number of kerning pairs.
262
Font Flags Bit 0 of this BYTE is set to indicate extended mode. Extended mode fonts require a higher quality of font rendering (such as chess pieces). If Bit 0 is clear, the font is in Compact mode (the default). Bits 1-7 are currently reserved.
263
Classification Flags A BYTE value whose bits indicate the font classification as follows: Bit Meaning

0 Italic

1 Monospace

2 Serif

3 Display

4-7 Reserved
264
Family Classification A BYTE indicating the family classification of the font as follows: Value Meaning

0 Don't Care

1 Serif

2 Sans Serif

3 Monospace

4 Script

5 Decorative
265
Font Form Classification A BYTE classifying the width and weight of characters in the font as follows: Bits 0-3 Meaning

0-3 (Reserved)

4 Condensed

5 (Reserved for 3⁄4 condensed)

6 Semi-Condensed

7 (Reserved for 1⁄4 condensed)

8 Normal

9 (Reserved for 3⁄4 expanded)

10 Semi-Expanded

11 (Reserved for 1⁄4 expanded)

12 Expanded

13-15 (Reserved)

Bits 4-7 Meaning

0 (Reserved)

1 Thin

2 Ultralight

3 Extralight

4 Light

5 Book

6 Normal

7 Medium

8 Semibold

9 Demibold

10 Bold

11 Extrabold

12 Ultrabold

13 Heavy

14 Black

15 (Reserved)

266 Short Font Name A 32-byte character string containing the abbreviation of the name of the Postscript compatible font.

298 Short Face Name A 16-byte character string containing the abbreviation of the typeface family name.

314 Font Form A 14-byte character string containing the font form classification (as above).

328 Italic Angle A WORD indicating the number of 1/256 degrees that characters are slanted clockwise.

330 ORUs per Em A WORD indicating the number of Outline Resolution Units (ORUs) per Em.

332 Width of Word Space A WORD value which expresses the width of a 'word space' (i.e. ASCII 32) in ORUs.

334 Width of Em Space A WORD value which expresses the width of Em space in ORUs (this is not always the same as the number of ORUs in the letter 'M').

336 Width of En Space A WORD value which expresses the width of En space in ORUs. This is always half the width of Em space (not the width of the letter 'N').

338 Width of Thin Space A WORD value which expresses the width of 'thin space' in ORUs. This is the width applied between two words and is normally the same as 'word space'.

340
Width of Figure Space A WORD value which expresses the width of 'figure space' in ORUs. This is the width of tabular characters in the font.
342
XMIN (Min X coordinate in font) A WORD indicating the minimum X coordinate used in the font.
344
YMIN (Min Y coordinate in font) A WORD indicating the minimum Y coordinate used in the font.
346
XMAX (Max X coordinate in font) A WORD indicating the maximum X coordinate used in the font.
348
YMAX (Max Y coordinate in font) A WORD indicating the maximum Y coordinate used in the font.
350
Underline Position A WORD value indicating the distance the center of an underline should be applied from the baseline of the font.
352
Underline Thickness A WORD value indicating the thickness an underline applied to this font should be (in ORUs).
354
Small Caps A 6-byte Transformation Parameter used for small capitals (eg: abcdefg).
360
Display Superiors A 6-byte Transformation Parameter used for display superiors (eg: $350).
366
Footnote Superiors A 6-byte Transformation Parameter used for footnote superiors (eg: see footnote1).
372
Alpha Superiors A 6-byte Transformation Parameter used for alpha superiors (eg: Sra).
378
Chemical Inferiors A 6-byte Transformation Parameter used for chemical inferiors (eg: H20).
384
Small Numerators A 6-byte Transformation Parameter used for small numerators (eg:).
390
Small Denominators A 6-byte Transformation Parameter used for small denominators (see above).
396
Medium Numerators A 6-byte Transformation Parameter used for medium numerators (eg:).
402
Medium Denominators A 6-byte Transformation Parameter used for medium denominators (see above).
408
Large Numerators A 6-byte Transformation Parameter used for large numerators (eg:).
414
Large Denominators A 6-byte Transformation Parameter used for large denominators (see above).

