A SOLECTRON SUBSIDIARY

SYS68K/IBC-20 Rev.2
Firmware User's Manual

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Please refer to the *FGA-002 User’s Manual*, chapter 10, which includes a guide to the latest revision of the boot software.

VMEPROM SYSTEM OVERVIEW

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1. General Overview

1.1 VMEPROM Modules

VMEPROM is a PDOS based real time Monitor. It consists of two basic parts:

1) PDOS Kernel with BIOS modules
2) User Interface

The first part, the PDOS Kernel with the BIOS modules, consumes around 32 Kbytes. This part is responsible for all the system calls and the hardware interface.

The second part is much bigger and contains the complete user interface, the built-in functions and debugging facilities. The size of this part is about 256 Kbytes.

The remaining space in the EPROM is reserved for future expansions.

The kernel features over 100 system calls and is 100% identical to PDOS.

The user interface gives the user both a debugging tool and an interface to the system functions. It includes breakpoint setting, tracing, a powerful line assembler/disassembler, task management, and event control.

1.2 Features of VMEPROM

1.2.1 Debugging Functions

- Line assembler/disassembler with full support of all 68020/68881 instructions.
- Over 20 commands for program debugging, including breakpoints, tracing, processor register display and modify.
- Display and modify floating point data registers.
- S-record up/downloading from any port in the system.
- Time stamping of user programs.
- Built-in Benchmarks
- Support of RAM disk, floppy and Winchester disks, including disk formatting and initialization.

Debugging Functions Continued

- Serial I/O support for up to two SYS68K/SIO-1/2 or SYS68K ISIO-1/2 boards in the system.
- Support for EAGLE modules and base boards equipped with an Application Command Interface (ACI).
- EPROM programming utility using the SYS68K/RR-2/3 board.
- Full screen editor.
- Numerous commands to control the PDOS kernel and file manager.

1.2.2 System Functions

- EPROM programming utility, using the SYS68K/RR-2/RR-3 boards.
- FLASH EPROM programming utility
- Complete task management.
- I/O redirection on the command line.

1.2.3 System Calls

- Over 100 system calls.
- Data conversion and file management functions.
- Task management system calls.
- Terminal I/O functions.

1.2.4 Application Command Interface

Depending on the state of the front panel rotary switch, two additional tasks are started together with VMEPROM. The Application Command Interface software is started as a second task and a third task - the DMA task - is started by the ACI.

Please refer to the "*ACI Programming Guide*" in this manual for further details about the Application Command Interface (ACI).

2. Starting VMEPROM

2.1 Power Up Sequence

The first executed software after powerup is the IBC Boot Software. Immediately after this, the VMEPROM will be started. Control is given to the BIOS modules of VMEPROM to perform all the necessary hardware initialization of the IBC. The real time kernel is started and the user interface of VMEPROM is invoked as the first task. This sequence also reads the Real Time Clock (RTC) of the IBC board and initializes the software clock of the kernel.

If a terminal is connected to the terminal port of the IBC board, the VMEPROM banner and the VMEPROM prompt ("? ") will be displayed upon powerup or reset. Otherwise the VMEPROM installs a RAM port to be used as an alternate I/O port of the VMEPROM.

The default terminal port setup is as follows:

Asynchronous communication
9600 Baud
8 data bits
1 stop bit
no parity
Hardware handshake protocol

If the above message does not appear, check the following:

1. Baud rate and character format setting of the terminal (default upon delivery of the IBC board is 9600 Baud, 8 data bits, 1 stop bit, no parity).

2. Cable connection from the IBC board to the terminal (refer to the Hardware User’s Manual for the pinning of the DSub connector and the required handshake signals).

3. Power supply, +5V, +12V, -12V must be present. See the Hardware User’s Manual for the power consumption of the IBC board.

If everything goes well, the header and prompt are displayed on the terminal and VMEPROM is now ready to accept commands.

The Application Command Interface provides a unique interface to access the physical devices on available EAGLE modules.

2.2 Front Panel Switches

2.2.1 RESET Switch

Pressing the RESET switch on the front panel causes all programs to terminate immediately and resets the 68020 processor and all I/O devices.

When the VMEPROM kernel is started, it overwrites the first word in the user memory after the task control block with an EXIT system call. If breakpoints were defined and a user program was running when the RESET button was pressed, the user program could possibly be destroyed.

Pressing reset while a program is running should only be done as a last resort when all other actions (such as pressing ^C twice or the ABORT Switch) have failed.

2.2.2 ABORT Switch

The ABORT Switch is defined by VMEPROM to cause a level 7 interrupt. This interrupt cannot be disabled and is therefore the appropriate way to terminate a user program and return to the command level of VMEPROM.

If ABORT is pressed while a user program is under execution, all user registers are saved at the current location of the program counter and the message "Aborted Task" is displayed along with the contents of the processor register.

If ABORT is pressed while a built-in command is executed or the command interpreter is waiting for input, only the message is displayed and control is transferred to the command interpreter. The processor register are not modified and are not displayed in this case.

NOTE: Tasks with port 0 as its input port will not be aborted.

2.3 The Rotary Switches

Two rotary switches are available on the IBC-20 base board: The rotary switch accessible on the front panel is called the "Upper Rotary" switch; whereas the second rotary switch on the base board is called the "Lower Rotary" switch. The state of these two rotary switches are read by VMEPROM after RESET and control the options described below:

2.3.1 Lower Rotary Switch

Table 1: Lower Rotary Switch

Bit	Description
0	Reserved
1	Controls whether a startup file is executed (typically SY$STRT)
2,3	Selects one of four addresses where to continue execution after the kernel has been initialized.

2.3.2 Executing the Startup File

The second bit (bit 1) of the lower rotary switch controls whether a given startup file has to be executed by the VMEPROM shell. The name of this startup file is included in the configuration table at offset 0_{16} and is called "SY$STRT".

If the second bit is set (bit 1), then no startup file is executed by the VMEPROM shell; otherwise, when the bit is cleared (0), the VMEPROM shell executes the startup file specified by the appropriate entry in the configuration table.

2.3.3 Program Start

Bits 2 and 3 are used to control where the firmware continues execution after the VMEPROM kernel is initialized. Depending on the state of bits 2 and 3, the firmware fetches one of four addresses from a table within the configuration table. This table contains the addresses where the firmware continues execution after the kernel is initialized. The table below lists the relationship between the state of the two bits of the lower rotary switch and the address being fetched.

Table 2: Program Execution

Lower Rotary Switch		Description
Bit 3	**Bit 2**	
0	0	Fetch the address at offset 40_{16} in the configuration table (continue execution at location 40800000_{16})
0	1	Fetch the address at offset 44_{16} in the configuration table (fetch stack pointer and program counter)
1	0	Fetch the address at offset 48_{16} in the configuration table (continue execution at location $FFC80000_{16}$)
1	1	Fetch the address at offset $4C_{16}$ in the configuration table (continue to execute VMEPROM)

As shown in the table above, the firmware continues execution in all four cases at predefined locations. In the first, third and fourth cases, the firmware continues execution at the appropriate addresses via *Jump-Subroutine* instruction (JSR); when the application returns to the firmware by a *Return-From-Subroutine* instruction (RTS), the firmware continues to start the VMEPROM shell.

In the second case, the firmware fetches the stack pointer and the program counter, located at offset 0_{16} and 4_{16} of the binary image addressed by the entry, and continues execution at the location specified by the program counter (the firmware uses a *Jump* instruction (JMP) to continue execution).

In general, it is wise to keep at least the fourth entry of the table located at offset 40_{16} within the configuration table; however, the first three entries of the table at offset 40_{16} are to be modified accordingly.

2.3.4 Upper Rotary Switch

Table 3: Upper Rotary Switch

Bit	Description
0,1	Memory Configuration
2	Terminal/RAM port
3	Start Application Command Interface (ACI)

2.4 Memory Configuration

These two bits are used to describe how the on-board memory has to be shared between the VMEPROM and the task supporting the Application Command Interface. In the table below all possible memory configurations are stated:

Table 4: Memory Configurations

Bit 1	Bit 0	Memory Configuration
0	0	Three fourths of the *on-board* memory is available to VMEPROM. The remaining memory is available to ACI.
0	1	One half of the *on-board* memory is available to VMEPROM. The remaining memory is available to ACI.
1	0	One fourth of the *on-board* memory is available to VMEPROM. The remaining memory is available to ACI.
1	1	One eighth of the *on-board* memory is available to VMEPROM. The remaining memory is available to ACI.

NOTE: The state of these two bits are only evaluated when the most significant bit (bit 3) of the upper rotary switch is set.

2.5 Terminal/RAM Port

This bit specifies whether the I/O port of VMEPROM will be either the RAM port provided by the Application Command Interface or the first serial communications channel (channel A) of the base board's SCC Z85C30.

If the bit is set, then the port 1 is selected to be the I/O port of VMEPROM. The firmware verifies whether a terminal is connected with the serial interface of the first port (CTS and DCD must be active for the firmware to assign the first port as I/O port to VMEPROM.) In case a terminal attached to the serial interface, port 1 is used as I/O port; otherwise, the RAM port is being used as the task's I/O port. If the bit is cleared, then the RAM port is specified to be the task's I/O port.

NOTE: The state of this bit is only evaluated when the most significant bit (bit 3) of the upper rotary switch is set.

2.6 Start Application Command Interface

This bit specifies whether the Application Command Interface (ACI) has to be provided by the base board. If this bit is set, then the firmware starts a second task - supporting the ACI - in addition to VMEPROM. The *on-board* memory is shared between the two tasks as specified by the first and second bits (bit 0 and 1) of the rotary switch.

If this bit is cleared, then the base board does not provide the ACI and no further tasks are started by the firmware. The entire *on-board* memory is available to VMEPROM.

2.6.1 Default Memory Usage

By default, VMEPROM uses the following memory assignment for the IBC board:

Table 5: Memory layout of the on-board RAM

MEMORY LAYOUT OF THE ON-BOARD RAM	
$00000	Vector Storage of the 68020
$00400	System Configuration Data
$00800	General Purpose RAM, reserved for System Commands
$01000	Kernel System RAM
$07000	Task Control Block for first task
$080000	User Memory
Highest On-board Memory Address	Task Control Block for ACI
	Task Memory of the ACI
	RAM disk
	Mail Array

2.6.2 Default EPROM Usage

Table 6: Layout of the Default EPROM Usage

EPROM USAGE LAYOUT	
$FFE00000	Initial Supervisor Stackpointer
$FFE00004	Initial Program Counter
	FGA-002A Boot Software
$FFE10000	Initial Supervisor Stackpointer
	Initial Program Counter
	BIOS Modules Kernel VMEPROM (VMEPROM Initialization Code, Shell, System Tools) Application Command Interface Software

3. Details of the IBC Board

3.1 EPROM/RAM Address and Device Table

Table 7: EPROM/RAM Addresses

Address	Device
0000 0000 ↓ ....*	Local RAM
FFC0 0000 ↓ FFC7 FFFF	SRAM Area
FFC8 0000 ↓ FFCF FFFF	FLASH EPROM Area
FFE0 0000 ↓ FFEF FFFF	EPROM Area
* → **Highest On-Board Memory Address**	

3.2 On-board I/O Devices

The following table shows the base addresses of the on-board I/O devices.

Table 8: On-board I/O Devices

BASE ADDRESS	DEVICE
$FF803000	RTC 72423
$FF802000	SCC Z8530 (Channel B)
$FF802020	SCC Z8530 (Channel A)
$FF800C00	CIO Z8536
$FFD00000	FGA-002A

3.3 On-board Interrupt Sources

The following table is used for the on-board interrupt sources and levels which are defined by VMEPROM. All interrupt levels and vectors of the on-board I/O devices are software programmable via the FGA-002A Gate Array.

Table 9: On-board Interrupt Sources

DEVICE	INTERRUPT LEVEL	INTERRUPT VECTOR
Abort Switch	7	232
CIO	5	242
SCC	4	245
Application Command Interface	2	192
EAGLE UART Driver	5	196
EAGLE Disk Driver	5	198

3.4 The On-board Real Time Clock

During the powerup sequence, the on-board real time clock of the IBC board is read and loaded in the VMEPROM. This sequence is done automatically and requires no user intervention. If the software clock of VMEPROM is set by the ID command, the RTC is set automatically to the new time and date values.

3.5 Off-board Interrupt Sources

VMEPROM supports several VMEbus boards. As these boards are interrupt driven the level and vectors must be defined for VMEPROM to work properly. The following table shows the default setup of the interrupt levels and vectors of the supported hardware. For a detailed description of the hardware setup of the boards, please refer to the Appendix of this manual. The supported I/O boards together with the base addresses and the interrupt level and vector are summarized in Table 9. In order for these boards to work correctly with VMEPROM, the listed interrupt vectors may not be used.

Table 10: Off-board Interrupt Sources

Board	Interrupt Level	Interrupt Vector	Board Base Address
SIO-1/2	4	169-181	$FCB00000
ISIO-1/2	4	161-168	$FC960000
ISCSI-1	4	160	$FCA00000
IBC UART Driver	5	197	---
IBC Disk Driver	5	199	---

4. VMEPROM Kernel

The functions of the VMEPROM kernel are described here in detail. There are three main sections of VMEPROM; namely, the BIOS, kernel, and the user interface.

VMEPROM is based on the powerful PDOS real time kernel.

Features of the kernel:

1. Multitasking scheduling
2. System clock
3. Memory allocation
4. Task synchronization
5. Task suspension
6. Event processing
7. Character I/O including buffering
8. Support primitives

The PDOS kernel is the multitasking, real time nucleus of the VMEPROM. Tasks are the components comprising a real time application. It is the main responsibility of the kernel to see that each task is provided with the support it requires in order to perform its designated function.

The main responsibilities of the kernel are the allocation of memory and the scheduling of tasks. Each task must share the system processor with other tasks. The kernel saves the task's context when it is not executing and restores it again when it is scheduled. Other responsibilities of the kernel are maintenance of a 24 hour system clock, task suspension and rescheduling, event processing, character buffering and other support functions.

4.1 Special VMEPROM commands for the IBC-20 board

The commands described below are provided by VMEPROM in addition to the commands described in Section 3 of this manual.

4.2 CONFIG - Search VMEbus for Hardware

Format: CONFIG

This command searches the VMEbus for available hardware. It is useful if VMEPROM is started and bit 0 of the lower rotary switch on the front panel is set to "1", so that VMEPROM does not check the configuration by default.

In addition this command allows the user to install additional memory in the system. Additional memory can ONLY be installed with this command.

The following hardware is detected:

1. ISIO-1/2
2. SIO-1/2
3. ISCSI-1
4. Boards providing the Application Command Interface
5. Contiguous memory starting at the highest on-board memory address

The boards must be set to the default address for 32 bit systems. This setup is summarized for all supported boards in the Appendix of this manual.

Additional memory must be contiguous to the on-board memory of the CPU board. This memory is cleared by the config command to allow DRAM boards with parity to be used. Please remember that the installation of additional memory does not effect the RAM size of the running task. However, VMEPROM identifies this installed memory area and every time memory is required (i.e. with CT or FM) it is taken from this area as long as there is enough free space.

The CONFIG command also installs Winchester disks in the system and initializes the disk controller (if available). So if a SYSFAIL is active on the VMEbus (which can come for example from the ISIO-1/2 or ISCSI-1 controller during selftest), the command is suspended until the SYSFAIL signal is no longer active.

An example follows on the next page.

Example:

```
?       CONFIG<cr>
UART FORCE ISIO1/2 (U3) INSTALLED
ISCSI-1:    1     boards available
ISIO-1/2:   1     boards available

? _
```

4.3 FLUSH - Set Buffered Write Mode

```
Format:    FLUSH
           FLUSH <disk number>,<time>
```

The first command flushes all buffers on all disks in the system.

The second command sets a flush time for the device driver task. The device driver task has to flush its buffers periodically every <time> seconds. Please refer to the USER’S MANUAL of the Module to see if the device driver task is able to handle this service. The parameter <disk number> is only used to select a specific device driver task. Every disk which is connected to this task is flushed.

Example

```
? FLUSH

All modified buffers are flushed

? FLUSH 2 20

Flush time: 20 seconds

? _
```

VMEPROM BUILT-IN COMMANDS

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1. GENERAL INFORMATION

The VMEPROM command interpreter is a set of resident routines for program debugging and handling of the most common kernel functions. The command interpreter then searches for a given command. If a match is found, the command is executed.

The prompt of VMEPROM is a single question mark, followed by a space ("? ").

1.1 Command Line Syntax and Line Editing

Command Line Arguments

The VMEPROM command interpreter allows several options. In general the complete command line is divided into separate arguments. The arguments must be separated by one or more spaces or a comma. If a null-argument has to be entered, it must be represented by a comma only.

Example: ? PROG ARG1,,ARG3,

In this example, the arguments number 2 and 4 are null-arguments.

If any argument is using a comma, space, period or one of the I/O redirection arrows, it has to be put in brackets to suspend the command line interpretation.

Example: ? PROG1 (Hello, world.),(<....>),>2

Port 2 now shows the output of PROG1 which may be:

```
ARGUMENT 1 was: Hello, world.
ARGUMENT 2 was: <....>
ARGUMENT 3 was:
ARGUMENT 4 was:
ARGUMENT 5 was:
```

Input/Output Redirection

VMEPROM supports simple I/O redirection. The specifiers are the signs '<' for input and '>' for output and may appear at any location in the command line, but must be after the command name. Immediately after the redirection signs '<' and '>', a port number must be specified. The port number may be one of the ports available in the system. It is expected to be given in hexadecimal number system. The arguments specifying the I/O redirection are removed from the command line by the command interpreter and do not appear in the built-in command.

Example: **? PROG <2>3 ARG1,ARG2,ARG3,ARG4**

In this example, the program PROG is started. It is getting all inputs from port 2 and all output is redirected to port 3.

Multiple Commands

VMEPROM allows command lines of up to 78 characters. This command line can contain several different commands. The parsing of the command line is terminated at the first period (".") and the remaining command line is saved to be used later.

Example:

```
? RM D0 12345678.SM 2,Hello
? SM 2,Hello
?
```

Command Line Editing

The PDOS get line (XGLM) primitive is used to get a command line of up to 78 characters into the command line buffer.

Input is normally in replace mode which means an incoming character replaces the character at the cursor. Various control characters can be used to edit the input line.

The following table summarizes the control characters:

[ESC]	=	Cancel current line
[CTRL-C]	=	Cancel current line
[CTRL-I]	=	Enter insert mode
[CTRL-A]	=	Recall last entered line
[CTRL-L]	=	Move right 1 character
[CTRL-H]	=	Move left 1 character
[CTRL-D]	=	Delete character under cursor
[RUBOUT]	=	Delete 1 character to the left

A [CTRL-I] changes input from replace to insert mode. The mode returns to replace mode when any other editing control code is entered. Replace mode overwrites the character under the cursor. Insert mode inserts a character at the current cursor position.

In either mode, the cursor need not be at the end of the line when the [CR] is entered. The command line is passed as it appears on the screen.

When a line is accepted, it is copied to another buffer (MPB$) where it can be recalled by using the [CTRL-A] character. A [CR] and [LF] are output to the console followed by the recalled line. The cursor is positioned at the end of the line. This is a circular buffer and commands will rotate through it as they are recalled.

Numeric parameters are entered as signed decimal, unsigned hex, unsigned octal or unsigned binary numbers. All numbers are converted to two’s complement 32-bit or 16-bit integers depending on their function. Therefore it ranges from -2,147,483,648 to 2,147,483,647 (hex $80000000 to $7FFFFFFF) or -32,768 to 32,767 (hex $8000 to $7FFF). All built-in commands assume that numbers are entered in hex if not noted otherwise. To change from the expected number system, numbers must be preceded with a special sign. These are: a dollar sign ($) to enter into hexadecimal, an ampersand (&) to enter into decimal, an at/around sign (@) to enter into octal and a percent sign (%) to enter into the binary number system.

(Note: Numbers are not checked for overflow. Hence, $FFFFFFFF or 4,294,967,295 are equivalent to -1). A line beginning with an ’*’ is ignored. This is very useful to insert comment lines in command files.

In addition, every numeric parameter is passed through a Regular Expression Processor. This processor calculates numbers. For this calculation the following operations are allowed:

*:	Multiplication
/:	Division
+:	Addition
-:	Subtraction
^:	Power of
(:	Opening Bracket
):	Closing Bracket

Line Editing

Some commands allow inputting data outside the command line. For this a line editor is used. There are some control characters to edit the line:

[ESC]	=	Cancel current line and exit
[CTRL-C]	=	Cancel current line and exit
[CTRL-I]	=	Toggle between insert and replace mode. First the line editor is in insert mode.
[CTRL-A]	=	Dependent on the called command.
[CTRL-L]	=	Move right one character
[CTRL-E]	=	Move to end of line
[CTRL-H]	=	Move one character left
[CTRL-B]	=	Move to begin of line
[CTRL-D]	=	Delete character under cursor
[RUBOUT]	=	Delete one character to the left
[CTRL-\]	=	Delete character under cursor to end of line
[CTRL-O]	=	Delete whole line

The cursor need not be at the end of the line when the [CR] is entered.

Program or Command Abort

There are two basic methods of aborting a running program or command. The first one is the ABORT switch on the CPU board. This switch causes a level 7 interrupt to the processor. If a VMEPROM command was under execution at this time, the message "Abort switch pressed" is displayed and control is transferred back to the command interpreter immediately. If a user program is running when the ABORT switch is pressed, the current contents of the processor registers are saved and a message along with the processor registers is displayed.