The Bitstream International Character Set

The **vst_charmap()** and **vqt_get_table()** functions provide access to the entire Speedo character set by specifying characters as **WORD** size Bitstream index values rather than **BYTE** size ASCII values. The following table lists the available Bitstream Speedo index and ID numbers.

All current Atari calls refer to Bitstream indexes rather than character ID. There is an important difference between these two. Characters never change ID numbers between fonts, however they may change index positions. When specifying character indexes with Atari calls it is important to note which character set the font was created with to provide accurate mapping. The following table lists indexes for the most common set, the Bitstream International Character Set represented in the typeface 'Swiss 721'.

IDX	ID	Char
0	32	
1	33	!
2	34	"
3	35	#
4	36	$

IDX	ID	Char
5	37	%
6	38	&
7	39	'
8	40	(
9	41	)

IDX	ID	Char
10	42	*
11	43	+
12	44	,
13	45	-
14	46	.

G.8 – Speedo Character Map

IDX	ID	Char
15	47	/
16	48	0
17	49	1
18	50	2
19	51	3
20	52	4
21	53	5
22	54	6

IDX	ID	Char
23	55	7
24	56	8
25	57	9
26	58	:
27	59	;
28	60	<
29	61	=
30	62	>

IDX	ID	Char
31	63	?
32	64	@
33	65	A
34	66	B
35	67	C
36	68	D
37	69	E
38	70	F

IDX	ID	Char
39	71	G
40	72	H
41	73	I
42	74	J
43	75	K
44	76	L
45	77	M
46	78	N

IDX	ID	Char
47	79	O
48	80	P
49	81	Q
50	82	R
51	83	S
52	84	T
53	85	U
54	86	V

IDX	ID	Char
55	87	W
56	88	X
57	89	Y
58	90	Z
59	91	[
60	92	\
61	93	]
62	94	^

G.10 – Speedo Character Map

IDX	ID	Char
63	95	_
64	96	`
65	97	a
66	98	b
67	99	c
68	100	d
69	101	e
70	102	f

IDX	ID	Char
71	103	g
72	104	h
73	105	i
74	106	j
75	107	k
76	108	l
77	109	m
78	110	n

IDX	ID	Char
79	111	o
80	112	p
81	113	q
82	114	r
83	115	s
84	116	t
85	117	u
86	118	v

IDX	ID	Char
87	119	w
88	120	x
89	121	y
90	122	z
91	123	{
92	124	|
93	125	}
94	126	~

IDX	ID	Char
95	129	fi
96	130	fl
97	131	£
98	132	¢
99	133	ƒ
100	134	‰
101	135	´
102	136	•

IDX	ID	Char
103	137	‘
104	138	“
105	139	”
106	140	’
107	141	„
108	142	†
109	143	‡
110	144	§

G.12 – Speedo Character Map

IDX	ID	Char
111	145	—
112	146	—
113	147	Å
114	148	Æ
115	149	Ø
116	150	Œ
117	151	å
118	152	æ

IDX	ID	Char
119	153	ø
120	154	œ
121	155	ß
122	156	ı
123	157	‹
124	158	›
125	159	«
126	160	»

IDX	ID	Char
127	161	¿
128	162	¡
129	163	´
130	164	´
131	165	`
132	167	`
133	168	^
134	169	^

IDX	ID	Char
135	170	¨
136	171	¨
137	172	~
138	173	~
139	174	ˇ
140	175	ˇ
141	176	¸
142	177	–

IDX	ID	Char
143	178	—
144	179	˘
145	180	˘
146	181	°
147	182	°
148	183	Ç
149	184	Ç
150	185	⅛

IDX	ID	Char
151	186	¼
152	187	⅜
153	188	½
154	189	⅝
155	190	¾
156	191	⅞
157	192	⅓
158	193	⅔

G.14 – Speedo Character Map

IDX	ID	Char
159	194	1
160	195	2
161	196	3
162	197	4
163	198	5
164	199	6
165	200	7
166	201	8

IDX	ID	Char
167	202	9
168	203	0
169	225	Đ
170	226	Ł
171	227	Ą
172	228	Ę
173	229	đ
174	230	ł