The second method is typing ^C twice on the keyboard. If that happens, VMEPROM will abort the current command and control is transferred to the command interpreter. The processor register is not saved by this action. They show the same status as they had before the program was started.

NOTE: Tasks with port 0 as input port will not be aborted.

1.2 VMEPROM Built-in Commands

The VMEPROM built-in commands are described in detail in this chapter.

The following notations are used throughout this document:

- Symbolic representation is put in arrows (i.e. <address> where an absolute address has to be inserted.
- Optional arguments are in square brackets (i.e. [<option>]). Those arguments must not be specified and have a default value.
- If one argument out of more can be selected, the arguments are separated by a "|" (i.e. [B | W | L] to select Byte, Word or Long Word size).
- If more than one out of many possibilities for an argument has to be selected, these are marked with a "&" sign (i.e. [B|W|L&N&O|E] to select B or W or L together with N and O or E).

Most of the VMEPROM commands assume that the parameters are given in hex (without a leading $ sign).

However, some values are assumed in decimal.

These are:

Port	VMEPROM port numbers are in the range 0-15 and have to be entered in decimal.
Tasks	The task numbers have to be entered in decimal
Task Priorities	The task priority has to be entered in decimal
Error Numbers	The error numbers are displayed in decimal and have to be entered in decimal

1.2.1 # - Symbolic Command Name

Format:
#
# <name>
# <name>,<command string>

The symbolic name command is used to display, delete or define a symbolic name for often used command lines. The first format displays all currently defined names, the second deletes a defined name from the list and the third one defines a new name with the command string. VMEPROM supports up to 5 symbolic names with command lines of up to 40 characters.

Symbolic names can reference other symbolic names.

Example:

```
? # ASM AS 8000               Define ASM for the command AS

? # DISP LT                   Define DISP for list tasks

? # D DISP                    Define D for DISP

? #                           Show defined symbolic names
ASM: AS 8000
DISP: LT
D: DISP

? DISP
task    pri    tm    ev1/ev2    size    pc          tcb          eom         ports      name
*0/0    1      1                 256    FFE1D46A    00007000     00047000    1/1/0/0/0  lt
  1/-1  1      1                1762    FFE1010C    00047000  0  01FF800     0/0/0/0/0  MEtask
  2/-1  1      1                   6    0004FA1C    0004E9EE     000503AE    0/0/0/0/0  DMAtask

? D
?_

? ASM
8000           : XEXT
               : _
```

1.2.2 ARB - Set the Arbiter of the IBC Board

Format: **ARB**

The ARB command allows the user top set the arbitration mode of the IBC board for VMEbus. This command is also used to select the Standard Access Mode for the VMEbus. Additionally, the VMEbus interrupts can be enabled or disabled.

Example:

```
?ARB<cr>

Current arbiter mode: enabled, Mode = Prioritized ROUND ROBIN
  Set arbiter mode ? (Y,y/-) : Y
   ROUND ROBIN mode ? (Y,y/-) : Y
   Prioritized ROUND ROBIN ? (Y,y/-) : N
New arbiter mode = ROUND ROBIN
Set arbiter mode for VME-BUS:

STATUS:     ROR & RAT & RBCLR & FAIR
SET:        Release on bus clear (RBCLR)           (Y/N)  Y
SET:        Fair    VME-BUS arbitration (FAIR)     (Y/N)  Y
```

```
Standard Access Mode (A24) for Slave Accesses currently disabled.
 Enable A24 mode ? (Y,y/-) : Y
   A31-A24 = 80
 Change interrupt mask ? (Y,y/-) : Y

Enable(1) / Disable(0)  VMEbus interrupts by level:

STATUS:                              Level:  7  6  5  4  3  2  1
                                             1  1  1  1  1  1  1
SET:                  Enter new interrupt mask:  1  1  1  1  1  1  0


?_
```

1.2.3 AS - LINE ASSEMBLER

Format: **AS <address>**

The AS command invokes the line assembler/disassembler of VMEPROM. It can assemble and disassemble all 68020 instructions and all the PDOS system calls.

The AS command, when invoked, displays the current address offset and the address within the window. Then the current location is disassembled.

After the prompt on the next line, the user can enter one of the following:

1) A valid 680x0 mnemonic. Some 68020 addressing modes allow omission of arguments. These addressing modes can be entered by omitting the argument and typing the dividing character ','.

   Examples:
   ```
   CLR.W ([$1,A0],D0.W,$2)
   CLR.W ([$1,A0],,$2)
   CLR.W ([,A0],,)
   ```

2) A '#' sign followed by the new address within the window. This is an absolute address change.

3) An '=' to disassemble the same location again.

4) A '+' to disassemble the next location.

5) A '-' sign forces the disassembler to step back one possible opcode. If none is found the same location will be opened.

6) A '+' or '-' sign followed by the number of bytes the address has to be increased or decreased. This is a relative address change.

7) A '.' or [ESC] to exit the line assembler and return control to the command interpreter.

8) [CTRL-A] to edit the disassembled opcode.

All immediate values, addresses and offsets inside mnemonics are assumed to be entered in decimal. So hex values have to be proceeded with a dollar ($) sign. In addition, binary values may be used if proceeded by a percent sign ("%") and octal values if proceeded by an at/around sign ("@"). The disassemblers display all values in hex representation.

The line assembler accepts a pseudo opcode of the form DC.B, DC.W and DC.L to define constant data storage. An ASCII pattern can be stored by using DC.B with the format DC.B "ASCII. All characters after '"' will be written to memory. The disassembler displays all illegal opcodes as DC.W.

Both the line assembler and disassembler support the opcodes as described in Chapter 4 of the VMEPROM Manual.

Example:

```
 ? AS 8000
8000       : XEXT
           : MOVE.L #$123,D1        New opcode entered
8006       : ORI.B #0,D0
           : -                      Step back one opcode
8000       : MOVE.L #$123,D1
           : [CTRL-A]               Recall line
           : MOVE.L #$1234,D1       Line edited
8006       : ORI.B #0,D0
           : XRDM                   New opcode
8008       : ORI.B #0,D0
           : -8                     Back 8 bytes
8000       : MOVE.L #$1234,D1
           : +                      Disassemble next instruction
8006       : XRDM
           : [CR]                   Disassemble next instruction
8008       : ORI.B #0,D0
           : #8010                  Go to absolute address $8010
8010       : ORI.B #0,D0
           : .                      Back to the command interpreter

 ? _
```

1.2.4 ASSIGN - Assign New Input or Output Ports

Format: **ASSIGN <port>**
ASSIGN <port>,<output port>

The ASSIGN command has two functions, depending on the command line arguments. If the output port is omitted, ASSIGN sets a new input and output port for the current task. If the output port is specified, the default input/output ports are unchanged, but the alternate output ports of the task are changed. The output port specified must be in the range 1-4.

Example:

```
? ASSIGN 3              VMEPROM now uses port 3 for I/O

? ASSIGN 3,2            Use port 3 as unit 2 port
```

1.2.5 BASE - SET/DISPLAY BASE REGISTER

Format: **BASE**
BASE <address>

The BASE register in VMEPROM is used to offset all memory accesses into the tasks memory. So all debugging can be done relative to address 0, which is actually the begin address of your tasks memory. This saves a lot of typing and makes sure that no other tasks memory is destroyed by a typing error.

Example:

```
? base<cr>                 Display BASE register
Base = 00000000  : <cr>    No changes

? base 8000<cr>            Set BASE register to $8000
? base<cr>                 Display BASE register
Base = 00008000  : <cr>

? M 0<cr>                  Open address $0 +BASE register
8000+0000   A00E : <cr>
8000+0002   0000 : <cr>
8000+0004   0000 : .

?
```

1.2.6 BENCH - Built-in Benchmarks

Format: **BENCH**
BENCH <#>,<address>

These function can execute one of the built-in benchmarks. If only BENCH is entered, a short descriptions of all benchmarks is displayed on the terminal. A benchmark is executed by entering the number of the benchmark (in decimal) and the address where it shall run in memory (in hex).

The following benchmarks are available:

Bench 1:	Decrement long word in memory, 10.000.000 times
Bench 2:	Pseudo DMA 1K bytes, 50.000 times
Bench 3:	Substring character search, 100.000 times, taken from EDN, 08/08/85
Bench 4:	Bit Test/Set/Reset, 100.000 times, taken from EDN,08/08/85
Bench 5:	Bit Matrix Transposition, 100.000 times, taken from EDN, 08/08/85
Bench 6:	Cache test, executes 128K bytes program 1000 times CAUTION: This benchmark will destroy 128K bytes memory
Bench 7:	Floating Point - 1.000.000 Additions
Bench 8:	Floating Point - 1.000.000 Sines
Bench 9:	Floating Point - 1.000.000 Multiplications
Bench 10:	100.000 Context switches
Bench 11:	100.000 Set system event
Bench 12:	100.000 Change task priority
Bench 13:	100.000 Send and Receive task message
Bench 14:	100.000 Read system time

Example:

```
? bench 1 8000      Execute benchmark #1 at address $8000

Bench  1: Decrement long word in memory, 10.000.000 times
Benchmark time = 0:07.23

?
```

1.2.7 BF - Block Fill

Format: **BF <begin>,<end>,<value>,[B | W | L]**
BF <begin>,<end>,<pattern>,P
BF <begin>,<end>,<opcode>,O

This command fills the specified memory area with a constant. The type of the constant is defined by the option and may be a Byte, Word, Long word, Pattern or an Opcode. A pattern is an ASCII string which is to be put in inverted commas. The maximum length is only restricted by the length of the input line, which may not exceed 78 characters. An Opcode is each valid 680x0 mnemonic or an opcode as described in Chapter 4 of the VMEPROM Manual. If the pattern or the opcode contains argument separators, such as space, comma, or full stop, the data has to be put in brackets. If no option is specified, a default of Word is assumed.

Example:

```
? BF 8000 8100 NOP O

? MD 8000 10
00008000: 4E 71 4E 71 4E 71 4E 71  4E 71 4E 71 4E 71 4E 71 NqNqNqNqNqNqNqNq

? BF 8000 8100 ("Hello World") P

? MD 8000 10
00008000: 48 65 6C 6C 6F 20 57 6F  72 6C 64 48 65 6C 6C 6F Hello World Hello

? BF 8000 8100 12345678 L

? MD 8000 10
00008000: 12 34 56 78 12 34 56 78  12 34 56 78 12 34 56 78 .4Vx.4Vx.4Vx.4Vx

? BF 8000 8100 &255

? MD 8000 10
00008000: 00 FF 00 FF 00 FF 00 FF  00 FF 00 FF 00 FF 00 FF ................

? _
```

1.2.8 BM - Block Move

Format: **BM <begin>,<end>,<destination>**

The BM command copies a memory from one area to another. The areas may be overlapped.

Example:

```
? MD 8000 20
00008000: 00 FF 00 FF 00 FF 00 FF  00 FF 00 FF 00 FF 00 FF ................
00008010: 00 FF 00 FF 00 FF 00 FF  00 FF 00 FF 00 FF 00 FF ................

? BM 8000 8020 9000

? MD 9000 20
00009000: 00 FF 00 FF 00 FF 00 FF  00 FF 00 FF 00 FF 00 FF ................
00009010: 00 FF 00 FF 00 FF 00 FF  00 FF 00 FF 00 FF 00 FF ................

? _
```

1.2.9 BP - BAUD PORT

Format: **BP**
BP <port #>
BP {-}<port #>,<baud rate>
BP {-}<port #>,<baud rate>,<type>,<UART base addr>

The BAUD PORT command initializes a VMEPROM I/O port and binds a physical UART to a character buffer. The command sets the UART character format, receiver and transmitter baud rates, and enables receiver interrupts. The first parameter <port #> selects the console port in ranges from 1 to 15. This corresponds to character input buffers defined in the VMEPROM system RAM (SYRAM). If a minus (-) precedes the port number, then the associated port # is stored in the UNIT 2 (U2P$(A6)) variable. Receiver and transmitter baud rates are initialized to the same value according to the <baud rate> parameter. The <baud rate> parameter ranges from 0 to 8 or the corresponding baud rates of 19200, 9600, 4800, 2400, 1200, 600, 300, 110, or 38400. Either parameter type is acceptable.

Baud Rates Allowed:

0	=	19200 baud	1	=	9600 baud
2	=	4800 baud	3	=	2400 baud
4	=	1200 baud	5	=	600 baud
6	=	300 baud	7	=	110 baud
8	=	38400 baud			

The <type> and <UART base addr> are optionally included when binding a logical port to a different UART. For <type> information, refer to the User's Manual of your CPU-board. The <port #> can also be used to set or reset the port flags. These are bit positions 8 through 15 of the resulting integer value and are defined to the right. It is recommended that hex format be used when setting these parameters.

$100 + port = CtrlS CtrlQ protocol	$200 + port = Pass control characters
$400 + port = DTR protocol	$800 + port = 8-bit character I/O
$1000 + port = receiver interrupts disable	$2000 + port = even parity enable
$4000 + port = clear flag bits	

If the BP command has no arguments, a listing of all currently installed ports is sent to the console. 'Task' parameter indicates the currently assigned task to that port.

Example:

```
? BP
Port  Type   fwpi8dcs    Base     Baud    task
# 1    1    00001100  FF800000  9600      1

? BP 2,1,1,$FF800200   Initialize the UART
?
```

1.2.10 BR - Set/Display/Delete Breakpoints

Format: **BR**
BR *
BR <number>
BR <number>,<address>
BR <number>,<address>,<command>
BR <number>,<address>,[<command>],<count>

VMEPROM supports a maximum of 10 breakpoints in the range 0-9. The BR command is used to set, display or delete breakpoints.

The first format displays all currently defined breakpoints. The second one deletes all defined breakpoints. The third format is used to delete one single breakpoint. The other formats are used to define one breakpoint. If a breakpoint is already defined it will be overwritten. Two breakpoints looking for the same address are not possible.

If a count is specified, the program first stops at the breakpoint when this specification has been achieved. The default value is one.

The default action taken by a breakpoint is a display of the breakpoint number encountered and a display of all processor registers.

So there is a fourth option of the command line to change the default behavior at a breakpoint. The command, which can be specified is executed instead of the display described before. The command may not have any arguments and may have a length of up to 9 characters.

The command may be a symbolic name, one of the built-in commands of VMEPROM, an installed utility or a disk file (command file or program).

Example:

```
? BR 0 8020            Define breakpoint 0 at address $8020

? BR
Defined Breakpoints:
 B0  $8020  1

?
```

1.2.11 BS - Block Search

Format: **BS <begin>,<end>,[/]<value>[,<option>]**
BS <begin>,<end>,[/]<pattern>,P
BS <begin>,<end>,[/]<opcode>,O

This command searches the specified memory area for a constant. The type of the constant is defined by the option and may be a Byte, Word, Long word, Pattern, or an Opcode. A pattern is an ASCII string which is to be put in inverted commas. The maximum length is only restricted by the length of the input line, which may not exceed 78 characters. An Opcode is each valid 680x0 mnemonic or an opcode as described in Chapter 4 of the VMEPROM Manual. If the pattern or the opcode contains argument separators, such as space, comma, or full stop, the data has to be put in brackets. If no option is specified, a default of Word is assumed.

The data which has to be searched in memory may be preceded by a ’/’ to look only for locations not containing the value, pattern or opcode.

Example:

```
? BS 8000 8100 /1234        Search memory for "not" value
Search:  8020    = 5678      Found

? BS 8000 8100 5678         Search memory for value
Search:  8020    = 5678      Found

? BS 8000 8100 ("Hello World") P       Search memory for pattern
                                        None found
? BS 8000 8100 (ADDQ.L #1,D0) O        Search memory for opcode
                                        None found
? _
```

1.2.12 BT - Block Test

Format: **BT <begin>,<end>**

The Block Test command performs an in-depth memory test within the specified address limits. The following passes are performed:

1) Byte Pattern Test
2) Word Pattern Test
3) Long Pattern Test
4) Word Shift Test
5) Address Test

If any errors are found they are reported with the type of test which failed, the address and the differing values. In addition the error counter in the task control block (TCB) is incremented.

Example:

```
? bt 200000 300000       Test memory from $200000 to $300000
?
```

1.2.13 BV - Block Verify

Format: **BV <begin>,<end>,<destination>**

This command compares two blocks of memory. If the specified blocks are not equal, the different values and the memory location is displayed. In addition the error counter in the task control block (TCB) is incremented.

Example:

```
? bv 8000 8080 8080
Verify:  8021    = 70  80A1    = 71

?
```

1.2.14 COLD - Cold Start VMEPROM

Format: **COLD**

The COLD command is used to reinitialize all VMEPROM variables. It takes the same action as a reset, except that the kernel and all associated tasks are not affected.

Example:

```
? COLD
*****************************************************************
*                                                               *
*                        V M E P R O M                          *
*                                                               *
*           SYS68K/IBC-20     Version  a.bb      Date           *
*                                                               *
*            (c) FORCE Computers  and  Eyring Research          *
*                                                               *
*****************************************************************

? _
```

1.2.15 CREATE TASK

Format: **CT <command>,<size>,<[time*256+]priority>,<port>**
CT ,<size>,<[time*256+]priority>,<port>
CT <address>,<size>,<[time*256+]priority>,<port>

The CREATE TASK command places a new task entry in the task queue and lists the realtime kernel of VMEPROM. Parameters for the new task include a command line, memory size, task priority/time slice, and an I/O port. The new task number is reported after task creation.

The <command> parameter is the command line for the new task. The string is passed to the new task via a message buffer and cannot exceed 64 characters in length.

Multiple commands and parameters are passed by using parentheses. If the first parameter is omitted, then the VMEPROM monitor is invoked.

If an address is specified instead of <command>, this address is interpreted as the start address of a program in memory. The address must be specified in hexadecimal and start with a number 0-9 not to conflict with a program name.

The amount of memory for the new task is given by <size> and is in 1 Kbyte increments (although rounded to the next 2 Kbyte boundary). The minimum amount of memory is 8 Kbyte. The system memory bit map is searched for a contiguous block of memory equal to <size>. If the search fails to find a large enough block, then memory is taken from the parent task and allocated to the new task.

The <priority> parameter specifies the new tasks priority. The range of task priority is from 1 to 255 where 255 is the highest priority. The highest priority, ready task always executes. Tasks on the same priority level are scheduled in a round robin fashion. The time a task is in running state is also given with the <priority> parameter. If no time is specified it will default to one time slice. Otherwise it is calculated to "time*256+priority".

The <port> parameter assigns an I/O port to the new task. Port 0 is the default and is called the phantom port. On the phantom port, all character outputs and conditional inputs are ignored while requests for character input result in the task aborting with error 86. More than one task may be assigned to an output port. The input port cannot be shared with another task. Input ports are allocated on a first come basis.

After a task is created, the spawned task number is reported. This number is used in killing the new task.

The values for size, priority and port have to be entered in decimal.

Example:

```
? lt
task    pri     tm      ev1/ev2     size      pc          tcb         eom         ports       name
*0/0    1       1                    256      FFE1D46A    00007000    00047000    1/1/0/0/0  lt
  1/-1  1       1                   1762      FFE1010C    00047000    001FF800    0/0/0/0/0  MEtask
  2/-1  1       1                      6      0004FA1C    0004E9EE    000503AE    0/0/0/0/0  DMAtask

? ct ,10,64,2
 Sontask number = 3

? lt
task    pri     tm      ev1/ev2     size      pc          tcb         eom         ports       name
*0/0    1       1                    246      FFE1D46A    00007000    00044800    1/1/0/0/0  lt
  1/-1  1       1                   1762      FFE1010C    00047000    001FF800    0/0/0/0/0  MEtask
  2/-1  1       1                      6      0004FA1C    0004E9EE    000503AE    0/0/0/0/0  DMAtask
  3/0   64      1       98            10      FFE06F50    00044800    00047000    2/2/0/0/0

? ct ,,256*10+40,3
 Sontask number = 4

? lt
task    pri     tm      ev1/ev2     size      pc          tcb         eom         ports       name
*0/0    1       1                    238      FFE1D46A    00007000    00042800    1/1/0/0/0  lt
  1/-1  1       1                   1762      FFE1010C    00047000    001FF800    0/0/0/0/0  MEtask
  2/-1  1       1                      6      0004FA1C    0004E9EE    000503AE    0/0/0/0/0  DMAtask
  3/0   64      1       98            10      FFE06F50    00044800    00047000    2/2/0/0/0
  4/0   40      10      99             8      FFE06F50    00042800    00044800    3/3/0/0/0

? _
```

1.2.16 DI - Disassembler

Format: **DI <address>**
DI <address>,<count>

The DI command causes the disassembler to be invoked and display the mnemonic, starting at the specified address. If count is specified, it is interpreted as the number of lines to display. If count is omitted, a full page is displayed on the terminal and the user is then prompted to continue disassembly (enter <cr>) or to return to the command interpreter (enter any other key).

The disassembler supports all 68020 mnemonics.

Example:

```
? DI 8000 5

8000   NOP
8002   NOP
8004   NOP
8006   NOP
8008   NOP

?
```

1.2.17 DR - Display Processor Registers

Format: **DR [T]**

The DR command displays processor registers. The displayed registers are not real current processor registers, but those kept in memory and loaded to the processor when a program is started. When program execution is terminated (XEXT instruction, trap or breakpoint or other exception) the processor registers are resaved and can be displayed by the DR command.

When choosing the option ’T’, only the program counter, stack pointer, and address registers A5 and A6 will be displayed until ’T’ is used a second time. Then all registers will once again be displayed. First VMEPROM is configured to display all registers.