IDX	ID	Char
175	231	L’
176	233	J
177	234	ą
178	235	ę
179	236	L·L
180	237	l·l
181	238	·
182	239	·

IDX	ID	Char
183	240	″
184	241	″
185	242	’
186	243	–
187	244	▪
188	245	’
189	246	‚
190	247	‘

IDX	ID	Char
191	248	-
192	249	–
193	320	ń
194	321	Ń
195	322	ñ
196	323	Ñ
197	324	ň
198	325	Ň

IDX	ID	Char
199	326	ó
200	327	Ó
201	328	ò
202	329	Ò
203	330	ô
204	331	Ô
205	332	ö
206	333	Ö

G.16 – Speedo Character Map

IDX	ID	Char
207	334	õ
208	335	Õ
209	336	ú
210	337	Ú
211	338	ù
212	339	Ù
213	340	û
214	341	Û

IDX	ID	Char
215	342	ü
216	343	Ü
217	344	ũ
218	345	Ũ
219	346	ů
220	347	Ů
221	348	ÿ
222	349	Ÿ

IDX	ID	Char
223	350	ý
224	351	Ý
225	353	¼
226	354	½
227	355	¾
228	362	)
229	363	(
230	366	—

IDX	ID	Char
231	367	´
232	368	Ì’
233	369	Ì˜
234	370	Ì˜
235	371	Ì¨
236	372	Ì¨
237	373	Ì^
238	374	Ì^

IDX	ID	Char
239	375	Ì€
240	376	Ì€
241	377	Ì
242	378	Ì
243	379	Ě
244	380	ě
245	383	Ë
246	384	ë

IDX	ID	Char
247	385	Ê
248	386	ê
249	387	È
250	388	è
251	389	É
252	390	é
253	391	Ã
254	392	ã

G.18 – Speedo Character Map

IDX	ID	Char
255	393	Ä
256	394	ä
257	395	Â
258	396	â
259	397	À
260	398	à
261	399	Á
262	400	á

IDX	ID	Char
263	404	’n
264	410	ı
265	411	!!
266	414	Pt
267	418	—
268	421	ų
269	422	’
270	423	…

IDX	ID	Char
271	424	Þ
272	425	þ
273	426	ð
274	427	¥
275	433	ij
276	434	lJ
277	435	¦
278	436	¤

IDX	ID	Char
279	442	¶
280	446	ffl
281	447	ffi
282	448	ff
283	449	—
284	450	×
285	451	÷
286	452	±

IDX	ID	Char
287	453	≡
288	454	≠
289	455	≈
290	456	≥
291	457	≤
292	458	↓
293	459	←
294	460	→

IDX	ID	Char
295	461	↑
296	462	↕
297	463	↔
298	464	∈
299	465	∩
300	470	∫
301	471	∫
302	476	√

G.20 – Speedo Character Map

IDX	ID	Char
303	478	∞
304	479	
305	480	
306	481	
307	482	
308	484	
309	486	⌐
310	487	¬

IDX	ID	Char
311	488	—
312	489	+
313	500	Γ
314	501	Δ
315	505	Θ
316	515	Σ
317	518	Φ
318	521	Ω

IDX	ID	Char
319	522	α
320	523	β
321	526	δ
322	527	ϵ
323	529	η
324	530	θ
325	534	μ
326	538	π

IDX	ID	Char
327	540	σ
328	542	τ
329	544	ϕ
330	562	♪
331	563	♫
332	564	©
333	565	®
334	566	™

IDX	ID	Char
335	567	■
336	568	□
337	570	′
338	571	″
339	572	°
340	573	↕
341	575	•
342	576	●

IDX	ID	Char
343	577	●
344	579	◘
345	581	▶
346	582	◀
347	583	▼
348	584	▲
349	585	♂
350	586	♀

G.22 – Speedo Character Map

IDX	ID	Char
351	587	♥
352	588	♣
353	589	♦
354	590	♠
355	591	▬
356	592	▮
357	593	⠿
358	594	▩

IDX	ID	Char
359	595	▦
360	598	☼
361	599	☺
362	600	☻
363	605	ť
364	606	T’
365	607	ŷ
366	608	Ŷ