Example:

```
? DR
       0        1        2        3         4        5        6        7
D: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000
A: 00000000 00000000 00000000 00000000  00000000 00001000 00007000 0009AFFC

 VBR = 00000000   CAAR = 00000000   CACR = 00000001   SFC  = 0   DFC = 0
*USP = 0009AFFC   SSP  = 00007BE6   MSP  = 000078C4
 PC  = 00008000   SR   = 0000 ..U..0........

? DR T
PC = 00008000  SP = 0009AFFC  A6 = 00007000  A5 = 00001000

? DR
PC = 00008000  SP = 0009AFFC  A6 = 00007000  A5 = 00001000

? DR T
       0        1        2        3         4        5        6        7
D: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000
A: 00000000 00000000 00000000 00000000  00000000 00001000 00007000 0009AFFC

 VBR = 00000000   CAAR = 00000000   CACR = 00000001   SFC  = 0   DFC = 0
*USP = 0009AFFC   SSP  = 00007BE6   MSP  = 000078C4
 PC  = 00008000   SR   = 0000 ..U..0........
? _
```

1.2.18 DT - DATE AND TIME

Format: **DT**

The DT command outputs the current date and time to the user console. These values can be changed by the ID command.

Example:

```
? DT
16-Mar-88
16:47:38

?
```

1.2.19 DU - Dump S-record

Format: **DU <begin>,<end>**
DU <begin>,<end>,<command line>

This command sends an S-Record to the standard output port. It may be redirected with the usual redirection method.

An optional command line may be specified which is sent via the output port before the S-record starts. This can be used to start a load command on the host system.

The following S-record types are supported:

S1	Start record
S2	Data record, this type is needed if the end address is smaller than $8000.
S3	Data record, this type is used if the end address is bigger than $800000.
S7	End-record for S3 records.
S8	End-record for S2 records.
S9	End-record for S1 records.

The address field of all End-records is 0.

Example:

```
? DU 8000 8020
S0030000FC
S2180080004E714E714E714E714E714E714E714E714E714E71F1
S2100080144E714E714E714E714E714E71E1
S804000000FB

? DU 8000 8020 >2
?
```

1.2.20 EAGLE - Display All Information About Available EAGLE Modules

Format: **EAGLE**

This command is intended to display all information about available EAGLE modules on the IBC-20 board. The information displayed by this command is contained in the ID EPROM of an EAGLE module and the content of such an ID EPROM has a fixed structure which has been specified by FORCE COMPUTERS.

However, the EAGLE command provides the following information about an EAGLE module.

- The EAGLE module identifier
- The name of the manufacturer who had developed the EAGLE module.
- The serial number of the board, the hardware and software revision number.
- Up to eight Ethernet addresses (these addresses are always displayed independent from the presence of a corresponding LAN controller).
- Detailed information about available software modules relating to different operating systems.
- Detailed information about the available devices on the EAGLE modules (base addresses, interrupt and DMA capabilities, logical device number, etc.).

1.2.21 ER - LIST ERRORS

Format: **ER [-c]**
ER 0 [-c]
ER <error#>

The LIST ERROR command has three functions. The first one, with no argument, displays the number of errors found on one of the following commands:

1) Block Test
2) Block Verify
3) Block Search.

The second format, with the argument "0" resets the above error count to 0.

If the optional parameter [-c] is given when using the first two formats, an execution count will be displayed or reset to zero. The execution count will be incremented before it is displayed.

The third format requires a valid error number as an argument and displays the VMEPROM error message associated with <error#>.

Error numbers range as follows:

VMEPROM errors	1-49
PDOS errors	50-99
Disk errors	100-299

Example:

```
? ER
Current error count = 6

? er 0

? er 2
Command line argument error

?er 0 -c

?er -c
 Current error count = 0    Execution count = 1
```

1.2.22 EV - SET/RESET EVENT

Format: **EV**
EV {-|+}<event>
EV {-|+},<address>,<bit#>

VMEPROM events are set, reset, or listed with the EV command. Both logical and physical events can be accessed with EV. The delayed event queue can also be listed or cleared with the EV command.

If the first parameter is zero, the delay queue is cleared. For accessing a logical event, the event number <event> has to be entered. If <event> is proceeded by a plus (+) sign, the event is set and the old status is returned. If <event> is proceeded by a minus (-) sign, the specified event is cleared and its old status is displayed. For accessing a physical event, the second parameter must be the byte address followed by the bit number (0-7), where bit 7 is the most significant bit of the byte. Physical events are set (+), reset(-) and list(_) in the same way as logical events are accessed. If no special sign is specified, the current status of the event is displayed. If <event> is omitted, a status list of all events in the system and all pending delay events are displayed.

The event number has to be entered in decimal.

Current logical event definitions are as follows:

1-63 = Software events
64-80 = Software resetting events
81-95 = Output port events
96-111 = Input port events
112 = 1/5 second event
113 = 1 second event
114 = 10 second event
115 = 20 second event
116 = Reserved
117 = Reserved
118 = Reserved
119 = Reserved
120 = Level 2 lock
121 = Level 3 lock
122 = Batch event
123 = Spooler event
124 = Reserved
125 = Reserved
126 = Reserved
127 = Virtual ports
128 = Local event

Example:

```
? EV
  00000000  00000000  00000000  0000FE00
  EV 128 : TASK 0  SET DELAY = 43 TICS

? EV 10
  Is  0

? EV +10
  Was 0

? EV -10
  Was 1

? EV 10
  Is  0

? EV +,$10000,1
  Was 0

? EV, $10000,1
  Is 1
```

1.2.23 FGA - Change Boot Setup for Gate Array

Format: **FGA**

Some registers of the gate array are definable by the user. The contents of this register is stored in the on-board battery SRAM in a short form.

The boot software for the gate array swill take these values after reset to initialize the gate array. The FGA command may be used to enter an interactive mode for changing this boot table in the battery SRAM.

The FGA command will show the actual value stored in the battery SRAM. To change any value, a new one has to be entered in binary form. If only a <cr> is entered, no change will be made. To step backward a minus has to be entered. If a <.> or <ESC> is given, the FGA command returns to the shell.

Example:

```
? FGA

> > >  Setup for FGA-002 BOOTER  < < <

REGISTER   FGA offset   Value in SRAM    Changed Value

SPECIAL    $0420        %00011110        %00011110
CTL_01     $0238        %00000100        %00000100
CTL_02     $023C        %00000000        %00000000
CTL_05     $0264        %00001100        %00001100
CTL_12     $032C        %00000000        %00000000
CTL_14     $0354        %00000000        %00000000
CTL_15     $0358        %01001100        %01000110
CTL_16     $035C        %00100000        %00100000
MBX_00     $0000        %00000000        %00001001
MBX_01     $0004        %00000000        %00000000
MBX_02     $0008        %00000000        %00000000
MBX_03     $000C        %00000000   .
MBX_04     $0010        %00000000
MBX_05     $0014        %00000000
MBX_06     $0018        %00000000
MBX_07     $001C        %00000000
```

1.2.24 FM - FREE MEMORY

Format: **FM**
FM -E
FM {-}<size>

The FREE MEMORY command drops memory from your current task.

If no parameter is given all free memory contiguous to tasking memory is displayed.

If parameter ’-E’ is given all free memory is displayed. This includes memory which is not contiguous to tasking memory but deallocated in the memory bit map.

If the <size> parameter is positive, then the memory is deallocated and made available to the system for other task usage. If the <size> parameter is negative, then the memory is simply dropped from the current task and is not recoverable. The size parameter must be entered in decimal.

Example:

```
? FM
No free memory contiguous to tasking memory

? FM -E
Free memory:    2 kbyte at $B6000

? FM 100
100 Kbytes free at address $9C800

? FM
Free memory: 100 Kbyte

? FM -10
10 Kbytes free at address $9A000

? FM
No free memory contiguous to tasking memory

? FM -E
Free memory:  100 kbyte at $9C800
Free memory:    2 kbyte at $B6000

 ? _
```

1.2.25 FMB - Force Message Broadcast

Format: **FMB <slotlist>,<FMB channel>,<message>**
FMB [<FMB channel>]

The FMB command allows sending a byte message to individual slots in the backplane, broadcast to all the boards, and getting a pending message.

The first format is used to send a message. With this the first parameter is used to select the slots to which a message should be sent. Each slot number can be separated with a '/' sign; a '-' defines a range of slot numbers. Slot numbers can range from 0 to 21. A slot number of 0 sends the message to all slots. The second parameter defines which FMB channel should be used. It can be '0' or '1'. The message is the byte to be deposited into the FMB channel(s).

The second format is used to get messages. If no parameter is given, one message of each FMB channel is fetched and displayed. If a channel is specified only this channel is addressed and the message will be displayed.

Example:

```
? FMB
FMB channel 0 is empty
FMB channel 1 is empty

? FMB 1-21,0,$EF

? FMB 1-21,1,%10100001

? FMB
FMB channel 0 = $EF
FMB channel 1 = $A1

? FMB 1-21,1,$77

? FMB 1
FMB channel 1 = $77

? FMB 1/2/5/7-19/21,0,$1

? _
```

1.2.26 FUNCTIONAL - Perform Functional Test

Format: **FUNCTIONAL**

NOTE: This command is not designed for the user, but instead for internal purposes by FORCE COMPUTERS.

1.2.27 GO - Start User Program

Format: **G**
G <address>
GO
GO <address>

A user program in memory is started with this command. The start address may be specified on the command line, or the value of the program counter, as displayed by the DR command, is taken if this field is omitted.

The following actions are taken by VMEPROM if this command is specified:

1) The processor registers are loaded with the user values.

2) The first instruction is executed.

3) If any breakpoints are defined, they are inserted in the user program.

4) The program is continued at the second instruction.

Example:

```
? G 8000
>>> This is a Test <<<

?
```

1.2.28 GD - Start User Program Without Breakpoints

Format: **GD**
GD <address>

The GD command takes the same actions as the G or GO command, except that defined breakpoints are ignored and not inserted in the user program.

Example:

```
? GD 8000
>>> This is a Test <<<

?
```

1.2.29 GM - GET MEMORY

Format: **GM**
GM <size>

The GM command adds memory to the current task. The amount of memory is specified by <size>. The <size> parameter has to be given in decimal. If no parameter follows GM, then all of the available memory is added. No error is reported if the memory request cannot be met.

Example:

```
? FM
No free memory contiguous to tasking memory

? FM 20
20 Kbytes free at address $00071800

? GM
? FM
No free memory contiguous to tasking memory

?
```

1.2.30 GT - Start User Program with Temporary Breakpoint

Format: **GT <breakpoint>**
GT <breakpoint>,<address>
GT <breakpoint>,<address>,<command>
GT <breakpoint>,<address>,<command>,<count>

This is almost the same function as the G or GO command, except that an additional temporary breakpoint is inserted. This breakpoint is automatically removed if the program counter reaches this breakpoint.

If a command is given, it will be executed at the breakpoint. Otherwise all processor registers are displayed.

If a count is specified, the program first stops at the breakpoint when this specification has been achieved. The default value is one.

Example:

```
? GT 10020 10000
At temporary breakpoint
       0        1        2        3         4        5        6        7
D: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000
A: 00000000 00000000 00000000 00000000  00000000 00001000 00007000 00099FFC

 VBR = 00000000   CAAR = 00000000   CACR = 00000001   SFC  = 0   DFC = 0
*USP = 00099FFC   SSP  = 00007BDE   MSP  = 000078C4
 PC  = 00010020   SR   = 0000 ..U..0........

? GT 10020 10000 lt

task   pri   tm  ev1/ev2  size     pc       tcb      eom      ports    name
*0/0    64    1            588  FF01FAB8 00007000 0009A000  1/1/0/0/0  lt

? GT 10020,10000,,2
At temporary breakpoint
       0        1        2        3         4        5        6        7
D: 00000000 00000000 00000000 00000000  00000000 00000000 00000000 00000000
A: 00000000 00000000 00000000 00000000  00000000 00001000 00007000 00099FFC

 VBR = 00000000   CAAR = 00000000   CACR = 00000001   SFC  = 0   DFC = 0
*USP = 00099FFC   SSP  = 00007BDE   MSP  = 000078C4
 PC  = 00010020   SR   = 0000 ..U..0........

? _
```

1.2.31 HELP - HELP

Format: **HELP**
HELP <command>

The HELP command first displays a short description of all VMEPROM built-in commands on the terminal. Then a more detailed description of all commands is displayed.

After every screen full, the output stops. It may be continued by entering a <cr>. Control is transferred back to the command interpreter on any key other than <cr>.

If HELP is followed by a command name, a short description of this command is displayed.

If HELP is followed by one or more characters, but not a complete command name, a start description of all commands matching with the given character is displayed.

Example:

```
? HE M
M <address>[,B|W|L&N&O|E|F#]          Modify memory contents
MD <address>[,<count>]                Display memory in Hex and ASCII
MEM [16|32]                           Set data bus width
MM <address>[,B|W|L&N&O|E|F#]         Alias for M command
MS <address>,<data|"string">          Preset memory with constant or string

? _
```

1.2.32 HIST - Command history

Format: **HIST**

The HIST command is used to show which commands can be recalled with [CTRL-A]. This is an easy way to check if a command is inside the alternate command line buffer. If it is, recalling the line is possible and it need not to be written a second time.

Example:

```
? HIST
BT 10000 20000
DR
BT 200000 300000

? [CTRL-A]
BT 10000 20000[CTRL-A]
DR[CTRL-A]
BT 200000 300000<cr>

? _
```

1.2.33 ID - SET SYSTEM DATE/TIME

Format: **ID**

The SET SYSTEM DATE/TIME command displays the VMEPROM header and prompts for the date and time. The header shows the version of VMEPROM and the used CPU-type as displayed after reset.

The date can be entered in either a day, ASCII month, year form or numeric month, day, year.

Any delimiter can be used to separate date and time parameters.
Pressing [CR] leaves the old date and time.

Example:

```
? ID
*****************************************************************
*                                                               *
*                        V M E P R O M                          *
*                                                               *
*           SYS68K/IBC-20     Version  a.bb      Date           *
*                                                               *
*            (c) FORCE Computers  and  Eyring Research          *
*                                                               *
*****************************************************************

Date: 17-Aug-89   <cr>
Time: 18:45:21    <cr>

? _
```

1.2.34 INFO - Information about the CPU board

Format: **INFO**

The INFO command is used to obtain information about the board. The output is strongly dependent on the used board.

These outputs are given at all board types:

1) Board type.

2) VMEPROM Version and it’s start address.

3) EPROM base address.

4) I/O devices: Depending on the board type all I/O devices are listed including their base address.

5) RAM addresses SYRAM start address.
Current tasks task control block start address.

Additional information may occur.

Example:

```
? INFO
FORCE IBC-20
VMEPROM Version a.bb at $FFE0484A

EPROM base addresses:
        System EPROM        at $FFE00000;      EEPROM             at $FFC80000
        Boot EPROM          at $FFE00000

I/O Devices:
        BIM                 at $FF803E00;      RTC                at $FF803000
        CIO                 at $FF800C00;      SCC channel A      at $FF802020

RAM addresses:
        Local RAM     $0    to $001FFFFF;      SRAM               at $FFC00000
        SYRAM               at $00001000;      TCB                aT $00007000

 ? _
```

1.2.35 KM - KILL MESSAGE

Format: **KM**
KM <task #>

The KM command removes all task messages associated with <task #> from the message buffers.

If no task is specified, then all messages associated with the current task are deleted from the message buffers.

See also *SEND MESSAGE*.

1.2.36 KT - KILL TASK

Format: **KT**
KT {-}<task #>

The KILL TASK command removes a task from the task list and returns the task's memory to the free pool for use by other tasks. Only your current task or a task spawned by your task can be killed. (Task 0 can kill any task except itself or a task that is kill protected.)

Each task is assigned a unique task number which is shown by the LIST TASK command. Only the current task (indicated by '*') or those spawned by the current task (indicated by current task number following a "/" character) may be killed. Task #0 is the system task and cannot be killed.

If a minus sign (-) precedes the task number, then the task's memory is not deallocated to the memory bit map. If the task number is zero, then the current task is killed without deallocating memory.

If no parameter is given, then the current task is killed and memory is deallocated.

All open files associated with the killed task are closed by the KT command.

Example:

```
? lt
task    pri     tm      ev1/ev2      size       pc          tcb         eom         ports       name
*0/0    1       1                     238       FFE1D46A    00007000    00042800    1/1/0/0/0   lt
  1/-1  1       1                    1762       FFE1010C    00047000    001FF800    0/0/0/0/0   MEtask
  2/-1  1       1                       6       0004FA1C    0004E9EE    000503AE    0/0/0/0/0   DMAtask
  3/0   64      1       98             10       FFE06F50    00044800    00047000    2/2/0/0/0
  4/0   40      10      99              8       FFE06F50    00042800    00044800    3/3/0/0/0

? kt 3

? lt
task    pri     tm      ev1/ev2      size       pc          tcb         eom         ports       name
*0/0    1       1                     238       FFE1D46A    00007000    00042800    1/1/0/0/0   lt
  1/-1  1       1                    1762       FFE1010C    00047000    001FF800    0/0/0/0/0   MEtask
  2/-1  1       1                       6       0004FA1C    0004E9EE    000503AE    0/0/0/0/0   DMAtask
  4/0   40      10      99              8       FFE06F50    00042800    00044800    3/3/0/0/0

? _
```

1.2.37 LO - Load S-record

Format: **LO**
LO <address> , <command line>,<-V|-T>

The LO command loads a S-record into memory from a standard input port. Normal I/O redirection may be used for input from other ports. The starting load address is optionally specified by <address>.

An optional command line may be specified which is sent to the host before S-record loading starts. It can be used to initiate a host system download without using the TM Command.

Two possible options exist which must be proceeded by a minus sign. If option V is given, the contents of the S-records will only be compared with contents of those memory locations which are to be loaded. The different values of the memory locations and the S-record data are displayed. If option T is given without an address parameter, the S-records are loaded immediately following the TCB. The following S-record types are supported by VMEPROM:

S0	Start record, ignored by VMEPROM and may be omitted.
S1	Data record with 16 bit address field
S2	Data record with 24 bit address field
S3	Data record with 32 bit address field
S7	End record with 32 bit address field
S8	End record with 24 bit address field
S9	End record with 16 bit address field

If the address for the LO command is specified on the command line, address fields in the data records are ignored and the S-record is loaded contiguously from the specified address upwards.

If the end record address field is equal, 0 control is transferred back to the VMEPROM command interpreter. If the address file holds an address, VMEPROM automatically executes a "G address" command after the S-record is loaded and an end record is found. Because of the "G" command all breakpoints which are defined are inserted in the program.

See also *DU - Dump S-records*

Example:

```
? lo <2 8800

?
```

1.2.38 LT - LIST TASKS

Format: **LT**

The LT command displays all tasks currently in the task list to the console. Task 0 is the system task and is created automatically during system initialization. This task cannot be killed.

Your current task is indicated by an '*' preceding the task number. Following the task number is a slash and the parent task number. Subsequent data provides the current status of each task and is defined as follows:

task	{*=current} Task #/parent task #
pri	Task priority (1-255)
tm	Time slice (1-255)
ev1/ev2	Suspended event(s)
size	Task size (k bytes)
pc	Current program counter. If the task is in suspended state or ready state the program counter points to the first opcode this task will execute after the task is moved to run state.
tcb	Task control block
eom	End of memory
ports	Task I/O ports in the following order: input port/output port/Unit 2 port/Unit 4 port/Unit 8 port
name	The name of the command currently executing

Example:

```
? lt
task    pri    tm    ev1/ev2    size    pc          tcb         eom         ports       name
*0/0    1      1                 256    FFE1D46A    00007000    0004700     1/1/0/0/0   lt
  1/-1  1      1                1762    FFE1010C    00047000    001FF800    0/0/0/0/0   MEtask
  2/-1  1      1                   6    0004FA1C    0004E9EE    000503AE    0/0/0/0/0   DMAtask

? _
```

1.2.39 M - Modify Memory

Format: **M <address>[,<option>]**
MM <address>[,<option>]

Option is B | W | L & N & O | E | Fx

The Modify Memory command is used to inspect and change memory locations. Several options are allowed on the command line to specify the size of the memory and the access type. The following options are allowed:

B	memory is byte sized (8 bits).
W	memory is word sized (16 bits). This is the default.
L	memory is long word sized (32 bits).
O	memory is byte sized and on odd addresses only.
E	memory is byte sized and on even addresses only.
N	memory is write only, the current contents is not displayed.
Fx	specifies the 68020 function code signals which should be driven from the 68020 to perform the read/write. The default value is 1. Possible values are:

1:	User Data Space	6:	Supervisor Program Space
2:	User Program Space	7:	CPU Space
5:	Supervisor Data Space		

The Odd and Even options are overriding the B/W/L options. The N (no read) option has to be specified after the size qualifier and after the Odd/Even specification. All memory accesses check that the write access was successful by performing a read after the write unless N is specified. If the data written and the data read do not match, the command is terminated and an error message is displayed. The memory modify command supports a number of sub-commands, which can be entered instead of a new memory value. These sub-commands do not change the access option specified on the command line. The following sub-commands are supported:

<cr>	open next location
=	open same location again
-	open previous location
-<count>	go back <count> bytes
+	open next location
+<count>	go forward <count> bytes
#<address>	open new absolute address
?<mnemonic>	insert 68000 opcode at current address
.	exit to the command interpreter

Example:

```
? M 8000
8000   4246 : <cr>
8002   1C2E : <cr>
8004   0441 : <cr>
8006   4247 : ?nop<cr>
8008   A05A : -2<cr>
8006   4E71 : -<cr>
8004   0441 : #8000<cr>
8000   4246 : <cr>
8002   1C2E : .
? M $10000, F5B

10000 48 : .

?_
```

1.2.40 MD - Display Memory

Format: **MD <address>**
MD <address>[,<count>]

The MD command displays the memory contents of the specified address. The data is displayed in hex and ASCII representation, 16 bytes on every line. If the hex value cannot be displayed in ASCII representation, a full stop (".") is displayed instead.

If no count is specified on the command line, the Display Memory command displays 16 lines, representing 256 bytes of data, and prompts the user to display more or to return to the command interpreter.

If a carriage return (<cr>) is entered, the next 256 bytes are displayed. Any other character returns control back to the command interpreter of VMEPROM.

If a count is specified on the command line, the value is interpreted as the number of bytes to be displayed. All values are assumed to be in hex.

If a base is specified with the BASE command this value is printed at the first line which is put out.

Example:

```
? MD 8000 30
00008000:  A0 0E 00 00 00 21 00 08  01 00 00 00 00 1C 00 04  .....!..........
00008010:  00 00 00 00 00 00 00 00  00 00 00 08 00 00 00 00  ................
00008020:  40 B0 00 00 24 E4 00 04  02 D5 00 00 00 80 00 08  @...$...........

? MD A000 30
0000A000:  08 98 00 00 04 88 00 01  00 80 00 08 40 08 00 80  ............@...
0000A010:  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
0000A020:  40 03 00 00 00 00 00 00  02 04 00 40 00 00 00 00  @..........@....

? BASE 2000

? MD 8000 30
00002000+
00008000:  08 98 00 00 04 88 00 01  00 80 00 08 40 08 00 80  ............@...
00008010:  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00008020:  40 03 00 00 00 00 00 00  02 04 00 40 00 00 00 00  @..........@....

? _
```

1.2.41 MEM - Set Data Bus Width of the VMEbus

Format: **MEM**
MEM 16
MEM 32

This command can display or set the data bus width of the CPU board on the VMEbus.
If no argument is entered, the current data bus width is displayed. If an argument of ’16’ or ’32’ is given, the data bus width is set to 16 or 32 bits respectively.

Example:

```
? MEM<cr>
Data bus width is set to 32 bits

? MEM 16<cr>

? MEM<cr>
Data bus width is set to 16 bits

? MEM 32<cr>

? _
```

1.2.42 MS - Set Memory to Constant or String

Format: **MS <address>,<data|"string">**

This command writes the specified data pattern to memory. The data may consist of hex numbers and ASCII data in any combination. The ASCII data must be put in inverted commas.

Example:

```
? BF 8000 8100 @377 B

? MD 8000 20
00008000:  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
00008010:  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................

? MS 8000 "Hello World"0D0A00

? MD 8000 20
00008000:  48 65 6C 6C 6F 20 57 6F  72 6C 64 0D 0A 00 FF FF  Hello World.....
00008010:  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................

? _
```

1.2.43 PROG - Program FLASH EPROM

Format: **PROG [<source>[,<destination>[,<length>[,<width>]]]]**

This command is used to program FLASH EPROMs. All parameters may be specified on the command line or may be entered interactively after the function has been invoked.

The first parameter <source> is the start address of the data which is to program into the FLASH EPROM.

The second parameter <destination> represents the base address of the FLASH EPROM.

The third parameter <length> specifies the length of the FLASH EPROM. If 0 is entered the length and width is automatically calculated.

The fourth parameter <width> selects the data width of the FLASH EPROMs. Three values are possible:

'1':	Byte width (8-bit)
'2':	Word width (16-bit)
'4':	Long width (32-bit)

Please note that the FLASH EPROM(s) must be completely programmed. Therefore programming only parts of a FLASH EPROM is not possible.

Example:

```
? PROG $100000 $FFC80000 0
  programming......
  FLASH EPROM successfully programmed

? PROG
  Source base address                        =    $40800000
  FLASH EPROM base address                   =    $FFC80000
  Source length (0 for automatic select)     =    $20000
  Width (1,2 or 4)                           =    1
  programming......
  FLASH EPROM successfully programmed

?_
```

1.2.44 PROMPT - CHANGE PROMPT SIGN

Format: **PROMPT [<data|"string">]**

The PROMPT command is used to change the prompt for the current task in the used specified pattern.

The data may consist of hex numbers and ASCII data in any combination. The ASCII data must be put in inverted commas.

If no parameter is given, the default VMEPROM prompt "?" will occur. The user defined prompt sign will be truncated to nine characters maximum.

Example:

```
? PROMPT "#"_
#_

#PROMPT ("HELLO> ")_
HELLO> _

HELLO> PROMPT_
? _
```

1.2.45 RM - Modify Processor Registers

Format: **RM**
RM <register>
RM <register>,<value>

The RM command modifies the processor registers or, if available, the data registers of the 68881 coprocessor. Three modes are allowed.

The first mode is an interactive mode, which scans all registers. For each register, the current value is displayed and the user is prompted to enter a new value. A <cr> leaves the register unchanged. After a new value or a <cr> has been entered, the same procedure will be started for the next register. If an <ESC> or <.> has been entered, control is transferred back to the command interpreter.

The second mode makes it possible to change only one specified register. The current value is then displayed and the user is prompted to enter a new value. A <cr> leaves the register unchanged. After a new value or a <cr> has been entered, control is transferred back to the command interpreter.

The third mode allows the specification of the new value for the given register on the command line and does not display the the old value.

The following registers may be modified by the user:

VBR	Vector base register, only on 68010/68020/68030 systems
SFC/DFC	Source and Destination function code register
CAAR	CACHE address register, only for 68020/68030 systems
CACR	CACHE control register, only for 68020/68030 systems
PC	Program counter
SR	Status register
USP	User Stack pointer
SSP	System Stack pointer
MSP	Master Stack pointer, only on 68020/68030 systems
D0-D7	Data registers D0-D7
A0-A7	Address registers A0-A7, where A7 is the current stack pointer as defined by the status register

Caution: **Be careful when modifying the Vector Base register (VBR) as VMEPROM is a interrupt driven system and any modifications to this register may crash the system.**

Example:

```
? RM D0
D0 = 00000000  : 12345678<cr>

? RM D1 1000

? DR
       0        1        2        3         4        5        6        7
D: 12345678 00001000 00000000 00000000  00000000 00000000 00000000 00000000
A: 00000000 00000000 00000000 00000000  00000000 00001000 00007000 0009CFFC

 VBR = 00000000   CAAR = 00000000   CACR = 00000001   SFC  = 0   DFC = 0
*USP = 0009CFFC   SSP  = 00007BE6   MSP  = 000078C4
 PC  = 00008000   SR   = 0000 ..U..0........

? _
```

1.2.46 RR2 - EPROM Programming

Format: **RR2 [<f>,<file>],<board>,<mode>,<option>**
RR2 [<m>,<addr>,<cnt>],<board>,<m>,<opt>

The RR2 command is used for programming EPROMS or EPROMS on a SYS68K/RR-2/RR-3 board. It can also be used to transfer files or memory contents into a SRAM area on the RR_2 or to load EPROM/EEPROM contents into the VMEPROM memory.

The following are examples on the usage of the RR2 command:

? RR2 F,FILENAME,RR_2_ADDRESS,MODE,OPTION
if the source is a disk file, or

? RR2 M,STRTADDR,BYTECNT,RR_2_ADDRESS,MODE,OPTION
if the source is in memory.

The following describes the parameters:

```
F,FILENAME.............source = disk file
                            F = source flag
                     FILENAME = the name of the source file
M,STRTADDR,BYTECNT.....source = memory
                            M = source flag
                     STRTADDR = source start address
                      BYTECNT = source length in bytes
RR_2_ADDR..............the address of the RR_2 bank
MODE...................1 = 8 bit mode (single EPROM)
                       2 = 16 bit mode (two EPROMS)
                       4 = 32 bit mode (four EPROMS)
OPTION.................P = program an EPROM (includes E and V and a bit
                                                      test)
                       E = check if EPROM is empty
                       V = verify source and EPROM contents
                       L = load EPROM contents to memory
```

For further information on the hardware setup of the SYS68K/RR2 or SYS68K/RR3 board please refer to the user’s manual of the RR-2/3 board.

Example:

```
? RR2 M,$0,$8000,$800000,2,E
```

executes an empty check in word mode for EPROM type 27128 (16k x 8) at RR_2 address $800000. The M - source flag and the memory address are dummy.

```
? RR2 F,PROG/2,$800000,4,P
```

programs EPROMS at address $800000 in 32-bit mode with the source file PROG from disk 2.

```
? RR2 M,$10000,$2000,$800000,1,L
```

loads the contents of an 8k x 8 EPROM at address $800000 into the memory to address $10000.

SYS68K/RR-2/RR-3 board configuration:

This example contains the RR-2 board configuration and and the program usage for 27128 EPROMs in the 16 bit mode.

Jumper settings for 16k x 8 EPROMs on bank 2 (TOSHIBA 27128):

```
B1b          Read time selection on bank 2

             8     5
             o o o o
               | |                              250 ns
             o o o o
             1     4

B2b          Write time selection on bank 2

             3       15
             o o o o o
                 |
             o o o o o                           50 ms

             o o o o o
             1       13

B4b          Device type bank 2

             4
             o o
               |                                EPROM type 1
             o o
             1

B13b         Device size bank 2

             10      6
             o o o o o
             | | | |                            4 x 16k x 8
             o o o o o
             1       5


B15          Device pinning bank 2

             3                   33
             o o o o o o o o o o o
             |       |
             o o o o o o o o o o o
                 |           | |
             o o o o o o o o o o o
             1                   31
```

```
B16         Enable VPP generator

            2
            o
            |
            o
            1


B17         Select VPP bank 2

            3
            o
            |
            o                              21V

            o
            1


B18         Select output enable on VPP bank 2

            2
            o

            o
            1


B19         Select chip erase bank 2

            3
            o

            o
            |
            o
            1


B11         Upper address bank 2

            2     8
            o o o o
              | | |                        $8
            o o o o
            1     7


B12         Lower address bank 2

            2     8
            o o o o
            | | | |                        $0
            o o o o
            1     7
```

Program call for subsequent jobs:

a) EPROM empty check

```
   ? RR2 M,$0,$8000,$800000,2,E
         │  │   │       │   │ └───option = empty check
         │  │   │       │   └─────mode = word
         │  │   │       └─────────RR-2 base address
         │  │   └─────────────────byte count (2 EPROMs 16k x 8)
         │  └─────────────────────memory address (don’t care)
         └────────────────────────source = memory
```

b) program EPROMs

```
   ? RR2 F,MYFILE:PRG/4,$800000,2,P
         │      │          │    │ └───option = program
         │      │          │    └─────mode = word
         │      │          └──────────RR-2 base address
         │      └─────────────────────source file name
         └────────────────────────────source = file
```

c) load EPROMs into memory

```
   ? RR2 M,$10000,$8000,$800000,2,L
         │    │     │      │    │ └───option = load
         │    │     │      │    └─────mode = word
         │    │     │      └──────────RR-2 base address
         │    │     └─────────────────byte count(2 EPROMs 16k x 8
         │    └───────────────────────memory address
         └────────────────────────────destination = memory
```

1.2.47 SELFTEST - Perform On-board Selftest

Format: SELFTEST

This command performs a test of the on-board functions of the IBC board. It may only be run if no other tasks are created. If there are any other tasks no selftest will be made and an error will be reported. The selftest tests the memory of the IBC board and all devices on the board.

The following tests are performed in this order:

1. **I/O test**

This function tests the access to and the interrupts from the SCC. If the SCC cannot generate interrupts an error will be reported.

2. **Memory test on the memory of the current task.**

The following procedures are performed:

1) Byte Test
2) Word Test
3) Long Word Test

All passes of the memory test perform pattern reading and writing as well as bit shift tests. If an error occurs while writing to or reading from memory it will be reported.

3. **Clock Test**

If the CPU does not receive timer interrupts from the CIO an error will be displayed. This ensures that VMEPROM could initialize the CIO 68230 properly and the interrupts from the CIO are working.

CAUTION: During this process, all memory is cleared.

Example:

```
? SELFTEST

VMEPROM Hardware Selftest

I/O test       . . . . . passed
Memory test      . . . . passed
Clock test       . . . . passed
? _
```

1.2.48 SM - SEND MESSAGE

Format: **SM [<task #>,<message>]**

The SEND MESSAGE command puts an ASCII text message in a message buffer. The destination is specified by <task#>. The message can be up to 63 characters in length.

If a message is sent to itself, i.e. the task which is sending the message, the complete message is interrupted as a command line and executed.

Note: No other commands can be appended to an ’SM’ command with a period, since the <message> parameter takes everything up to the carriage return.

If no parameter is given, all pending messages are displayed.

See also: *KM - KILL MESSAGE*.

Example:

```
? SM 2,Hello
?_
```

1.2.49 ST - SET TASK TERMINAL TYPE

Format: **ST**
ST <type>

The ST command sets the position cursor (PSC$) and clear screen (CSC$) variables in the task control block (TCB). This command makes it easy to use various types of terminals together with VMEPROM. Each task has its own characters for these two functions, which are initialized, when the task is started, to the parent task control set.

If a legal <type> is passed in the command line, then ST simply enters the corresponding sequences into the user status block.

Otherwise, the command prints the following table of options:

```
D = VT52
L = Lear Siegler ADM3a
V = VT100
T = TVI 950
U = User defined
Type = _
```

and prompts the user for an input. Enter the letter representing the type of terminal you are using.

The terminal type setup is only required for the VMEPROM screen editor. No other function uses the terminal dependant sequences.

The default setup of VMEPROM is the codes for a VT52 terminal.

In addition to the built in terminal types, the ST command allows to enter the values for position cursor, clear screen, clear to end of screen and clear to end of line interactively with the "C" option. So nearly every terminal can be used with VMEPROM.

? St U to to enter a user defined terminal

Enter encoded position cursor value: $.

Now the position cursor code can be entered in hex. The hex value must be 16 bit.

The format of the leading characters for cursor positioning is as follows (note that each letter represents a bit):

B111 1111 0222 2222

B = 0 then $00 bias
    1 then $20 bias
O = 0 then row before column, 1 then column before row
1 = 7 bits for first ASCII lead in character
2 = 7 bits for second ASCII lead in character
A value of 0 will result in the code for a VT100 terminal.

Enter encoded clear screen value: $_

The cursor home and clear screen can also be entered as a encoded 16 bit value. The format is (note that each letter represents a bit):

> E111 1111 E222 2222
>
> E = if 1 then precede with [ESC]
> 1 = 7 bits for first ASCII character
> 2 = 7 bits for second ASCII character
> If all 16 bits are 0 then a VT100 is selected

Enter encoded clear to end of screen value: $.

> This is the code to clear the access from the current cursor position to end of screen. The format is:
>
> 0111 1111 0222 2222
>
> 1 = 7 bit for first ASCII character
> 2 = 7 bit for second ASCII character

Enter encoded clear to end of line value: $_

This is the code to clear from the cursor position to the end of the line. The format is:

0111 1111 0222 2222

1 = 7 bit for first ASCII character
2 = 7 bit for second ASCII character

Example:

```
? ST
   D = VT52
   L = Lear Siegler ADM3a
   V = VT100
   T = TVI 950
   U = User defined
Type = L

? ST D
?
```

1.2.50 T - Trace Program Execution

Format: **T**
T <address>[,<begin>,<end>]
T <R|S|?>
TT
TT <address>[,<begin>,<end>]
TT <R|S|?>

The first format starts a user program in trace mode. The start address is the current value of the program counter (PC) as displayed by the DR command.

The second format is used to start a user program in trace mode at the specified address. Additionally two parameters (<begin> and <end>) are able to be given. These parameters specify an address range. Inside this range the program does not stop tracing.

The third format is used to display/set the trace mode. The parameter "S" toggles between enabling and disabling trace over subroutine. No stop inside a subroutine (i.e. started with BSR) will be done if trace over subroutine is enabled. The parameter "R" toggles between displaying the registers after each step and displaying only if trace count matches or the condition for trace over range is true. Displaying registers goes along with displaying the disassembled code of the next instruction which will be executed. The parameter "?" induces the displayal of the current settings.

If the program stops the user is prompted to continue the trace or to return to VMEPROM. Tracing can be continued by entering a space (" ") or a carriage return (<cr>).

See also: *TC - Set Trace Count*
TJ - Trace on change of flow

Example:

```
? DI 8000 7
8000   SUBA.L A5,A5
8002   ADDQ.L #1,A5
8004   BSR.B $800A
8006   ADDQ.L #3,A5
8008   XEXT
800A   ADDQ.L #2,A5
800C   RTS

? DR T
PC = 00008000  SP = 003B67FC  A6 = 00007000  A5 = 00001000

? T ?
Display registers after each step
Trace over subroutine is disabled
```

(Example cont’d)

```
? T 8000
Trace
PC = 00008002  SP = 003B67FC  A6 = 00007000  A5 = 00000000
8002 : ADDQ.L #1,A5<cr>
Trace
PC = 00008004  SP = 003B67FC  A6 = 00007000  A5 = 00000001
8004 : BSR.B $800A<cr>
Trace
PC = 0000800A  SP = 003B67F8  A6 = 00007000  A5 = 00000001
800A : ADDQ.L #2,A5<cr>
Trace
PC = 0000800C  SP = 003B67F8  A6 = 00007000  A5 = 00000003
800C : RTS<cr>
Trace
PC = 00008006  SP = 003B67FC  A6 = 00007000  A5 = 00000003
8006 : ADDQ.L #3,A5<cr>
Trace
PC = 00008008  SP = 003B67FC  A6 = 00007000  A5 = 00000006
8008 : XEXT<cr>

? T 8000 800A 9000
Trace
PC = 00008002  SP = 003B67FC  A6 = 00007000  A5 = 00000000
8002 : ADDQ.L #1,A5<cr>
Trace
PC = 00008004  SP = 003B67FC  A6 = 00007000  A5 = 00000001
8004 : BSR.B $800A<cr>
Trace
PC = 0000800A  SP = 003B67F8  A6 = 00007000  A5 = 00000001
800A : ADDQ.L #2,A5                                NO STOP!
Trace
PC = 0000800C  SP = 003B67F8  A6 = 00007000  A5 = 00000003
800C : RTS                                         NO STOP!
Trace
PC = 00008006  SP = 003B67FC  A6 = 00007000  A5 = 00000003
8006 : ADDQ.L #3,A5<cr>
Trace
PC = 00008008  SP = 003B67FC  A6 = 00007000  A5 = 00000006
8008 : XEXT<cr>

? T R
Display registers only if stop condition reached

? T 8000 800A 9000
Trace
PC = 00008002  SP = 003B67FC  A6 = 00007000  A5 = 00000000
8002 : ADDQ.L #1,A5<cr>
Trace
PC = 00008004  SP = 003B67FC  A6 = 00007000  A5 = 00000001
8004 : BSR.B $800A<cr>
Trace
PC = 00008006  SP = 003B67FC  A6 = 00007000  A5 = 00000003
8006 : ADDQ.L #3,A5<cr>
Trace
PC = 00008008  SP = 003B67FC  A6 = 00007000  A5 = 00000006
8008 : XEXT<cr>
```

(Example cont'd)

```
? T S
Trace over subroutine is enabled

? T 8000
Trace
PC = 00008002  SP = 003B67FC  A6 = 00007000  A5 = 00000000
8002 : ADDQ.L #1,A5<cr>
Trace
PC = 00008004  SP = 003B67FC  A6 = 00007000  A5 = 00000001
8004 : BSR.B $800A<cr>
Trace
PC = 00008006  SP = 003B67FC  A6 = 00007000  A5 = 00000003
8006 : ADDQ.L #3,A5<cr>
Trace
PC = 00008008  SP = 003B67FC  A6 = 00007000  A5 = 00000006
8008 : XEXT<cr>

? _
```

1.2.51 TC - Set Trace Count

Format: **TC <count>**

The Set Trace Count command sets the number of instructions to be traced continuously. The default after reset is 1.

See also: *T - Trace program execution* and *TJ - Trace on change of flow*

Example:

```
? TC
Trace count = 0

? TC 100
? TC
Trace count = 100

?
```

1.2.52 TIME - Enable/Disable Program Run Time Display

Format: **TIME**
TIME ON
TIME OFF

VMEPROM has the ability to measure the run time of user programs or command execution of the built in commands. This feature can be turned on and off with the TIME command. If only TIME is entered, the current status is displayed (i.e. On or OFF). VMEPROM displays the time in minutes, seconds, and tens and hundreds of seconds. If time measurement is enabled, a time stamp is taken whenever the command interpreter gets a complete input line. The timing stops when the function is executed and control is transferred back to the command interpreter.

Example:

```
? TIME
Time is off

? TIME ON
? BENCH 1 8000
Bench  1: Decrement long word in memory, 10.000.000 times
Benchmark time = 0:07.23
Programm execution time is 0:07.27

? TIME OFF
?
```

1.2.53 TJ - Trace on Change of Flow

Format: **TJ**
TJ <address>

This command is only supported on 68020 versions. It traces a user program (like the Trace command), but only on instructions where a change of program flow occurs. Such instructions are for example: BRA, BSR, JMP, JSR, RTS etc.

See the Trace command for a complete description of program tracing.

See also *T - Trace program execution*

Note: This command is only available for 32 bit processors.

1.2.54 TM - TRANSPARENT MODE

Format: **TM <port #>**
TM <port #>,<break>

The TRANSPARENT MODE command directs your current input to <port #>. Input received from <port #> is directed to your output. This command effectively allows you to access other systems as if you were a terminal.