IDX	ID	Char
367	609	ź
368	610	Ź
369	611	ž
370	612	Ž
371	613	ż
372	614	Ż
373	619	ă
374	620	Ă

IDX	ID	Char
375	621	ć
376	622	Ć
377	623	č
378	624	Č
379	625	ď
380	628	đ
381	629	Đ
382	630	ē

IDX	ID	Char
383	631	Ē
384	634	ģ
385	637	Ģ
386	638	ī
387	639	Ī
388	640	i
389	641	İ
390	642	į

IDX	ID	Char
391	643	Į
392	644	ķ
393	645	Ķ
394	646	Í
395	647	Ĺ
396	648	Ī
397	649	Ļ
398	650	ļ

G.24 – Speedo Character Map

IDX	ID	Char
399	651	Ļ
400	653	Ñ
401	654	ņ
402	655	Ņ
403	656	ő
404	657	Ő
405	660	ř
406	661	Ř

IDX	ID	Char
407	662	ŗ
408	663	Ŗ
409	664	ś
410	665	Ś
411	666	š
412	667	Š
413	669	Ş
414	670	ş

IDX	ID	Char
415	671	Ş
416	674	ŧ
417	675	Ŧ
418	676	ţ
419	677	Ţ
420	678	ū
421	679	Ū
422	680	ű

IDX	ID	Char
423	681	Ű
424	682	Ŵ
425	683	Ŵ
426	684	ǔ
427	685	Ǔ
428	693	∮
429	695	∝
430	797	¬

IDX	ID	Char
431	1223	/
432	1364	´
433	1365	´
434	1368	`
435	1369	`
436	1372	^
437	1373	^
438	1376	¨

IDX	ID	Char
439	1377	¨
440	1380	~
441	1381	~
442	1384	ˇ
443	1385	ˇ
444	1388	˚
445	1392	¯
446	1393	¯

G.26 – Speedo Character Map

IDX	ID	Char
447	1396	◡
448	1397	◡
449	1400	°
450	1401	°
451	1661	L•
452	1667	|•
453	1743	▪
454	1744	▪

IDX	ID	Char
455	1747	″
456	1748	″
457	1751	’
458	1752	’
459	1753	’
460	1756	–
461	1761	▪
462	1766	’

IDX	ID	Char
463	1771	‘
464	1776	‘
465	1996	—
466	2022	1
467	2028	2
468	2034	3
469	2040	4
470	2046	5

IDX	ID	Char
471	2052	6
472	2058	7
473	2064	8
474	2070	9
475	2076	0
476	2647	ā
477	2653	Ā
478	2776	D’

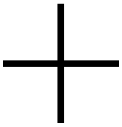
IDX	ID	Char
479	2984	ğ
480	2990	Ğ
481	3396	n̄
482	3580	ŕ
483	3586	Ŕ
484	3704	s̄
485	3738	ş
486	3744	Ş

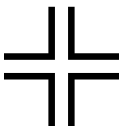
IDX	ID	Char
487	4472	=
488	4488	’
489	4489	’
490	4490	’
491	4524	Fr
492	4736	∓
493	4744	~
494	4903	L

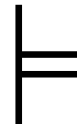
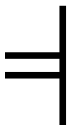
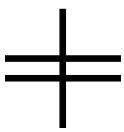
G.28 – Speedo Character Map

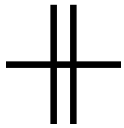
IDX	ID	Char
495	5042	
496	5085	
497	5147	
498	5196	
499	5243	
500	5244	
501	5249	
502	5262	

IDX	ID	Char
503	5371	
504	5372	
505	5403	
506	5408	
507	5410	
508	5418	
509	5421	
510	5422	

IDX	ID	Char
511	5423	
512	5424	
513	5427	
514	5428	
515	5429	
516	5430	
517	5431	
518	5432	

IDX	ID	Char
519	5434	
520	5435	
521	5436	
522	5437	
523	5438	
524	5441	
525	5442	
526	5443	

IDX	ID	Char
527	5444	
528	5445	
529	5446	
530	5461	
531	5462	
532	5463	
533	5464	
534	5465	