This process continues until an [ESC] character is entered. This can be changed to another character by adding the <break> parameter.

Caution: **Typing ^C twice will abort every command currently in the state of execution. This is independent of the brake character.**

1.2.55 TP - TASK PRIORITY

Format: **TP**
TP <task #>
TP <task #>,<[time * 256 +] priority>

The TASK PRIORITY command allows you to change task priority of different tasks. The task number is specified by <task #> and defaults to the current task if omitted. If no priority is given the tasks current priority is displayed. Otherwise the tasks priority is changed to the given value.

The range of <priority> is from 1 to 255 where 255 is the highest priority. The highest priority, ready task always executes. Tasks on the same priority level are scheduled in a round robin fashion. The time a task is in running state is also given with the <priority> parameter. If no time is specified the time slice will not be changed. Otherwise it is calculated to "time*256+priority".

Example:

```
? lt
task    pri     tm      ev1/ev2         size    pc          tcb         eom         ports       name
*0/0    1       1                       238     FFE1D46A    00007000    00042800    1/1/0/0/0  lt
  1/-1  1       1                       1762    FFE1010C    00047000    001FF800    0/0/0/0/0  MEtask
  2/-1  1       1                       6       0004FA1C    0004E9EE    000503AE    0/0/0/0/0  DMAtask


? tp
Current tasks priority = 1, time slice = 1

? tp 1
Task #1 priority = 1, time slice = 1

? tp 1,256*10+1

? lt
task    pri     tm      ev1/ev2         size    pc          tcb         eom         ports       name
*0/0    1       1                       238     FFE1D46A    00007000    00042800    1/1/0/0/0  lt
  1/-1  1       10                      1762    FFE1010C    00047000    001FF800    0/0/0/0/0  MEtask
  2/-1  1       1                       6       0004FA1C    0004E9EE    000503AE    0/0/0/0/0  DMAtask

? tp 1
Task #1 priority = 1, time slice = 10

? tp 1,256*1+1

? lt
task    pri     tm      ev1/ev2         size    pc          tcb         eom         ports       name
*0/0    1       1                       238     FFE1D46A    00007000    00042800    1/1/0/0/0  lt
  1/-1  1       1                       1762    FFE1010C    00047000    001FF800    0/0/0/0/0  MEtask
  2/-1  1       1                       6       0004FA1C    0004E9EE    000503AE    0/0/0/0/0  DMAtask
```

1.2.56 UN - CONSOLE UNIT

Format: **UN**
UN {[-128]-}<unit number>

The CONSOLE UNIT command displays/sets the console output unit number. Unit 1 is the system terminal. Unit 2 and 3 are auxiliary output ports. The unit 4 is used by VMEPROM for output redirection and shall not be used.

The first format is used to display the current output unit number.

The second format selects where the output is to be directed. If the parameter is negative no character echo to the input port will be done. Otherwise character echo to the input port is enabled.
If the parameter is lower than -128 only the system prompt will be displayed at the input port. No character echo of the input port is done. The correct parameter for this command is calculated to "-128-unit number". This command is very helpful to recognize if a command line can be entered.

Example:

```
? UN
Unit mask = 1

? UN 3

? UN
Unit mask = 3

? UN -1
{LT}                                    No echo

task    pri    tm     ev1/ev2       size    pc          tcb         eom         ports      name
*0/0    1      1                    238     FFE1D46A    00007000    00042800    1/1/0/0/0  lt
  1/-1  1      1                    1762    FFE1010C    00047000    001FF800    0/0/0/0/0  MEtask
  2/-1  1      1                    6       0004FA1C    0004E9EE    000503AE    0/0/0/0/0  DMAtask

{UN -129}                               No echo

? {LT}                                  No echo
task    pri    tm     ev1/ev2       size    pc          tcb         eom         ports      name
*0/0    1      1                    238     FFE1D46A    00007000    00042800    1/1/0/0/0  lt
  1/-1  1      1                    1762    FFE1010C    00047000    001FF800    0/0/0/0/0  MEtask
  2/-1  1      1                    6       0004FA1C    0004E9EE    000503AE    0/0/0/0/0  DMAtask

? {UN 1}                                No echo

? _
```

1.2.57 ZM - ZERO MEMORY

Format: **ZM**

The ZERO MEMORY command clears the entire user work space to zeros. All flags and pointers are reset.

The memory is cleared from the end of the TCB up to the current user stack pointer. The values on the stack are not destroyed.

Example:

```
? ZM
?
```

VMEPROM SYSTEM CALLS

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1. VMEPROM SYSTEM CALLS

1.1 General Information

PDOS assembly primitives are assembly language system calls to PDOS. They consist of one word A-line instructions (words with the first four bits equal to hexadecimal ’A’). PDOS calls return results in the 68000 status register as well as regular user registers.

PDOS calls are divided into three categories:

1) System
2) Console I/O
3) File support primitives. Please note that these primitives are included, but all of them will return with an error. This is because of the loss of any file system in the VMEPROM of IBC.

The following primitives are available in a PDOS operating system environment, but not in VMEPROM:

PDOS debugger:	*PDOS monitor command:*
XBUG	XCHF
	XLST
	XBFL
	XAIM
	XGTP
	XEXZ

These primitives give reference to the PDOS Monitor/Debugger and are not included in VMEPROM. The monitor calls XGNP and XPCB of PDOS are emulated by VMEPROM and perform their expected functions.

1.2 Assembly Language Calls

PDOS assembly primitives are one word A-line instructions which use the exception vector at memory location $00000028. Most primitives use 68000 registers to pass parameters to and results from resident PDOS routines. Observe the following example for Trapping an error after a PDOS call:

```
CALLX       LEA.L   FILEN(PC),A1       ;GET FILE NAME
            XSOP                       ;OPEN FILE, ERROR?
            BNE.S ERROR                ;Y
            MOVE.W  D1,SLTN(A4)        ;N, SAVE SLOT #
```

PDOS primitives return error conditions in the processor status register. This provides error processing allowing a program to do long or short branches on different error conditions.

PDOS command primitives can be grouped into six levels according to their function and calling hierarchy. These levels are System Calls, System Support Calls, Console I/O Calls, File Support Calls, File Management Calls, and Disk Access Calls.

Level 1 PDOS primitives consist of system calls that deal with functions such as swapping, message passing, events, TRAP vector initialization, etc.

The PDOS system calls are as follows:

XGML - Get memory limits
XGUM - Get user memory
XFUM - Free user memory
XRTS - Read task status
XSTP - Set/read task priority
XLKT - Lock task
XULT - Unlock task
XSWP - Swap to next task
XCTB - Create task block
XKTB - Kill task
XSTM - Send task message
XGTM - Get task message
XKTM - Kill task message
XGMP - Get message pointer
XSMP - Send message pointer
XSEV - Set event flag
XSEF - Set event flag w/swap

XTEF - Test event flag
XDEV - Delay set/reset event
XSUI - Suspend until interrupt
XDTV - Define trap vectors
XSUP - Enter supervisor mode
XUSP - Return to user mode
XRSR - Read status register
XLSR - Load status register
XRTE - Return from interrupt
X881 - 68881 enable
XDMP - Dump memory from stack
XRDM - Dump registers
XEXC - Execute PDOS call D7.W
XLER - Load error register
XERR - Return error D0 to VMEPROM
XEXT - Exit to VMEPROM
XEXZ - Exit to VMEPROM with command

Level 2 consists of system support calls. Data conversion and data/time processing are their main functions. They are as follows:

XCBD - Convert binary to decimal
XCBH - Convert binary to hex
XCBM - Convert to decimal w/message
XCDB - Convert decimal to binary
XCBX - Convert to decimal in buffer
XCHX - Convert binary to hex in buffer
XRDT - Read date
XRTM - Read time

XRTP - Read time parameters
XFTD - Fix time & date
XPAD - Pack ASCII date
XUAD - Unpack ASCII Date
XUDT - Unpack date
XUTM - Unpack time
XWDT - Write date
XWTM - Write time
XGNP - Get next parameter

Level 3 primitives deal with console I/O. Included are commands for setting the baud rate and other characteristics of an I/O port, reading and writing characters or lines, clearing the screen, positioning the cursor, and monitoring port status.

XGCB - Conditional get character
XGCC - Get character conditional
XGCR - Get character
XGCP - Get port character
XGLB - Get line in buffer
XGLM - Get line in monitor buffer
XGLU - Get line in user buffer
XPBC - Put buffer to console
XPCC - Put character(s) to console
XPCL - Put CRLF
XPCR - Put character raw
XPSP - Put space to console
XPLC - Put line to console

XPDC - Put data to console
XPEL - Put encoded line to console
XPMC - Put message to console
XPEM - Put encoded message to console
XCLS - Clear screen
XPSC - Position cursor
XTAB - Tab to column
XRCP - Read port cursor position
XBCP - Baud console port
XSPF - Set port flag
XRPS - Read port status
XCBC - Check for break character
XCBP - Check for break or pause

Level 4 primitives are file support calls for the file manager. However, important functions such as copying files, appending files, sizing disks, and resetting disks are included here.

XFFN - Fix file name
XLFN - Look for name in file slots
XBFL - Build file directory list
XRDE - Read next directory entry
XRDN - Read directory entry by name
XAPF - Append file

XCPY - Copy file
XLDF - Load file
XRCN - Reset console inputs
XRST - Reset disk
XSZF - Get disk size

Level 5 primitives are the file management calls of PDOS. They use the file lock (event 120) to prevent conflicts between multiple tasks. Functions such as defining, deleting, reading, writing, positioning, and locking are supported by the file manager.

XDFL - Define file	**XULF** - Unlock file
XRNF - Rename file	**XRFP** - Read file position
XRFA - Read file attributes	**XRWF** - Rewind file
XWFA - Write file attributes	**XPSF** - Position file
XWFP - Write file parameters	**XRBF** - Read bytes from file
XDLF - Delete file	**XRLF** - Read line from file
XZFL - Zero file	**XWBF** - Write bytes to file
XSOP - Open sequential	**XWLF** - Write line to file
XROO - Open random read only	**XFBF** - Flush buffers
XROP - Open random	**XFAC** - File altered check
XNOP - Open non-exclusive random	**XCFA** - Close file w/attribute
XLKF - Lock file	**XCLF** - Close file

The final level of primitives is for disk access via the read/write logical sector routines in the PDOS BIOS. A disk lock (event 121) is used to make these calls autonomous and prevent multiple commands from being sent to the disk controller.

XISE - Initialize sector	**XWSE** - Write sector
XRSE - Read sector	**XRSZ** - Read sector zero

1.3 Description of Kernel Primitives

The following chapters give a detailed description of all Kernel calls available in VMEPROM.

1.3.1 X881 - SAVE 68881 ENABLE

Mnemonic:	X881
Value:	$A006
Module:	MPDOSK1
Format:	X881

Description: The SAVE 68881 ENABLE sets the BIOS save flag (SVF$(A6)) thus signaling the PDOS BIOS to save and restore 68881 registers and status during context switches. The save flag is again cleared by exiting to VMEPROM.

See also: None

Possible Errors: None

1.3.2 XAPF - APPEND FILE

Mnemonic:	XAPF
Value:	$A0AA
Module:	MPDOSF
Format:	XAPF <status error return>

Registers: In (A1) = Source file name
(A2) = Destination file name

Note: A [CTRL-C] will terminate this primitive and return error -1 in data register D0.

Description: The APPEND FILE primitive is used to append two files together.

The source and destination file names are pointed to by address registers A1 and A2, respectively. The source file is appended to the end of the destination file. The source file is not altered.

See also: None

Possible Errors:

-1 = Break
50 = Invalid file name
53 = File not defined
60 = File space full
61 = File already open
68 = Not PDOS disk
69 = Not enough file slots
Disk errors

1.3.3 XBCP - BAUD CONSOLE PORT

Mnemonic:	XBCP
Value:	$A070
Module:	MPDOSK2
Format:	XBCP
	<status error return>

Registers:	In	D2.W = f0PI 8DBS / <port #>
		D3.W = Baud rate
		D1.W = Port type
		D5.L = Port base

Description: The BAUD CONSOLE PORT primitive initializes any one of the PDOS I/O ports and binds a physical UART to a character buffer. The primitive sets handshaking protocol, receiver and transmitter baud rates, and enables receiver interrupts.

Data register D2 selects the port number and sets (or clears) the corresponding flag bits. If D2.W is negative, then the absolute value is subsequently used and the port number is stored in U2P$(A6).

The right byte of data register D2 (bits 0-7) selects the console port.

The left byte of D2.W (bits 8-15) selects various flag options including ^S-^Q and/or DTR handshaking, receiver parity and interrupt enable, and 8-bit character I/O.

The receiver and transmitter baud rates are initialized to the same value according to register D3. Register D3 ranges from 0 to 7 or the corresponding baud rates of 19200, 9600, 4800, 2400, 1200, 600, 300, or 110.

If data register D4 is non-zero, then it selects the port type and register D5 selects the port base address. These parameters are system-defined and correspond to the UART module. If register D4 is zero, there is no change.

See also: XRPS - READ PORT STATUS
XSPF - SET PORT FLAG

Possible Errors: 66 = Invalid port or baud rate

1.3.4 XCBC - CHECK FOR BREAK CHARACTER

Mnemonic:	XCBC
Value:	$A072
Module:	MPDOSK2
Format:	XCBC <status return>

Registers:	Out	SR	=	EQ....No break
				LO....[CTRL-C], Clear flag & buffer
				LT....[ESC], Clear flag
				MI....[CTRL-C] or [ESC]

Note: If the ignore control character bit ($02) of the port flag is set, then XCBC always returns .EQ. status.

Description: The CHECK FOR BREAK CHARACTER primitive checks the current user input port break flag (BRKF.(A5)) to see if a break character has been entered. The PDOS break characters are [CTRL-C] and the [ESC] key. A [CTRL-C] sets the port break flag to one, while an [ESC] character sets the flag to a minus one. The XCBC primitive samples and clears this flag. The condition of the break flag is returned in the status register. An 'LO' condition indicates a [CTRL-C] has been entered. The break flag and the input buffer are cleared. All subsequent characters entered after the [CTRL-C] and before the XCBC call are dropped.

All open procedure files are closed and any system frames are restored. Also, the last error number flag (LEN$) is set to -1 and a '^C' is output to the port. An 'LT' condition indicates an [ESC] character has been entered. Only the break flag is cleared and not the input buffer. Thus, the [ESC] character remains in the buffer.

The [CTRL-C] character is interpreted as a hard break and is used to terminate command operations. The [ESC] character is a soft break and remains in the input buffer, even though the break flag is cleared by the XCBC primitive. (This allows an editor to use the [ESC] key for special functions or command termination.)

See also: None

Possible Errors: None

1.3.5 XCBD - CONVERT BINARY TO DECIMAL

Mnemonic:	XCBD
Value:	$A050
Module:	MPDOSK3
Format:	XCBD

Registers: In D1.L = Number
Out (A1) = String

Description: CONVERT BINARY TO DECIMAL primitive converts a 32-bit, 2's complement number to a character string. The number to be converted is passed to XCBD in data register D1. Address register A1 is returned with a pointer to the converted character string located in the monitor work buffer (MWB$).

Leading zeros are suppressed and a negative sign is the first character for negative numbers. The string is delimited by a null. The string has a maximum length of 11 characters and ranges from -2147483648 to 2147483647.

See also: XCBX - CONVERT TO DECIMAL IN BUFFER.

Possible Errors: None

1.3.6 XCBH - CONVERT BINARY TO HEX

Mnemonic:	XCBH
Value:	$A052
Module:	MPDOSK3
Format:	XCBH

Registers: In D1.L = Number
Out (A1) = String

Description: CONVERT BINARY TO HEX primitive converts a 32-bit number to its hexadecimal (base 16) representation. The number is passed in data register D1 and a pointer to the ASCII string is returned in address register A1. The converted string is found in the monitor work buffer (MWB$) of the task control block and consists of eight hexadecimal characters followed by a null.

See also: XCHX - CONVERT BINARY TO HEX IN BUFFER.

Possible Errors: None

1.3.7 XCBM - CONVERT TO DECIMAL W/MESSAGE

Mnemonic:	XCBM
Value:	$A054
Module:	MPDOSK3
Format:	XCBM <message>

Registers: In D1.L = Number
Out (A1) = String

Description: CONVERT TO DECIMAL WITH MESSAGE primitive converts a 32-bit, signed number to a character string. The output string is preceded by the string whose PC relative address is in the operand field of the call.

The string can be up to 20 characters in length and is terminated by a null character. The number to be converted is passed to XCBM in data register D1. Address register A1 is returned with a pointer to the converted character string which is located in the monitor work buffer (MWB$) of the task control block.

Leading zeros are suppressed and the result ranges from -2147483648 to 2147483647.

The message address is a signed 16-bit PC relative address.

See also: None

Possible Errors: None

1.3.8 XCBP - CHECK FOR BREAK OR PAUSE

Mnemonic:	XCBP
Value:	$A074
Module:	MPDOSK2
Format:	XCBP <status return>

Registers: Out SR = EQ...No character
LT...[ESC]
LO...[CTRL-C]
NE...Pause

Note: If a 'BLT' instruction does not immediately follow the XCBP call, then the primitive exits to PDOS when an [ESC] character is entered.

If the ignore control character bit ($02) of the port flag is set, then XCBP always returns .EQ. status.

Description: CHECK FOR BREAK OR PAUSE primitive looks for a character from your PRT$(A6) port. Any non-control character will cause XCBP to output a pause message and wait for another character.

The pause message consists of:

[CR]
'Strike any key...'
[CR]
'
[CR].

A [CTRL-C] will abort any assigned console file and return the status 'LO'. If a 'BLT' instruction follows the XCBP primitive and an [ESC] character is entered, then the call returns with status 'LT'. Otherwise, an [ESC] will abort your program to VMEPROM.

An 'EQ' status indicates that no character was entered. An 'NE' status indicates a pause has occurred.

See also: None

Possible Errors: None

1.3.9 XCBX - CONVERT TO DECIMAL IN BUFFER

Mnemonic:	XCBX
Value:	$A06A
Module:	MPDOSK3
Format:	XCBX

Registers: In D1.L = Number
(A1) = Buffer

Description: CONVERT TO DECIMAL IN BUFFER primitive converts a 32-bit, 2's complement number to a character string. The number to be converted is passed to XCBX in data register D1. Address register A1 points to the buffer where the converted string is stored.

Leading zeros are suppressed and a negative sign is the first character for negative numbers. The string is delimited by a null. The string has a maximum length of 11 characters and ranges from -2147483648 to 2147483647.

See also: XCBD - CONVERT BINARY TO DECIMAL.

Possible Errors: None

1.3.10 XCDB - CONVERT ASCII TO BINARY

Mnemonic:	XCDB
Value:	$A056
Module:	MPDOSK3
Format:	XCDB <status return>

```
Registers:  In    (A1) = String
            Out   D0.B = Delimiter
                  D1.L = Number
                  (A1) = Updated string
                  SR =   LT....No number
                         EQ....# w/o null delimiter
                         GT....#
```

Note: XCDB does not check for overflow.

Description: CONVERT ASCII TO BINARY primitive converts an ASCII string of characters to a 32-bit, 2’s complement number. The result is returned in data register D1 while the status register reflects the conversion results.

XCDB converts signed decimal, hexadecimal, or binary numbers.

Hexadecimal numbers are preceded by "$" and binary numbers by "%". A "-" indicates a negative number. There can be no embedded blanks.

An ’LT’ status indicates that no conversion was possible. Data register D0 is returned with the first character and address register A1 points immediately after it.

A ’GT’ status indicates that a conversion was made with a null delimiter encountered. The result is returned in data register D1. Address register A1 is returned with an updated pointer and register D0 is set to zero.

An ’EQ’ status indicates that a conversion was made but the ASCII string was not terminated with a null character.

The result is returned in register D1 and the non-numeric, non-null character is returned in register D0.

Address register A2 has the address of the next character.

See also: None

Possible Errors: None

1.3.11 XCFA - CLOSE FILE W/ATTRIBUTE

Mnemonic:	XCFA
Value:	$A0D0
Module:	MPDOSF
Format:	XCFA
	<status error return>

Registers:	In	D1.W = File ID
		D2.B = New attribute

Description: CLOSE FILE WITH ATTRIBUTES primitive closes the open file specified by data register D1. At the same time, the file attributes are updated according to the byte contents of data register D2.

D2.B	= $80	AC or Procedure file
	= $40	BN or Binary file
	= $20	OB or 68000 object file
	= $10	SY or 68000 memory image
	= $08	BX or BASIC binary token file
	= $04	EX or BASIC ASCII file
	= $02	TX or Text file
	= $01	DR or System I/O driver
	= $00	Clear file attributes

If the file was opened for sequential access and the file has been updated, then the END-OF-FILE marker is set at the current file pointer. If the file was opened for random or shared access, then the END-OF-FILE marker is updated only if the file has been extended (data was written after the current END-OF-FILE marker). The LAST UPDATE is updated to the current date and time only if the file has been altered. All files must be closed when opened! Otherwise, directory information and possibly even the file itself will be lost.

Note: If the file is not altered, then XCFA will not alter the file attributes.

See also: XRFA - READ FILE ATTRIBUTES
XWFA - WRITE FILE ATTRIBUTES
XWFP - WRITE FILE PARAMETERS

Possible Errors:

52 = File not open
59 = Invalid file slot
75 = File locked
Disk errors

1.3.12 XCHX - CONVERT BINARY TO HEX IN BUFFER

Mnemonic:	XCHX
Value:	$A068
Module:	MPDOSK3
Format:	XCHX

Registers: In D1.L = Number
(A1) = Output buffer

Description: CONVERT BINARY TO HEX IN BUFFER primitive converts a 32-bit number to its hexadecimal (base 16) representation. The number is passed in data register D1 and a pointer to a buffer in address register A1. The converted string consists of eight hexadecimal characters followed by a null.