IDX	ID	Char
535	5466	
536	5467	
537	5468	
538	5510	a
539	5514	e
540	5518	i
541	5521	l
542	5522	m

G.30 – Speedo Character Map

IDX	ID	Char
543	5523	n
544	5524	o
545	5527	r
546	5528	s
547	5529	t
548	5536	⊥
549	5537	⊤
550	5538	⊤

IDX	ID	Char
551	5539	⊣
552	5540	⊥
553	5541	⊣
554	5542	⊥
555	5543	⊨
556	5544	⊤
557	5545	⊧
558	5548	\

IDX	ID	Char
559	5554	
560	5594	
561	5595	
562	5596	
563	6458	

– APPENDIX H –

THE DRAG & DROP PROTOCOL

Overview

The drag and drop protocol provides a simple method of data transmission between applications that support it. Because this protocol relies on the use of named pipes, the use of the drag and drop protocol is only possible under **MultiTOS**.

A drag and drop operation involves the user selecting a piece of program data (or perhaps several pieces) in the 'originator' application and dragging that piece of data with the mouse to the window of a 'recipient' application. This appendix will detail the drag and drop protocol from the perspective of the originator and the recipient.

You should note that during a drag and drop operation, neither application should lock the screen with **wind_update()**.

The Originator

When the user selects an object or group of objects, drags the mouse (and objects), and releases the mouse button outside one of your application window's work areas, the operation is a candidate for a drag and drop operation.

When this action is initiated by the user, your application should call **wind_find()** to determine the window handle of the window at the drop location. From the window handle you can use **wind_get()** to determine the owner's application identifier which will be needed to send an **AES** message to the application.

At this point you should use **Psignal()** to cause **SIGPIPE** (13) signals to be ignored and create a pipe named DRAGDROP.xx where 'xx' is a unique two character combination. The pipe created should have its 'hidden' attribute set. This causes reads to return **EOF** when the other end of the pipe is closed. To ensure your value is unique, try using the ASCII representation of your own application ID. If the **Fcreate()** fails, try a new combination until you find one that is available.

Now use **appl_write()** to send an **AES** message to the application whose window was targeted (the recipient) as follows:

WORD	Contents
0	**AP_DRAGDROP** (63)
1	Originator's application id.
2	0
3	Window handle of the target.
4	Mouse X position at time of drop.
5	Mouse Y position at time of drop.
6	Keyboard shift status at time of drop.
7	2 character pipe ID packed into a **WORD** (this is the file extension of the created pipe).

The originator application should now use **Fselect()** to wait for either a write to the pipe or a timeout (3 to 4 seconds should be sufficient). If the call times out then the drag and drop operation failed and the pipe should be closed, otherwise, read one byte from the pipe which should be either **DD_OK** (0) or **DD_NAK** (1).

DD_OK means that the recipient wishes to continue the exchange. **DD_NAK** means that the user dropped the data on a window not prepared to accept data and that the pipe should be closed and the drag and drop operation aborted.

On receipt of a **DD_OK**, the originator should then read an additional 32 **BYTE**s from the pipe. These 32 **BYTE**s consist of eight 4 **BYTE** data type values that the recipient understands in order of preference. This list is not necessarily complete and the originator should not abort simply because it can't handle any of the listed data types. If less than eight data types are listed by the recipient the 32 bytes will be padded with zeros.

Data type values are four-byte ASCII values that represent data that might be exchanged. When these values are prefixed with a period, they represent data in a format that might be stored in a disk file. Examples of these are '.IMG', '.TXT', and '.GEM'. Some data types such as 'ARGS' or 'PATH' are not prefixed with a period because they represent special data.

The desktop sends an 'ARGS' drag and drop message to an application window when the user drags a group of file icons to an application window. The 'ARGS' data consists of a standard command line with the names of each file. 'ARGS' data should be translated for non-**TOS** file systems. Characters within single quotes should be interpreted as a single filename. Two single quotes in a row should be interpreted as a single quote.