See also: XCBH - CONVERT BINARY TO HEX.

Possible Errors: None

1.3.13 XCLF - CLOSE FILE

Mnemonic:	XCLF
Value:	$A0D2
Module:	MPDOSF
Format:	XCLF <status error return>
Registers:	In D1.W = File ID

Description: CLOSE FILE primitive closes the open file as specified by the file ID in data register D1. If the file was opened for sequential access and the file was updated, then the END-OF-FILE marker is set at the current file pointer.

If the file was opened for random or shared access, then the END-OF-FILE marker is updated only if the file was extended (ie. data was written after the current END-OF-FILE marker).

If the file has been altered, the current date and time is stored in the LAST UPDATE variable of the file directory. All open files must be closed at or before the completion of a task (or before disks are removed from the system)! Otherwise, directory information is lost and possibly even the file itself.

See also: None

Possible Errors:

52 = File not open
59 = Invalid slot #
75 = File locked
Disk errors

1.3.14 XCLS - CLEAR SCREEN

Mnemonic:	XCLS
Value:	$A076
Module:	MPDOSK2
Format:	XCLS

Registers: None

Note: The clear screen characters are located in the user TCB variable CSC$(A6).

Description: CLEAR SCREEN primitive clears the console screen, homes the cursor, and clears the column counter. This function is adapted to the type of console terminals used in the PDOS system.

The character sequence to clear the screen is located in the task control block variable CSC$(A6). These characters are transferred from the parent task to the spawned task during creation. The initial characters come from the BIOS module.

If CSC$ is nonzero, then the CLEAR SCREEN primitive outputs up to four characters: one or two characters; an [ESC] followed by a character; or an [ESC], character, [ESC], and a final character. The one-word format allows for two characters. The parity bits cause the [ESC] character to precede each character.

If CSC$ is zero, then PDOS makes a call into the BIOS for custom clear screens. The entry point is B_CLS beyond the BIOS table.

The ST command maintains the CSC$ field, although it can be altered under program control.

See also: XRCP - READ PORT CURSOR POSITION

Possible Errors: None

1.3.15 XCPY - COPY FILE

Mnemonic:	XCPY
Value:	$A0AE
Module:	MPDOSF
Format:	XCPY <status error return>

Registers: In (A1) = Source file name
(A2) = Destination file name

Note: A [CTRL-C] terminates this primitive and returns the error -1 in register D0.

Description: COPY FILE primitive copies the source file into the destination file. The source file is pointed to by address register A1 and the destination file is pointed to by register A2. A [CTRL-C] halts the copy, prints '^C' to the console, and returns with error -1.

The file attributes of the source file are automatically transferred to the destination file.

See also: None

Possible Errors:

-1 = Break file transfer
50 = Invalid file name
53 = File not defined
60 = File space full
61 = File already open
68 = Not PDOS disk
69 = No more file slots
70 = Position error
Disk errors

1.3.16 XCTB - CREATE TASK BLOCK

Mnemonic:	XCTB
Value:	$A026
Module:	MPDOSK1
Format:	XCTB <status error return>
Registers:	In D0.W = Task size (1 Kbyte increments) D1.W = Task time.B/priority.B D2.W = I/O port (A0) = Optional low memory pointer (A1) = Optional high memory pointer (A2) = Command line pointer or entry address Out D0.L = Spawned task number

Note: If D0.W is positive, A0 and A1 are undefined.

If D0.W equals zero, A0 and A1 are the new task's memory bounds and A2 contains the task's entry address.

If D0.W is negative, A0 and A1 are the new task's memory bounds and A2 points to the task's command line.

Description: CREATE TASK primitive places a new task entry in the PDOS task list. Memory for the new task is either from the parent task or the system memory bit map. Data register D0 controls the creation mode of the new task as well as the task size. If register D0.W is positive, the first available contiguous memory block equal to D0.W (in 1 Kbyte) is allocated to the new task. If the block is not big enough, the upper memory of the parent task is allocated to the new task. The parent task's memory is then reduced by D0.W x 1 Kbytes. Address register A2 points to the new task command line. If A2 is zero, VMEPROM is invoked. If register D0.W is zero, registers A0 and A1 specify the new task's memory limits. Register A2 specifies the task's starting PC. The task control block begins at (A0) and is immediately followed by an XEXT primitive. The task user stack pointer is set at (A1). Thus, the new program should allow $1000 bytes at the low end and enough user stack space at the upper end.

If data register D0.W is negative, registers A0 and A1 specify the new task's memory limits. Register A2 points to the new task command line. (If A2=0, VMEPROM is invoked). The command line is transferred to the spawned program by a system message buffer. The maximum command line length is 64 characters. When the task is scheduled for the first time, message buffers are searched for a command. Messages with a source task equal to $FF are considered commands and moved to the task's monitor buffer.

The task CLI then processes the line. If no command message is found, then the VMEPROM is called directly.

Data register D1.W specifies the new task's priority. The range is from 1 to 255. The larger the number, the higher the priority.

Data register D2.W specifies the I/O port to be used by the new task.

If register D2.W is positive, then the port is available for both input and output. If register D2.W is negative, then the port is used only for output. If register D2.W is zero, then no port is assigned. Only one task may be assigned to any one input port while many tasks may be assigned to an output port. Hence, a port is allocated for input only if it is available. An invalid port assignment does not result in an error.

A call is made to D$INT in the debugger module. This initializes all addresses, registers, breaks, and offsets.

Finally, the spawned task's number is returned in register D0.L to the parent task. This can be used later to test task status or to kill the task.

See also: None

Possible Errors:

72 = Too many tasks
73 = Not enough memory

1.3.17 XDEV - DELAY SET/RESET EVENT

Mnemonic:	XDEV
Value:	$A032
Module:	MPDOSK1
Format:	XDEV <status error return>

Registers: In D0.L = Time
D1.B = Event (+=Set, -=Reset)

Note: If D0.L=0, then the D1.B event is cleared.

Description: DELAY SET/RESET EVENT primitive places a timed event in a system stack controlled by the system clock. Data register D0.L specifies the time interval in clock tics. When it counts to zero, then the event D1.B is set if positive, or reset if negative.

If the event already exists in the stack, it is replaced by the new entry. If the time specified in D0 equals zero, then any pending timed event equal to D1.B is deleted from the stack.

If D1.B is positive, event D1.B is first cleared. If D1.B is negative, event D1.B is set before exiting the primitive.

See also: XSEF - SET EVENT FLAG W/SWAP
XSEV - SET EVENT FLAG
XSUI - SUSPEND UNTIL INTERRUPT
XTEF - TEST EVENT FLAG

Possible Errors: 83 = Delay event stack full

1.3.18 XDFL - DEFINE FILE

Mnemonic:	XDFL
Value:	$A0D4
Module:	MPDOSF
Format:	XDFL <status error return>

Registers: In D0.W = # of contiguous sectors
(A1) = File name

Description: DEFINE FILE primitive creates a new file entry in a PDOS disk directory, specified by address register A1. A PDOS file name consists of an alphabetic character followed by up to 7 additional characters. An optional 3 character extension can be added if preceded by a colon. Likewise, the directory level and disk number are optionally specified by a semicolon and slash respectively. The file name is terminated with a null.

Data register D0 contains the number of sectors to be initially allocated at file definition. If register D0 is nonzero, then a contiguous file is created with D0 sectors. Otherwise, only one sector is allocated. Each sector of allocation corresponds to 252 bytes of data.

A contiguous file facilitates random access to file data since PDOS can directly position to any byte within the file without having to follow sector links. A contiguous file is automatically changed to a non-contiguous file if it is extended with non-contiguous sectors.

See also: None

Possible Errors:

50 = Invalid file name
51 = File already defined
55 = Fragmentation error
57 = File directory full
61 = File already open
68 = Not PDOS disk
Disk errors

1.3.19 XDLF - DELETE FILE

Mnemonic:	XDLF
Value:	$A0D6
Module:	MPDOSF
Format:	XDLF <status error return>
Registers:	In (A1) = File name
Description:	DELETE FILE primitive removes the file whose name is pointed to by address register A1 from the disk directory and releases all sectors associated with that file for use by other files on that same disk. A file cannot be deleted if it is delete (*) or write (**) protected.
See also:	None

Possible Errors:

50 = Invalid file name
53 = File not defined
58 = File delete or write protected
61 = File already open
68 = Not PDOS disk
Disk errors

1.3.20 XDMP - DUMP MEMORY FROM STACK

Mnemonic:	XDMP
Value:	$A04A
Module:	MPDOSK3
Format:	XDMP

Registers:	In	USP.L = <# of bytes>.W
	<start address>.L	
	Out	USP.L = USP.L + 6

Description: DUMP MEMORY FROM STACK primitive dumps a block of memory to the console as specified by two parameters on the user stack (USP). The left side of the output is a hexadecimal dump and the right side is a masked ($7F) ASCII dump.

To use this primitive, first push a 32-bit address and then a 16-bit number of the amount of memory to be dumped. The primitive will automatically clean up the user stack.

See also: None

Possible Errors: None

1.3.21 XDPE - DELAY PHYSICAL EVENT

Mnemonic:	XDPE
Value:	$A114
Module:	MPDOSK1
Format:	XDPE

Registers:	In	A0	= Event address
		D0.L	= Time TICs for delay (0=clear entry)
		D1.W	= Event descriptor

Description: Causes the specified event to be set/cleared after the specified time has elapsed. Each event can have only one delayed action pending. Successive calls will supersede pending requests. Only the lower eight bits of the descriptor are used. To cancel pending actions, specify a delay time of 0.

The event descriptor is a 16-bit word that defines both the bit number at the specified A0 address and the action to take on the bit. The following bits are defined:

```
Bit number -  15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
              T  x  x  x  x  x x x S x x x x B B B
```

T = Should the bit be toggled on scheduling?
1 = Yes (toggle), 0 = No (do not toggle)

S = Suspend on event bit clear or set
1 = Suspend on SET, 0 = Suspend on CLEAR

BBB = The 680 x 0 bit number to use as an event
x = Reserved, should be 0

Since the bit number is specified in the lower three bits of the descriptor, you may use the descriptor with the 680 x 0 BTST, BCLR, BSET instructions.

See also: XDEV - Delay Set/Clear Event
XSOE - Suspend on Physical Event
XTLP - Translate Logical to Physical Event

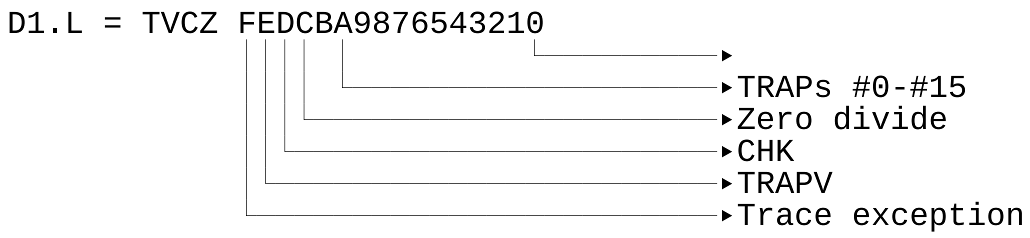
1.3.22 XDTV - DEFINE TRAP VECTORS

Mnemonic:	XDTV
Value:	$A024
Module:	MPDOSK1
Format:	XDTV

Registers: In D1.L = TVCZ FEDC BA98 7654 3210
(A0) = Table base address
(A1) = Vector table address

```
Vector table:  DC.L TRAP #0-<BASE ADR>
                    ....
                    DC.L TRAP #15-<BASE ADR>
                    DC.L ZDIV-<BASE ADR>
                    DC.L CHK-<BASE ADR>
                    DC.L TRAPV-<BASE ADR>
                    DC.L TRACE-<BASE ADR>
```

Note: The vector table size is variable and each entry corresponds to non-zero bits in the mask register (D1.L). Each entry is a long signed displacement from the base address register.



Description: The DEFINE TRAP VECTORS primitive loads user routine addresses into the task control block exception vector variables. Each task has the option to process its own TRAP, zero divide, CHK, TRAPV, and/or trace exceptions.

Data register D1 selects which vectors are to be loaded according to individual bits corresponding to vectors in the vector table pointed to by address register A1. Bits 0 through 19 (right to left) correspond to TRAPs 0 through 15, zero divide, CHK, TRAPV, and trace exceptions. A 1 bit moves a vector from the vector table (biased by base address A0) into the task control block.

When an exception occurs, the task control block is checked for a corresponding non-zero exception vector. If found, then the return address is pushed on the user stack (USP) followed by the exception address and condition codes. PDOS next moves to user mode and executes a return with condition codes (RTR). This effectively acts like a jump subroutine with the return address on the user stack.

The trace processing is handled differently. If the processor is in supervisor mode when a trace exception occurs, the trace bit is cleared and the exception is dismissed. The processor remains in supervisor mode. If the processor is in user mode and there is a non-zero trace variable in the task control block, then the trace is again disabled, the trace processor address is pushed on the supervisor stack along with status, and a return from exception is executed (RTE).

See also:

Possible Errors: None

1.3.23 XERR - RETURN ERROR D0 TO VMEPROM

Mnemonic:	XERR
Value:	$A00C
Module:	MPDOSK1
Format:	XERR

Registers: In D0.W = Error code

Description: RETURN ERROR D0 TO VMEPROM primitive exits to VMEPROM and passes an error code in data register D0. PDOS prints ’PDOS ERR’, followed by the decimal error number. The error call can be intercepted by changing the value of the ERR$ variable in the task TCB. This allows you to customize your own monitor.

See also: XEXT - EXIT TO VMEPROM

Possible Errors: None

1.3.24 XEXC - EXECUTE PDOS CALL D7.W

Mnemonic:	XEXC
Value:	$A030
Module:	MPDOSK1
Format:	XEXC

Registers: In D7.W = Aline PDOS CALL

Description: EXECUTE PDOS CALL D7.W primitive executes a variable PDOS primitive contained in data register D7. Any registers or error conditions apply to the corresponding PDOS call.

See also: Possible Errors: Call dependent

1.3.25 XEXT - EXIT TO VMEPROM

Mnemonic:	XEXT
Value:	$A00E
Module:	MPDOSK1
Format:	XEXT (Always exits to VMEPROM)
Registers:	None

Description: EXIT TO VMEPROM primitive exits a user program and returns to VMEPROM.

The exit can be intercepted by changing the value of the EXT$ variable in the task TCB. This primitive allows you to customize your own monitor.

See also: XERR - RETURN ERROR D0 TO VMEPROM

Possible Errors: None

1.3.26 XFAC - FILE ALTERED CHECK

Mnemonic:	XFAC
Value:	$A0CE
Module:	MPDOSF
Format:	XFAC
	<status error return>

Registers:	In	(A1) = FILE NAME
	Out	CC = File not altered
		CS = File altered
		NE = Error

Description: FILE ALTERED CHECK primitive looks at the altered bit (bit $80) of the file pointed to by address register A1. If the bit is zero (not altered), then the primitive returns with the carry status bit clear.

If the alter bit is set (file altered), then it is cleared and the primitive returns with carry set. If either case, the bit is always cleared.

See also: None

Possible Errors: Disk errors

1.3.27 XFBF - FLUSH BUFFERS

Mnemonic:	XFBF
Value:	$A0F8
Module:	MPDOSF
Format:	XFBF
	<status error return>

Registers: None

Description: FLUSH BUFFERS primitive forces all file slots with active channel buffers to write any updated data to the disk. It thus does a checkpoint of any open and altered file.

See also: None

Possible Errors: Disk errors

1.3.28 XFFN - FIX FILE NAME

Mnemonic:	XFFN
Value:	$A0A0
Module:	MPDOSF
Format:	XFFN <status error return>

Registers:	In	(A1) = File name
	Out	D0.L = Disks(4th/3rd/2nd/1st)
		(A1) = MWB$, Fixed file name

Description: FIX FILE NAME primitive parses a character string for file name, extension, directory level, and disk number. The results are returned in the 32-character monitor work buffer (MWB$(A6)). Data register D0 is also returned with the disk number. The error return is used for an invalid file name.

The monitor work buffer is cleared and the following assignments are made:

0(A1) = File name
8(A1) = File extension
11(A1) = File directory level

System defaults are used for the disk number and file directory level when they are not specified in the file name.

See also: XRDN - READ DIRECTORY ENTRY BY NAME

Possible Errors:

50 = Invalid file name

1.3.29 XFTD - FIX TIME & DATE

Mnemonic:	XFTD
Value:	$A058
Module:	MPDOSK3
Format:	XFTD

Registers: Out D0.W = Hours * 256 + Minutes
D1.W = (Year * 16 + Month) * 32 + Day

Description: FIX TIME & DATE primitive returns a two-word encoded time and date generated from the system timers. The resultant codes include month, day, year, hours, and minutes. The ordinal codes can be sorted and used as inputs to the UNPACK DATE (XUDT) and UNPACK TIME (XUTM) primitives.

Data register D0.W contains the time and register D1.W contains the date. This format is used throughout PDOS for time stamping items.

See also:
XPAD - PACK ASCII DATE
XRDT - READ DATE
XRTM - READ TIME
XUAD - UNPACK ASCII DATE
XUDT - UNPACK DATE
XUTM - UNPACK TIME

Possible Errors: None

1.3.30 XFUM - FREE USER MEMORY

Mnemonic:	XFUM	
Value:	$A040	
Module:	MPDOSK1	
Format:	XFUM	
	<status error return>	
Registers:	In	D0.W = Number of K bytes
		(A0) = Beginning address

Description: FREE USER MEMORY primitive deallocates user memory to the system memory bit map. Data register D0.W specifies how much memory is to be deallocated while address register A0 points to the beginning of the data block.

Memory thus deallocated is available for any task use including new task creation.

Possible Errors:

79 = Memory error

1.3.31 XGCB - CONDITIONAL GET CHARACTER

Mnemonic:	XGCB
Value:	$A048
Module:	MPDOSK2
Format:	XGCB <status return>

Registers: Out D0.L = Character in bits 0-7
SR = EQ....No character
LO....[CTRL-C]
LT....[ESC]
MI....[CTRL-C] or [ESC]

Note: If the ignore control character bit ($02) of the port flag is set, then XGCB ignores [CTRL-C] and [ESC].

Description: CONDITIONAL GET CHARACTER primitive checks for a character from first, the input message pointer (IMP$(A6)), second, the assigned input file (ACI$(A6)), and then finally, the interrupt driven input character buffer (PRT$(A6)). If a character is found, it is returned in the right byte of data register D0.L and the rest of the register is cleared.

If there is no input message, no assigned console port character, and the interrupt buffer is empty, the status is returned as ’EQ’.

The status is returned ’LO’ and the break flag cleared if the returned character is a [CTRL-C]. The input buffer is also cleared. Thus, all characters entered after the [CTRL-C] and before the XGCB call are dropped.

The status is returned ’LT’ and the break flag cleared if the returned character is the [ESC] character.

For all other characters, the status is returned ’HI’ and ’GT’. The break flag is not affected.

Possible Errors: None

1.3.32 XGCC - GET CHARACTER CONDITIONAL

Mnemonic:	XGCC
Value:	$A078
Module:	MPDOSK2
Format:	XGCC <status return>

```
Registers:   Out   D0.L = Character in bits 0-7
                   SR = EQ....No character
                   LO....[CTRL-C]
                   LT....[ESC]
                   MI....[CTRL-C] or [ESC]
```

Note: If the ignore control character bit ($02) of the port flag is set, then XGCC ignores [CTRL-C] and [ESC].

Description: GET CHARACTER CONDITIONAL primitive checks the interrupt driven input character buffer and returns the next character in the right byte of data register D0.L. The rest of the register is cleared. The input buffer is selected by the input port variable (PRT$) of the TCB.

If the buffer is empty, the 'EQ' status bit is set. If the character is a [CTRL-C], then the break flag and input buffer are cleared, and the status is returned 'LO'. If the character is the [ESC] character, then the break flag is cleared and the status is returned 'LT'.

If no special character is encountered, the character is returned in register D0 and the status set 'HI' and 'GT'.

If no port has been assigned for input (ie. port 0 or phantom port), then the routine always returns an 'EQ' status.

Possible Errors: None

1.3.33 XGCP - GET PORT CHARACTER

Mnemonic:	XGCP
Value:	$A09E
Module:	MPDOSK2
Format:	XGCP
	<status return>

Registers: Out D0.L = Character in bits 0-7
SR = LO....[CTRL-C]
LT....[ESC]
MI....[CTRL-C] or [ESC]

Note: If the ignore control character bit ($02) of the port flag is set, then XGCP ignores [CTRL-C] and [ESC].

Description: GET PORT CHARACTER primitive checks for a character in the interrupt driven input character buffer. If a character is found, it is returned in the right byte of data register D0.L and the rest of the register is cleared. The input buffer is selected by the input port variable (PRT$) of the TCB.

If the interrupt buffer is empty, the task is suspended pending a character interrupt.

The status is returned 'LO' and the break flag cleared if the returned character is a [CTRL-C]. The input buffer is also cleared. Thus, all characters entered after the [CTRL-C] and before the XGCR call are dropped.

The status is returned 'LT' and the break flag cleared if the returned character is the [ESC] character.

For all other characters, the status is returned 'HI' and 'GT'. The break flag is not affected.

If no port has been assigned for input, (ie. port 0 or phantom port), then an error 86 occurs.