After the originator has consulted the 32 byte list or preferred file types, it should construct its own structure consisting of the following data:

1. The type of data the originator has decided to send (4 ASCII bytes), ex: '.IMG'.
2. The length of data in bytes (**LONG**).
3. The data's name in ASCII format terminated by a **NULL** (this is a variable length field but should be brief as it will be used to label an icon which represents the data chunk), ex: "ASCII Text".
4. The filename the data is associated with in ASCII format terminated by a **NULL** (again, a variable length field), ex: "SAMPLE.TXT".

The originator should now write a **WORD** to the pipe signifying the length of the header and then the header itself. After doing so, the recipient will write a one byte reply indicating a return code from the following list:

Name	Value	Meaning
DD_OK	0	Ready to receive data. After receiving this message you should **Fwrite()** the actual data to the pipe and then **Fclose()** it to complete the operation.
DD_NAK	1	Abort the drag and drop. After receiving this message, close the pipe and abort the operation.
DD_EXT	2	The recipient cannot accept the format the data is in. You may either construct a new header and send it as before or close the pipe to abort the operation.
DD_LEN	3	The recipient cannot handle so much data. Either use a format which would cause less data to be sent or close the pipe to abort.
DD_TRASH	4	The data has been dropped on a trashcan. The pipe should be **Fclose()**'d and the data should be deleted from the originator application.
DD_PRINTER	5	The data has been dropped on a printer. The pipe should be **Fclose()**'d and the data should be printed.
DD_CLIPBOARD	6	The data has been dropped on a clipboard. The pipe should be **Fclose()**'d and the exchange should be treated like a 'Copy' clipboard operation.

The one exception to the above procedure involves the 'PATH' data type. If the recipient agrees to the 'PATH' data type by sending a **DD_OK**, the originator should *read* a path string (terminated by a **NULL** byte). The path string should be the complete pathname represented by the target window, ex: "C:\WORDPRO\FILES\". The size of the data, as specified in the header, specifies the maximum size of the string the recipient should write.

The Recipient

The drag and drop protocol begins for the recipient upon receipt of the **AP_DRAGDROP** message. When this message is received, the recipient should immediately open the pipe 'U:\PIPE\DRAGDROP.xx', where 'xx' is the two-byte ASCII identifier given in **WORD** 7 of the message, and write a **DD_OK** (0) to the pipe.

Next, as the recipient, you should construct a 32 byte structure consisting of eight 4 byte data names your application can receive. If your application recognizes less than eight types of data pad the 32 bytes with zeros. After this structure is constructed, write it to the pipe.

Now you should read a **WORD** from the pipe which will indicate the size of the message header which should be read immediately after. The message header consists of a four byte ASCII data type, a **LONG** indicating the size of the data, a **NULL** terminated string of variable size which identifies the data (or simply **NULL** if none), and a **NULL** terminated filename (or **NULL** if none).

After decoding the message header you should respond with one of the one-byte response codes as listed in the previous table. If the recipient cannot process the data type sent, it should send **DD_EXT** and wait for reception of another header (preceded again by a **WORD** headed size). If

the originator cannot supply any more data types you will receive a 0 byte return from the **Fread()** call and you should **Fclose()** the pipe and abort.

If the data type is acceptable, respond with **DD_OK**, read the number of data bytes as indicated in the header to receive the actual data, and then close the pipe.

A special case arises if the header specifies 'PATH' as a data type. In this case you should send a **DD_OK** message (if appropriate) and write the pathname associated with the target window (you can write as many bytes as is specified in the message header data length).

– APPENDIX I –

THE PROGRAMMABLE SOUND GENERATOR

Controlling the PSG

Creating sound effects and music is possible with either of two system calls. **Dosound()** processes commands in a supplied buffer during interrupt processing (50 times per second). It is best suited, therefore, at playing musical passages while program flow continues. **Giaccess()** provides register-level control over the PSG resulting in a higher level of flexibility and constant updating by the application. This makes **Giaccess()** more suited for short sound effects.

The function definitions of **Dosound()** and **Giaccess()** both reference the register numbers of the PSG. It should be noted that registers 14 and 15 actually control periperals connected to Port A and Port B of the PSG. The PSG's registers are assigned as follows:

Name	*register*	Meaning
PSG_APITCHLOW **PSG_BPITCHHIGH**	0 1	Set the pitch of the PSG's channel A to the value in registers 0 and 1. Register 0 contains the lower 8 bits of the frequency and the lower 4 bits of register 1 contain the upper 4 bits of the frequency's 12-bit value.
PSG_BPITCHLOW **PSG_BPITCHHIGH**	2 3	Set the pitch of the PSG's channel B to the value in registers 0 and 1. Register 0 contains the lower 8 bits of the frequency and the lower 4 bits of register 1 contain the upper 4 bits of the frequency's 12-bit value.
PSG_CPITCHLOW **PSG_CPITCHHIGH**	2 3	Set the pitch of the PSG's channel C to the value in registers 0 and 1. Register 0 contains the lower 8 bits of the frequency and the lower 4 bits of register 1 contain the upper 4 bits of the frequency's 12-bit value.
PSG_NOISEPITCH	6	The lower five bits of this register set the pitch of white noise. The lower the value, the higher the pitch.
PSG_MODE	7	This register contains an eight bit map which determines various aspects of sound generation. Setting each bit on causes the following actions: **Name** — **Bit Mask** — **Meaning** **PSG_ENABLEA** 0x01 Chnl A tone enable **PSG_ENABLEB** 0x02 Chnl B tone enable **PSG_ENABLEC** 0x04 Chnl C tone enable **PSG_NOISEA** 0x08 Chnl A white noise on **PSG_NOISEB** 0x10 Chnl B white noise on **PSG_NOISEC** 0x20 Chnl C white noise on **PSG_PRTAOUT** 0x40 Port A: 0 = input, 1 = output **PSG_PRTBOUT** 0x80 Port B: 0 - input, 1 = output
PSG_AVOLUME	8	This register controls the volume of channel A. Values from 0-15 are absolute volumes with 0 being the softest and 15 being the loudest. Setting bit 4 causes the PSG to ignore the volume setting and to use the envelope setting in register 13.
PSG_BVOLUME	9	This register controls the volume of channel B. Values from 0-15 are absolute volumes with 0 being the softest and 15 being the loudest. Setting bit 4 causes the PSG to ignore the volume setting and to use the envelope setting in register 13.

PSG_CVOLUME	10	This register controls the volume of channel C. Values from 0-15 are absolute volumes with 0 being the softest and 15 being the loudest. Setting bit 4 causes the PSG to ignore the volume setting and to use the envelope setting in register 13.
PSG_FREQLOW **PSG_FREQHIGH**	11 12	Register 11 contains the low byte and register 12 contains the high byte of the frequency of the waveform specified in register 13. This value may range from 0 to 65535.
PSG_ENVELOPE	13	The lower four bits of the register contain a value which defines the envelope wavefrom of the PSG. The best definition of values is obtained through experimentation.
PSG_PORTA	14	This register accesses Port A of the Yamaha PSG. It is recommended that the functions **Ongibit()** and **Offgibit()** be used to access this register.
PSG_PORTB	15	This register accesses Port B of the Yamaha PSG. This register is currently assigned to the data in/out line of the Centronics Parallel port.

The following table lists the twelve-bit value required to produce the desired musical tones with the PSG's tone generators A, B, and C. The upper nibble of the value is placed into the 'coarse-tuning' register and the lower **BYTE** is placed into the 'fine-tuning' register. In addition, because the PSG must approximate musical frequencies according to an equal-tempered scale, the ideal and actual frequencies are also listed.

Note	Ideal Frequency	Actual Frequency	Value
C1	32.703	32.698	0xD5D
C#1	34.648	34.653	0xC9C
D1	36.708	36.712	0xBE7
D#1	38.891	38.895	0xB3C
E1	41.203	41.201	0xA9B
F1	43.654	43.662	0xA02
F#1	46.249	46.243	0x973
G1	48.999	48.997	0x8EB
G#1	51.913	51.908	0x86B
A1	55.000	54.995	0x7F2
A#1	58.270	58.261	0x780
B1	61.735	61.733	0x714
C2	65.406	65.416	0x6AE
C#2	69.296	69.307	0x64E
D2	73.416	73.399	0x5F4
D#2	77.782	77.789	0x59E
E2	82.406	82.432	0x54D
F2	87.308	87.323	0x501
F#2	92.498	92.523	0x4B9
G2	97.998	98.037	0x475
G#2	103.826	103.863	0x435
A2	110.000	109.991	0x3F9
A#2	116.540	116.522	0x3C0
B2	123.470	123.467	0x38A
C3	130.812	130.831	0x357