Possible Errors: None

1.3.34 XGCR - GET CHARACTER

Mnemonic:	XGCR
Value:	$A07A
Module:	MPDOSK2
Format:	XGCR <status return>

Registers: Out D0.L = Character in bits 0-7
SR = LO....[CTRL-C]
LT....[ESC]
MI....[CTRL-C] or [ESC]

Note: If the ignore control character bit ($02) of the port flag is set, then XGCR ignores [CTRL-C] and [ESC].

Description: GET CHARACTER primitive checks for a character from first, the input message pointer (IMP$(A6)); second, the assigned input file (ACI$(A6)); and then finally, the interrupt driven input character buffer (PRT$(A6)). If a character is found, it is returned in the right byte of data register D0.L and the rest of the register is cleared.

If there is no input message, no assigned console port character, and the interrupt buffer is empty, the task is suspended pending a character interrupt.

The status is returned 'LO' and the break flag cleared if the returned character is a [CTRL-C]. The input buffer is also cleared. Thus, all characters entered after the [CTRL-C] and before the XGCR call are dropped.

The status is returned 'LT' and the break flag cleared if the returned character is the [ESC] character.

For all other characters, the status is returned 'HI' and 'GT'. The break flag is not affected.

If no port has been assigned for input, (ie. port 0 or phantom port), then an error 86 occurs.

Possible Errors: None

1.3.35 XGLB - GET LINE IN BUFFER

Mnemonic:	XGLB
Value:	$A07C
Module:	MPDOSK2
Format:	XGLB
	{BLT.x ESCAPE} optional
	<status return>

Registers:	In	(A1) = Buffer address
	Out	D1.L = Number of characters
		SR = EQ...[CR] only
		LT...[ESC]
		LO...[CTRL-C]

Note: If the ignore control character bit ($02) of the port flag is set, then XGLB ignores [CTRL-C] and [ESC].

Description: LINE IN BUFFER primitive gets a character line into the buffer pointed to by address register A1. The XGCR primitive is used by XGLB and hence characters can come from a memory message, a file, or the task console port.

The buffer must be at least 80 characters in length. The line is delimited by a carriage return. The status returns EQUAL if only a [CR] is entered.

If an [ESC] is entered, the task exits to VMEPROM unless a ’BLT’ instruction immediately follows the XGLB call. If such is the case, then XGLB returns with status set at ’LT’.

If the assigned console flag (ACI$(A6)) is set, then the ’&’ character is used for character substitutions. ’&0’ is replaced with the last system error number. ’&1’ is replaced with the first parameter of the command line, ’&2’ with the second, and so forth up to ’&9’.

The command line can be edited with various system defined control characters. A [BACKSPACE] ($08) moves the cursor one character to the left. A [CTRL-F] ($0C) moves the cursor one character to the right. A [RUB] ($7F) deletes one character to the left. A [CTRL-D] ($04) deletes the character under the cursor. The cursor need not be at the end of the line when the [CR] is entered.

See also: XGLU - GET LINE IN USER BUFFER

Possible Errors: None

1.3.36 XGLM - GET LINE IN MONITOR BUFFER

Mnemonic:	XGLM
Value:	$A07E
Module:	MPDOSK2
Format:	XGLM
	{BLT.x ESCAPE} optional
	<status return>

Registers: Out (A1) = String
D1.L = Number of characters
SR = EQ...[CR] only
LT...[ESC]
LO...[CTRL-C]

Note: If the ignore control character bit ($02) of the port flag is set, then XGLM ignores [CTRL-C] and [ESC].

Description: The GET LINE IN MONITOR BUFFER primitive gets a character line into the monitor buffer located in the task control block. The XGCR primitive is used by XGLM and hence, characters can come from a memory message, a file, or the task console port.

The buffer has a maximum length of 80 characters and is delimited by a carriage return. The status returns EQUAL if only a [CR] is entered. If an [ESC] is entered, the task exits to VMEPROM unless a 'BLT' instruction immediately follows the XGLM call. If such is the case, then XGLM returns with status set at 'LT'.

If the assigned console flag (ACI$(A6)) is set, then the '&' character is used for character substitutions. '&0' is replaced with the last system error number. '&1' is replaced with the first parameter of the command line, '&2' with the second, and so forth up to '&9'.

The command line can be edited with various system-defined control characters. A [BACKSPACE] ($08) moves the cursor one character to the left. A [CTRL-L] ($0C) moves the cursor one character to the right. A [RUB] ($7F) deletes one character to the left. A [CTRL-D] ($04) deletes the character under the cursor. The cursor need not be at the end of the line when the [CR] is entered.

The last command line can be recalled to the buffer by entering a [CTRL-A] ($01). This line can then be edited using the above control characters.

Possible Errors: None

1.3.37 XGLU - GET LINE IN USER BUFFER

Mnemonic: XGLU
Value: $A080
Module: MPDOSK2
Format: XGLU
{BLT.x ESCAPE ;optional}
<status return>

Registers: Out (A1) = String
D1.L = Number of characters
SR = EQ...[CR] only
LT...[ESC]
LO...[CTRL-C]

Note: If the ignore control character bit ($02) of the port flag is set, then XGLU ignores [CTRL-C] and [ESC].

Description: The GET LINE IN USER BUFFER primitive gets a character line into the user buffer. Address register A6 normally points to the user buffer. The XGCR primitive is used by XGLU; hence, characters come from a memory message, a file, or the task console port. The line is delimited by a carriage return. The status returns EQUAL if only a [CR] is entered. Address register A1 is returned with a pointer to the first character.

The user buffer is located at the beginning of the task control block and is 256 characters in length. However, the XGLU routine limits the number of input characters to 78 plus two nulls.

If an [ESC] ($1B) is entered, the task exits to VMEPROM unless a 'BLT' instruction immediately follows the XGLU call. If such is the case, then XGLU returns with status set at 'LT'.

If the assigned console flag (ACI$(A6)) is set, then the '&' character is used for character substitutions. '&0' is replaced with the last system error number. '&1' is replaced with the first parameter of the command line, '&2' with the second, and so forth up to '&9'.

The command line can be edited with various system defined control characters. A [BACKSPACE] ($08) moves the cursor one character to the left. A [CTRL-L] ($0C) moves the cursor one character to the right. A [RUB] ($7F) deletes one character to the left. A [CTRL-D] ($04) deletes the character under the cursor. The cursor need not be at the end of the line when the [CR] is entered.

Possible Errors: None

1.3.38 XGML - GET MEMORY LIMITS

Mnemonic:	XGML
Value:	$A010
Module:	MPDOSK1
Format:	XGML

Registers: Out (A0) = End TCB (TBE$)
(A1) = Upper memory limit (EUM$-USZ)
(A2) = Last loaded address (BUM$)
(A5) = System RAM (SYRAM)
(A6) = Task TCB

Description: GET MEMORY LIMITS subroutine returns the user task memory limits. These limits are defined as the first usable location after the task control block ($500 beyond address register A6) and the end of the user task memory. The task may use up to but not including the upper memory limit.

Address register A0 is returned pointing to the beginning of user storage (which is the end of the TCB). Register A1 points to the upper task memory limit less $100 hexadecimal bytes for the user stack pointer (USP). Register A2 is the last loaded memory address as provided by the PDOS loader. Address registers A5 and A6 are returned with the pointers to system RAM (SYRAM) and the task control block (TCB).

Possible Errors: None

1.3.39 XGMP - GET MESSAGE POINTER

Mnemonic:	XGMP
Value:	$A004
Module:	MPDOSK1
Format:	XGMP <status return>

Registers:	In	D0.L = Message slot number (0..15)
	Out	D0.L = Source task # (-1 = no message)
		SR = EQ....Message (Event[64+Message slot#]=0)
		NE....No message
		D0.L = Error number 83 if no message
		(A1) = Message

Description: GET MESSAGE POINTER primitive looks for a task message pointer. If no message is ready, then data register D0 returns with a minus one (-1) and status is set to ’Not Equal’.

If a message is waiting, then data register D0 returns with the source task number, address register A1 returns with the message pointer, event (64 + message slot #) is set to zero indicating message received, and status is returned equal.

See also:
XGTM - GET TASK MESSAGE
XKTM - KILL TASK MESSAGE
XSMP - SEND MESSAGE POINTER
XSTM - SEND TASK MESSAGE

Possible Errors:

83 = Message slot empty

1.3.40 XGNP - GET NEXT PARAMETER

Mnemonic:	XGNP
Value:	$A05A
Module:	Emulated by VMEPROM
Format:	XGNP
	<status return>

```
Registers:   Out   SR   =   LO....No parameter
                                  [(A1)=0]
                            EQ....Null Parameter
                                  [(A1)=0]
                            HI....Parameter
                                  [(A1)=PARAMETER]
```

Description: GET NEXT PARAMETER primitive parses the VMEPROM command buffer for the next command parameter. The XGNP primitive clears all leading spaces of a parameter. A parameter is a character string delimited by a space, comma, period, or null. If a parameter begins with a left parenthesis, then all parsing stops until a matching right parenthesis or null is found. Hence, spaces, commas, and periods are passed in a parameter when enclosed in parentheses. Parentheses may be nested to any depth.

A ’LO’ status is returned if the last parameter delimiter is a null or period. XGNP does not parse past a period. In this case, address register A1 is returned pointing to a null string.

An ’EQ’ status is returned if the last parameter delimiter is a comma and no parameter follows. Address register A1 is returned pointing to a null string.

A ’HI’ status is returned if a valid parameter is found. Address register A1 then points to the parameter.

Possible Errors: None

1.3.41 XGTM - GET TASK MESSAGE

Mnemonic:	XGTM
Value:	$A01E
Module:	MPDOSK1
Format:	XGTM <status return>

Registers:	In	(A1)	=	Buffer address
	Out	D0.L	=	Source task #
		(-1 = no message)		
		SR	=	EQ....message found
				NE....no message

Description: GET TASK MESSAGE primitive searches the PDOS message buffers for a message with a destination equal to the current task number. If a message is found, it is moved to the buffer pointed to by address register A1. The message buffer is then released, and the status is set EQUAL. If no message is found, status is returned NE.

The buffer must be at least 64 bytes in length. (This is a configuration parameter.) The message buffers are serviced on a first in, first out basis (FIFO). Messages are data independent and pass any type of binary data.

See also:
XGMP - GET MESSAGE POINTER
XKTM - KILL TASK MESSAGE
XSMP - SEND MESSAGE POINTER
XSTM - SEND TASK MESSAGE

Possible Errors: None

1.3.42 XGUM - GET USER MEMORY

Mnemonic:	XGUM	
Value:	$A03E	
Module:	MPDOSK1	
Format:	XGUM	
	<status error return>	
Registers:	In	D0.W = Number of K bytes
	Out	(A0) = Beginning memory address
		(A1) = End memory address

Description: GET USER MEMORY primitive searches the system memory bit map for a contiguous block of memory equal to D0.W Kbytes. If found, the ’EQ’ status is set, address registers A0 and A1 are returned the start and end memory address, and the memory block is marked as allocated in the bit map.

See also: XFUM - FREE USER MEMORY

Possible Errors:

73 = Not enough memory

1.3.43 XISE - INITIALIZE SECTOR

Mnemonic:	XISE
Value:	$A0C0
Module:	MPDOSF
Format:	XISE <status error return>

Registers:	In	D0.B = Disk number
		D1.W = Logical sector number
		(A2) = Buffer address

Description: INIT SECTOR primitive is a system-defined, hardware-dependent program which writes 256 bytes of data from a buffer (A2) to a logical sector number (D1) on disk (D0). This routine is meant to be used only for disk initialization and is equivalent to the WRITE SECTOR (XWSE) primitive for all sectors except 0. Sector 0 is not checked for the PDOS ID code.

See also: XRSE - READ SECTOR
XRSZ - READ SECTOR ZERO
XWSE - WRITE SECTOR

Possible Errors:

Disk errors

1.3.44 XKTB - KILL TASK

Mnemonic:	XKTB
Value:	$A0FA
Module:	MPDOSK1
Format:	XKTB <status error return>
Registers:	In D0.B = Task number
Note:	If D0.B equals zero, then kill current task. If D0.B is negative, then kill task without allocating task memory to system bit map.
Description:	KILL TASK primitive removes a task from the PDOS task list and optionally returns the task's memory to the system memory bit map. Only the current task or a task spawned by the current task can be killed. Task 0 cannot be killed.

The kill process includes releasing the input port assigned to the task and closing all files associated with the task.

The task number is specified in data register D0.B. If register D0.B equals zero, then the current task is killed and its memory deallocated in the system memory bit map.

If D0.B is positive, then the selected task is killed and its memory deallocated. If D0.B is negative, then task number ABS(D0.B) is killed, but its memory is not deallocated in the memory bit map.

See also: XCTB - CREATE TASK BLOCK

Possible Errors:

74 = No such task
76 = Task locked

1.3.45 XKTM - KILL TASK MESSAGE

Mnemonic:	XKTM
Value:	$A028
Module:	MPDOSK1
Format:	XKTM <status return>

Registers:	In	D0.B	=	Task #
		(A1)	=	Buffer address
	Out	D0.L	=	Source task #
		(-1 = no message)		
		SR	=	EQ....message found
				NE....no message

Description: KILL TASK MESSAGE primitive allows you to read (and thus clear) any task's messages from the system message buffers.

See also:
XGMP - GET MESSAGE POINTER
XGTM - GET TASK MESSAGE
XSMP - SEND MESSAGE POINTER
XSTM - SEND TASK MESSAGE

Possible Errors: None

1.3.46 XLDF - LOAD FILE

Mnemonic:	XLDF	
Value:	$A0B0	
Module:	MPDOSF	
Format:	XLDF	
	<status error return>	
Registers:	In	D1.B = Execution flag
		(A0) = Start of load memory
		(A1) = End of load memory
		(A3) = File name
	Out	(A0) = EAD$ - Lowest loaded address
		(A1) = BUM$ - Last loaded address

Note: If D1.B=0, then XLDF returns to your calling program. If D1.B<>0, then the program is immediately executed.

Description: LOAD FILE primitive reads and loads 68000 object code into user memory. The file name pointer is passed in address register A3. Registers A0 and A1 specify the memory bounds for the relocatable load. The file must be typed 'OB' or 'SY'. If data register D1.B is zero, then XLDF returns to the calling program. Otherwise, the loaded program is immediately executed.

The 68000 object should be position-independent section 0 code without any external references or definitions.

A 'SY' file is generated from an 'OB' file by the MSYFL utility. The condensed object is a direct memory image and must be position-independent code.

The XLDF primitive uses long word moves and may move up to three bytes more than contained in an 'SY' file. As such, you must allow for extra space for data moves to an existing program.

Possible Errors:

63 = Illegal object tag
64 = Illegal section
65 = File not loadable
71 = Exceeds task size
73 = Not enough memory
Disk errors

1.3.47 XLER - LOAD ERROR REGISTER

Mnemonic:	XLER
Value:	$A03A
Module:	MPDOSK1
Format:	XLER

Registers: In D0.W = Error number

Description: LOAD ERROR REGISTER primitive stores data register D0.W in the task control block variable LEN$(A6). This variable will replace the parameter substitution variable ’&0’ during a procedure file.

User programs should execute this call when an error occurs.

The enable echo flag (ECF$(A6)) is cleared by this call.

Possible Errors: None

1.3.48 XLFN - LOOK FOR NAME IN FILE SLOTS

Mnemonic:	XLFN
Value:	$A0A2
Module:	MPDOSF
Format:	XLFN <status return>

Registers:	In	D0.B	=	Disk number
		(A1)	=	Fixed file name
	Out	D3.W	=	File ID (Disk #/Index)
		(A3)	=	Slot entry address
		SR	=	NE...File name not found
				EQ...File name found

Note: If D3.W=0, then no slots are available.

Description: LOOK FOR NAME IN FILE SLOTS primitive searches through the file slot table for the file name as specified by registers D0.B and A1. If the name is not found, register D3.W returns with a -1 or 0. The latter indicates the file was not found and there are no more slots available. Otherwise, register D3.W returns the associated file ID and register A3 returns the address of the file slot.

A file slot is a 38-byte buffer where the status of an open file is maintained. There are 32 file slots available. The file ID consists of the disk # and the file slot index.

File slots assigned to read-only files are skipped and not considered for file match.

Possible Errors: None

1.3.49 XLKF - LOCK FILE

Mnemonic:	XLKF
Value:	$A0D8
Module:	MPDOSF
Format:	XLKF <status error return>
Registers:	In D1.W = File ID
Description:	LOCK FILE primitive locks an opened file so that no other task can gain access until an UNLOCK FILE (XULF) primitive is executed. Only the locking task has access to the locked file. A locked file is indicated by a -1 ($FF) in the left byte of the lock file parameter (LF) of the file slot usage (FS) command. The locking task number is stored in the left byte of the task number parameter (TN).
See also:	XULF - UNLOCK FILE

Possible Errors:

52 = File not open
59 = Invalid slot #
75 = File locked
Disk errors

1.3.50 XLKT - LOCK TASK

Mnemonic:	XLKT
Value:	$A014
Module:	MPDOSK1
Format:	XLKT <status return>

Registers: Out SR = EQ...Not locked
NE...Locked

Description: LOCK TASK primitive locks the requesting task in the run state by setting the swap lock variable in system RAM to nonzero. The task remains locked until an UNLOCK TASK (XULT) is executed. The status of the lock variable BEFORE the call is returned in the status register.

XLKT waits until all locks (Level 2 and Level 3 locks) are cleared before the task is locked.

See also: XULT - UNLOCK TASK

Possible Errors: None

1.3.51 XLSR - LOAD STATUS REGISTER

Mnemonic:	XLSR
Value:	$A02E
Module:	MPDOSK1
Format:	XLSR

Registers: In D1.W = 68000 status register

Description: LOAD STATUS REGISTER primitive allows you to directly load the 68000 status register. Of course, only appropriate bits (i.e. the interrupt mask too high, supervisor mode, trace mode, etc.) are to be set so that the system is not crashed.

See also: XSUP - ENTER SUPERVISOR MODE

Possible Errors: None

1.3.52 XNOP - OPEN SHARED RANDOM FILE

Mnemonic:	XNOP
Value:	$A0DA
Module:	MPDOSF
Format:	XNOP
	<status error return>

Registers:	In	(A1) = File name
	Out	D0.W = File attribute
		D1.W = File ID

Notes: Uses multiple directory file search. You MUST lock and position file before each multitask access.

Description: OPEN SHARED RANDOM FILE primitive opens a file for shared random access by assigning the file to an area of system memory called a file slot. The file ID and file attribute are returned to the calling program in registers D1 and D0, respectively. Thereafter, the file is referenced by the file ID and not by the file name. A new entry in the file slot table is made only if the file is not already opened for shared access.

The file ID (returned in register D1) is a 2-byte number. The left byte is the disk number and the right byte is the file slot index. The file attributes are returned in register D0.

The END-OF-FILE marker on a shared file is changed only when the file has been extended. All data transfers are buffered through a channel buffer; data movement to and from the disk is by full sectors.

An "opened count" is incremented each time the file is shared-opened and is decremented by each close operation. The file is only closed by PDOS when the count is zero. This count is saved in the right byte of the locked file parameter (LF) and is listed by the file slot usage command (FS).

Possible Errors:

50 = Invalid file name
53 = File not defined
60 = File space full
61 = File already open
68 = Not PDOS disk
69 = Not enough file slots
Disk errors

1.3.53 XPAD - PACK ASCII DATE

Mnemonic:	XPAD
Value:	$A00A
Module:	MPDOSK3
Format:	XPAD

```
Registers:   In    (A1)   =    'DY-MON-YR'
             Out   D1.W   =    (Year*16+month)*32+day
                   (YYYY YYYM MMMD DDDD)
                   (A1)   =    Updated
                   SR     =    .EQ. - Conversion ok
                               .NE. - Error
```

Description: PACK ASCII DATE primitive converts an ASCII date string to an encoded binary number in data register D1. The result is compatible with other PDOS date primitives such as XUAD.

See Also:
XFTD - FIX TIME & DATE
XRDT - READ DATE
XRTM - READ TIME
XUAD - UNPACK ASCII DATE
XUDT - UNPACK DATE

Possible Errors: Status errors.

1.3.54 XPBC - PUT BUFFER TO CONSOLE

Mnemonic:	XPBC
Value:	$A084
Module:	MPDOSK2
Format:	XPBC

Registers: None

Description: PUT USER BUFFER TO CONSOLE primitive outputs the ASCII contents of the user buffer to the user console and/or SPOOL file. The output string is delimited by the null character. The user buffer is the first 256 bytes of the task control block and is pointed to by address register A6. With the exception of control characters and characters with the parity bit on, each character increments the column counter by one. A [BACKSPACE] ($08) decrements the counter while a [CR] ($0D) clears the counter. [TAB]s ($09) are expanded with blanks to MOD 8 character zone fields. If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

See also: XGLB - GET LINE IN BUFFER

Possible Errors: None

1.3.55 XPCC - PUT CHARACTER(S) TO CONSOLE

Mnemonic:	XPCC
Value:	$A086
Module:	MPDOSK2
Format:	XPCC

Registers: In D0.W = Character(s)

Description: PUT CHARACTER TO CONSOLE primitive outputs one or two ASCII characters in data register D0 to the user console and/or SPOOL file. The right byte (bits 0 through 7) is first and is followed by the left byte (bits 8 through 15) if non-zero. If the right byte or both bytes are zero, nothing is output to the console.

With the exception of control characters and characters with the parity bit on, each character increments the column counter by one. A [BACKSPACE] ($08) decrements the counter while a [CR] ($0D) clears the counter. [TAB]s ($09) are expanded with blanks to MOD 8 character zone fields.