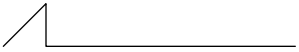
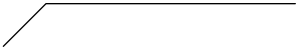
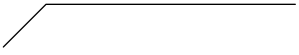
Note	Ideal Frequency	Actual Frequency	Value
C#3	138.592	138.613	0x327
D3	146.832	146.799	0x2FA
D#3	155.564	155.578	0x2CF
E3	164.812	164.743	0x2A7
F3	174.616	174.510	0x281
F#3	184.996	184.894	0x25D
G3	195.996	195.903	0x23B
G#3	207.652	207.534	0x21B
A3	220.000	220.198	0x1FC
A#3	233.080	233.043	0x1E0
B3	246.940	246.933	0x1C5
C4	261.624	261.357	0x1AC
C#4	277.184	276.883	0x194
D4	293.664	293.598	0x17D
D#4	311.128	310.724	0x168
E4	329.624	329.973	0x153
F4	349.232	349.565	0x140
F#4	369.992	370.400	0x12E
G4	391.992	392.494	0x11D
G#4	415.304	415.839	0x10D
A4	440.000	440.397	0xFE
A#4	466.160	466.087	0xF0
B4	493.880	494.959	0xE2
C5	523.248	522.714	0xD6
C#5	554.368	553.766	0xCA

Note	Ideal Frequency	Actual Frequency	Value
D5	587.328	588.741	0xBE
D#5	622.256	621.449	0xB4
E5	659.248	658.005	0xAA
F5	698.464	699.130	0xA0
F#5	739.984	740.800	0x97
G5	783.984	782.243	0x8F
G#5	830.608	828.598	0x87
A5	880.000	880.794	0x7F
A#5	932.320	932.173	0x78
B5	987.760	989.918	0x71
C6	1046.496	1045.428	0x6B
C#6	1108.736	1107.532	0x65
D6	1174.656	1177.482	0x5F
D#6	1244.512	1242.898	0x5A
E6	1318.496	1316.009	0x55
F6	1396.928	1398.260	0x50
F#6	1479.968	1471.852	0x4C
G6	1567.968	1575.504	0x47
G#6	1661.216	1669.564	0x43
A6	1760.000	1747.825	0x40
A#6	1864.640	1864.346	0x3C
B6	1975.520	1962.470	0x39
C7	2092.992	2110.581	0x35
C#7	2217.472	2237.216	0x32

Note	Ideal Frequency	Actual Frequency	Value
D7	2349.312	2330.433	0x30
D#7	2489.024	2485.795	0x2D
E7	2636.992	2663.352	0x2A
F7	2793.856	2796.520	0x28
F#7	2959.936	2943.705	0x26
G7	3135.936	3107.244	0x24
G#7	3322.432	3290.023	0x22
A7	3520.000	3495.649	0x20
A#7	3729.280	3728.693	0x1E
B7	3951.040	3995.028	0x1C
C8	4185.984	4142.992	0x1B
C#8	4434.944	4474.431	0x19
D8	4698.624	4660.866	0x18
D#8	4978.048	5084.581	0x16
E8	5273.984	5326.704	0x15
F8	5587.712	5593.039	0x14
F#8	5919.872	5887.410	0x13
G8	6271.872	6214.488	0x12
G#8	6644.864	6580.046	0x11
A8	7040.000	6991.299	0x10
A#8	7458.560	7457.560	0xF
B8	7902.080	7990.056	0xE

Sound Envelopes

An envelope may be applied to sounds generated by the PSG. Registers 11 and 12 specifiy the frequency of this envelope and the low four bits of register 13 specifies the envelope shape as follows (an ‘x’ digit means either 0 or 1):

Value	Waveform Shape
%00xx	
%01xx	
%1000	
%1001	
%1010	
%1011	
%1100	
%1101	
%1110	
%1111	

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INDEX

A

B

C

D

E

F

G

N

O

T

U

V

W

X