If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

See also: XPCR - PUT CHARACTER RAW
XPDC - PUT DATA TO CONSOLE

Possible Errors: None

1.3.56 XPCL - PUT CRLF TO CONSOLE

Mnemonic:	XPCL
Value:	$A088
Module:	MPDOSK2
Format:	XPCL
Registers:	None

Description: PUT CRLF TO CONSOLE primitive outputs the ASCII characters carriage return <$0A> and line feed <$0D> to the user console and/or SPOOL file. The column counter is cleared.

If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

Possible Errors: None

1.3.57 XPCP - PLACE CHARACTER IN PORT BUFFER

Mnemonic:	XPCP
Value:	$AOBC
Module:	MPDOSK2
Format:	XPCP

Registers:	In	D0.B	=	Character to insert		
		D1.W	=	Input port number (1 to 15)		
	Out	SR	=	.EQ.	=	High water (character is inserted)
				.NE.	=	Character is inserted

Description: XPCP allows a character to be placed into the input buffer of any VMEPROM port from a task or program.

Note: Once the status returns EQ (high water)_, subsequent XPCP calls will return a status of NE as if everything were normal, but the data is discarded. Once the status of EQ is detected, the transmitting task should monitor the status of the port with the XRPS (read port status) call until bit 56 is cleared.

The port specified in the XPCP call is independent of window g - it refers to the physical port, not the logical port.

1.3.58 XPCR - PUT CHARACTER RAW

Mnemonic:	XPCR
Value:	$A0BA
Module:	MPDOSK2
Format:	XPCR

Registers: In D0.B = CHARACTER

Description: The PUT CHARACTER RAW primitive outputs the character in the lower byte of data register D0 to the user console. No attempt is made by PDOS to interpret control characters.

See also: XPCC - PUT CHARACTER(S) TO CONSOLE
XPDC - PUT DATA TO CONSOLE

Possible Errors: None

1.3.59 XPDC - PUT DATA TO CONSOLE

Mnemonic:	XPDC
Value:	$A096
Module:	MPDOSK2
Format:	XPDC

Registers: In D7.W = LENGTH
(A1) = DATA STRING

Description: PUT DATA TO CONSOLE primitive outputs data-independent bytes to the console. Address register A1 points to the string while data register D7 has the string length.

If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

See also: XPCC - PUT CHARACTER(S) TO CONSOLE
XPCR - PUT CHARACTER RAW

Possible Errors: None

1.3.60 XPEL - PUT ENCODED LINE TO CONSOLE

Mnemonic:	XPEL
Value:	$A06E
Module:	MPDOSK2
Format:	XPEL

Registers: In (A1) = Message

Description: PUT ENCODED LINE TO CONSOLE primitive outputs to the user console the message pointed to by address register A1. An encoded message is similar to any other string with the exception that the parity bit is used to output blanks and the character $80 outputs a carriage return/line feed.

If the parity bit is set and the masked character ($7F) is less than or equal to a blank, then the numeric value of the negated character is used as the number of blanks to be inserted in the output stream. If the mask character is greater than a blank, then that character is output followed by one blank.

With the exception of control characters, each character increments the column counter by one. A [BACKSPACE] ($08) decrements the counter while a [CR] ($0D) clears the counter. [TAB]s ($09) are expanded with blanks to MOD 8 character zone fields.

If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

See also: XPEM - PUT ENCODED MESSAGE TO CONSOLE
XPLC - PUT LINE TO CONSOLE
XPMC - PUT MESSAGE TO CONSOLE

Possible Errors: None

1.3.61 XPEM - PUT ENCODED MESSAGE TO CONSOLE

Mnemonic:	XPEM
Value:	$A09C
Module:	MPDOSK2
Format:	XPEM <message>

Registers: None

Description: PUT ENCODED MESSAGE TO CONSOLE primitive outputs to the user console the PC relative message contained in the word following the call. An encoded message is similar to any other string with the exception that the parity bit is used to output blanks and the character $80 outputs a carriage return/line feed.

If the parity bit is set and the masked character ($7F) is less than or equal to a blank, then the numeric value of the negated character is used as the number of blanks to be inserted in the output stream. If the mask character is greater than a blank, then that character is output followed by one blank.

With the exception of control characters, each character increments the column counter by one. A [BACKSPACE] ($08) decrements the counter while a [CR] ($0D) clears the counter. [TAB]s ($09) are expanded with blanks to MOD 8 character zone fields.

If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

See also: XPEL - PUT ENCODED LINE TO CONSOLE
XPLC - PUT LINE TO CONSOLE
XPMC - PUT MESSAGE TO CONSOLE

Possible Errors: None

1.3.62 XPLC - PUT LINE TO CONSOLE

Mnemonic:	XPLC
Value:	$A08A
Module:	MPDOSK2
Format:	XPLC

Registers: In (A1) = ASCII string

Description: PUT LINE TO CONSOLE primitive outputs the ASCII character string pointed to by address register A1 to the user console and/or SPOOL file. The string is delimited by the null character.

With the exception of control characters and characters with the parity bit on, each character increments the column counter by one. A [BACKSPACE] ($08) decrements the counter while a [CR] ($0D) clears the counter. [TAB]s ($09) are expanded with blanks to MOD 8 character zone fields.

If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

See also: XPEL - PUT ENCODED LINE TO CONSOLE
XPEM - PUT ENCODED MESSAGE TO CONSOLE
XPMC - PUT MESSAGE TO CONSOLE

Possible Errors: None

1.3.63 XPMC - PUT MESSAGE TO CONSOLE

Mnemonic:	XPMC
Value:	$A08C
Module:	MPDOSK2
Format:	XPMC <message>
Registers:	None

Description: PUT MESSAGE TO CONSOLE primitive outputs the ASCII character string pointed to by the message address word immediately following the PDOS call to the user console and/or SPOOL file. The address is a PC relative 16-bit displacement to the message. The output string is delimited by the null character.

With the exception of control characters and characters with the parity bit on, each character increments the column counter by one. A [BACKSPACE] ($08) decrements the counter while a [CR] ($0D) clears the counter. [TAB]s ($09) are expanded with blanks to MOD 8 character zone fields.

If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

See also: XPEL - PUT ENCODED LINE TO CONSOLE
XPEM - PUT ENCODED MESSAGE TO CONSOLE
XPLC - PUT LINE TO CONSOLE

Possible Errors: None

1.3.64 XPSC - POSITION CURSOR

Mnemonic:	XPSC
Value:	$A08E
Module:	MPDOSK2
Format:	XPSC

Registers: In D1.B = Row
D2.B = Column

Note: Uses PSC$(A6) as lead characters.

Description: POSITION CURSOR primitive positions the cursor on the console terminal according to the row and column values in data registers D1 and D2. Register D1 specifies the row on the terminal and generally ranges from 0 to 23, with 0 being the top row. Register D2 specifies the column of the terminal and ranges from 0 to 79, with 0 being the left-hand column. Register D2 is also loaded into the column counter reflecting the true column of the cursor.

The XPSC primitive outputs either one or two leading characters followed by the row and column. The leading characters output by XPSC are located in PSC$(A6) of the task control block. These characters are transferred from the parent task to the spawned task during creation. The initial characters come from the BIOS module.

The row and column characters are biased by $20 if the parity bit of the first character is set. Likewise, if the second character's parity bit is set, then row/column order is reversed. This accommodates most terminal requirements for positioning the cursor.

If PSC$ is zero, then PDOS makes a call into the BIOS for custom position cursor. The entry point is B_PSC beyond the BIOS table.

The ST command of the user interface can be used to change the position cursor codes.

See also: XCLS - CLEAR SCREEN
XRCP - READ PORT CURSOR POSITION

Possible Errors: None

1.3.65 XPSF - POSITION FILE

Mnemonic:	XPSF	
Value:	$A0DC	
Module:	MPDOSF	
Format:	XPSF	
	<status error return>	
Registers:	In	D1.W = File ID
		D2.L = Byte position

Note: A byte position equal to -1 positions to the end of the file.

Description: POSITION FILE primitive moves the file byte pointer to any byte position within a file. The file ID is given in register D1 and the long word byte position is specified in register D2.

An error occurs if the byte position is greater than the current end-of-file marker.

A contiguous file greatly enhances the speed of the position primitive since the desired sector is directly computed. However, the position primitive does work with non-contiguous files, as PDOS follows the sector links to the desired byte position.

A contiguous file is extended by positioning to the end-of-file marker and writing data. However, PDOS will alter the file type to non-contiguous if a contiguous sector is not available. This would result in random access being much slower.

See also: XRFP - READ FILE POSITION
XRWF - REWIND FILE

Possible Errors:

52 = File not open
59 = Invalid slot #
70 = Position error
Disk errors

1.3.66 XPSP - PUT SPACE TO CONSOLE

Mnemonic:	XPSP
Value:	$A098
Module:	MPDOSK2
Format:	XPSP

Registers: None

Description: PUT SPACE TO CONSOLE outputs a [SP] ($20) character to the user console. There are no registers or status involved. If there are coinciding bits in the unit (UNT$(A6)) and spool unit (SPU$(A6)) variables of the TCB, then the processed characters are written to the spool unit file slot (SPI$(A6)) and are not sent to the corresponding output ports. If a disk error occurs in the spool file, then all subsequent output characters echo as a bell until the error is corrected by selecting a different UNIT or resetting the SPOOL UNIT.

See also: XPCC - PUT CHARACTER(S) TO CONSOLE

Possible Errors: None

1.3.67 XRBF - READ BYTES FROM FILE

Mnemonic:	XRBF
Value:	$A0DE
Module:	MPDOSF
Format:	XRBF
	<status error return>

Registers:	In	D0.L = Number of bytes
		D1.W = File ID
		(A2) = R/W buffer address
	Out	D3.L = Number of bytes read
		(On EOF only.)

Description: READ BYTES FROM FILE primitive reads the number of bytes specified in register D0 from the file specified by the file ID in register D1 into a memory buffer pointed to by address register A2. If the channel buffer has been rolled to disk, the least-used buffer is freed and the desired buffer is restored to memory. The file slot ID is placed on the top of the last-access queue.

If an error occurs during the read operation, the error return is taken with the error number in register D0 and the number of bytes actually read in register D3.

The read is independent of the data content. The buffer pointer in register A2 is on any byte boundary. The buffer is not terminated with a null.

A byte count of zero in register D0 results in one byte being read from the file. This facilitates single byte data acquisition.

See also: XRLF - READ LINE FROM FILE
XWBF - WRITE BYTES TO FILE
XWLF - WRITE LINE TO FILE

Possible Errors:

52 = File not open
56 = End of file
59 = Invalid slot #
Disk errors

1.3.68 XRCN - RESET CONSOLE INPUTS

Mnemonic:	XRCN
Value:	$A0B2
Module:	MPDOSF
Format:	XRCN

Registers: None

Description: RESET CONSOLE INPUTS closes the current procedure file. If there are other procedure files pending (nested), then they become active again.

See also: XCBC - CHECK FOR BREAK CHARACTER

Possible Errors: None

1.3.69 XRCP - READ PORT CURSOR POSITION

Mnemonic:	XRCP	
Value:	$A092	
Module:	MPDOSK2	
Format:	XRCP	
Registers:	In	D0.W = Port #
	Out	D1.L = Row
		D2.L = Column

Note: If D0.W=0, then the current port (PRT$(A6)) is used.

Description: READ PORT CURSOR POSITION primitive reads the current cursor position for the port designated by data register D0.B. The PDOS system maintains a column count (0-79) and a row count (0-23) for each port. When the cursor reaches row 23, the count is not incremented, acting like a screen scroll.

See also: XCLS - CLEAR SCREEN
XPSC - POSITION CURSOR

Possible Errors: None

1.3.70 XRDE - READ NEXT DIRECTORY ENTRY

Mnemonic:	XRDE	
Value:	$A0A6	
Module:	MPDOSF	
Format:	XRDE	
	<status error return>	
Registers:	In	D0.B = Disk number
		D1.B = Read flag (0=1st)
		(A2) = Last 32 byte directory entry
		TW1$ = Sector number
		TW2$ = number of directory entries
	Out	D1.W = Sector number
		(A2) = Next entry

Description: READ NEXT DIRECTORY ENTRY primitive reads sequentially through a disk directory. If register D1.B is zero, then the routine begins with the first directory entry. If register D1.B is nonzero, then based on the last directory entry (pointed to by register A2), the next entry is read.

The calling routine must maintain registers D0.B and A2, the user I/O buffer, and temporary variables TW1$ and TW2$ of the task control block between calls to XRDE.

Possible Errors:

53 = File not defined (End of directory)
68 = Not PDOS disk
Disk errors

1.3.71 XRDM - DUMP REGISTERS

Mnemonic:	XRDM
Value:	$A02A
Module:	MPDOSK1
Format:	XRDM

Registers: In All

Description: The DUMP REGISTERS primitive formats and outputs all the current register values of the 68000 to the user console along with the program counter, status register, and the supervisor stack.

The registers and status are not affected by this primitive.

See also: XDMP - DUMP MEMORY FROM STACK

Possible Errors: None

1.3.72 XRDN - READ DIRECTORY ENTRY BY NAME

Mnemonic:	XRDN	
Value:	$A0A8	
Module:	MPDOSF	
Format:	XRDN	
	<status error return>	
Registers:	In	D0.B = Disk number
		MWB$ = File name
	Out	D1.W = Sector number in memory
		(A2) = Directory entry
		TW2$ = Entry count

Description: READ DIRECTORY ENTRY BY NAME primitive reads directory entries by file name. Register D0.B specifies the disk number. The file name is located in the Monitor Work Buffer (MWB$) in a fixed format. Several other parameters are returned in the monitor TEMP storage of the user task control block. These variables assist in the housekeeping operations on the disk directory.

See also: XFFN - FIX FILE NAME

Possible Errors:

53 = File not defined
68 = Not PDOS disk
Disk errors

1.3.73 XRDT - READ DATE

Mnemonic:	XRDT
Value:	$A05C
Module:	MPDOSK3
Format:	XRDT

Registers: Out (A1) = 'MN/DY/YR'<null>

Description: READ DATE primitive returns the current system date as a nine character string. The format is 'MN/DY/YR' followed by a null. Address register A1 points to the string in the monitor work buffer.

See also: XFTD - FIX TIME & DATE
XPAD - PACK ASCII DATE
XRTM - READ TIME
XUAD - UNPACK ASCII DATE
XUDT - UNPACK DATE
XUTM - UNPACK TIME

Possible Errors: None

1.3.74 XRFA - READ FILE ATTRIBUTES

Mnemonic:	XRFA
Value:	$A0E0
Module:	MPDOSF
Format:	XRFA <status error return>

Registers:	In	(A1) = File name
	Out	(A2) = Directory entry
		D0.L = Disk number
		D1.L = File size (in bytes)
		D2.L = Level/attributes

Note: Uses multiple directory file search.

Description: READ FILE ATTRIBUTES primitive returns the disk number of where the file was found in data register D0.L. Data register D1.L is returned with the size of the file in bytes. The file directory level is returned in the upper word of register D2.L and the file attributes are returned in register D2.W. The file name is pointed to by address register A1. File attributes are defined as follows:

$80xx	AC - Procedure file
$40xx	BN - Binary file
$20xx	OB - 68000 object file
$10xx	SY - 68000 memory image
$08xx	BX - BASIC binary token file
$04xx	EX - BASIC ASCII file
$02xx	TX - Text file
$01xx	DR - System I/O driver
$xx04	C - Contiguous file
$xx02	* - Delete protect
$xx01	** - Delete and write protect

See also: XCFA - CLOSE FILE W/ATTRIBUTE
XWFA - WRITE FILE ATTRIBUTES
XWFP - WRITE FILE PARAMETERS

Possible Errors:

50 = Invalid file name
53 = File not defined
60 = File space full
Disk errors

1.3.75 XRFP - READ FILE POSITION

Mnemonic:	XRFP	
Value:	$A0FE	
Module:	MPDOSF	
Format:	XRFP	
	<status error return>	
Registers:	In	D1.W = File ID
	Out	(A3) = File slot address
		D2.L = Byte position
		D3.L = EOF byte position

Description: READ FILE POSITION primitive returns the current file position, end-of-file position, and file slot address. The open file is selected by the file ID in data register D1.W.

Address register A3 is returned pointing to the open file slot. Data registers D2.L and D3.L are returned with the current file byte position and the end-of-file position respectively.

See also: XPSF - POSITION FILE
XRWF - REWIND FILE

Possible Errors:

52 = File not open
59 = Invalid slot #
Disk errors

1.3.76 XRLF - READ LINE FROM FILE

Mnemonic:	XRLF	
Value:	$A0E2	
Module:	MPDOSF	
Format:	XRLF	
	<status error return>	
Registers:	In	D1.W = File ID
		(A2) = R/W buffer address
	Out	D3.L = # of bytes read
		(On EOF only.)

Description: READ LINE primitive reads one line, delimited by a carriage return [CR], from the file specified by the file ID in register D1. If a [CR] is not encountered after 132 characters, then the line and primitive are terminated. Address register A2 points to the buffer in user memory where the line is to be stored. If the channel buffer has been rolled to disk, the least-used buffer is freed and the buffer is restored to memory. The file slot ID is placed on the top of the last-access queue. If an error occurs during the read operation, the error return is taken with the error number in register D0 and the number of bytes actually read in register D3.

The line read is dependent upon the data content. All line feeds ([LF]) are dropped from the data stream and the [CR] is replaced with a null. The buffer pointer in register A2 may be on any byte boundary. The buffer is not terminated with a null on an error return.

See also:
XRBF - READ BYTES FROM FILE
XWBF - WRITE BYTES TO FILE
XWLF - WRITE LINE TO FILE

Possible Errors:

52 = File not open
56 = End of file
59 = Invalid slot #
Disk errors

1.3.77 XRNF - RENAME FILE

Mnemonic:	XRNF
Value:	$A0E4
Module:	MPDOSF
Format:	XRNF <status error return>

Registers: In (A1) = Old file name
(A2) = New file name

Description: RENAME FILE primitive renames a file in a PDOS disk directory. The old file name is pointed to by address register A1. The new file name is pointed to by address register A2.

The XRNF primitive is used to change the directory level for any file by letting the new file name be a numeric string equivalent to the new directory level. XRNF first attempts a conversion on the second parameter before renaming the file. If the string converts to a number without error, then only the level of the file is changed.

See also: XDFL - DEFINE FILE
XDLF - DELETE FILE

Possible Errors:

50 = Invalid file name
51 = File already defined
Disk errors

1.3.78 XROO - OPEN RANDOM READ ONLY FILE

Mnemonic:	XROO
Value:	$A0E6
Module:	MPDOSF
Format:	XROO <status error return>

Registers:	In	(A1) = File name
	Out	D0.W = File attribute
		D1.W = File ID

Note: Uses multiple directory file search.

Description: OPEN RANDOM READ ONLY FILE primitive opens a file for random access by assigning the file to an area of system memory called a file slot, and returning a file ID and file attribute to the calling program. Thereafter, the file is referenced by the file ID and not by the file name. This type of file open provides read only access.

The file ID (returned in register R1) is a 2-byte number. The left byte is the disk number and the right byte is the channel buffer index. The file attribute is returned in register D0.

Since the file cannot be altered, it cannot be extended nor is the LAST UPDATE parameter changed when it is closed. All data transfers are buffered through a channel buffer and data movement to and from the disk is by full sectors.

A new file slot is allocated for each XROO call even if the file is already open. The file slot is allocated beginning with slot 1 to 32.

Possible Errors:

50 = Invalid file name
53 = File not defined
61 = File already open
68 = Not PDOS disk
69 = Not enough file slots
Disk errors

1.3.79 XROP - OPEN RANDOM

Mnemonic:	XROP
Value:	$A0E8
Module:	MPDOSF
Format:	XROP <status error return>

Registers:	In	(A1) = File name
	Out	D0.W = File attribute
		D1.W = File ID

Note: Uses multiple directory file search.

Description: The OPEN RANDOM FILE primitive opens a file for random access by assigning the file to an area of system memory called a file slot, and returning a file ID and file attribute to the calling program. Thereafter, the file is referenced by the file ID and not by the file name.

The file ID (returned in register D1) is a 2-byte number. The left byte is the disk number and the right byte is the channel buffer index. The file attribute is returned in register D0.

The END-OF-FILE marker on a random file is changed only when the file has been extended. All data transfers are buffered through a channel buffer and data movement to and from the disk is by full sectors.

The file slot is allocated beginning with slot 32 to slot 1. If the file is already open, then the file slot is shared.

Possible Errors:

50 = Invalid file name
53 = File not defined
61 = File already open
68 = Not PDOS disk
69 = Not enough file slots
Disk errors

1.3.80 XRPS - READ PORT STATUS

Mnemonic:	XRPS
Value:	$A094
Module:	MPDOSK2
Format:	XRPS
	<status error return>

Registers:	In	D0.W = Port number
	Out	D1.L = ACI$.W / portflag.B / Status.B

Note: If D0.W=0, then the current port (PRT$(A6)) is used.

Description: The READ PORT STATUS primitive reads the current status of the port specified by data register D0.W. The high order word of data register D1.L is returned zero if no procedure file is open. Otherwise, it is returned with ACI$.

The low order word is returned with the port flag bits and the status as returned for the port UART routine. The flag bits indicate if eight bit I/O is occurring, if DTR or ^S ^Q protocol is in effect, and other flags.

See also: XBCP - BAUD CONSOLE PORT
XSPF - SET PORT FLAG

Possible Errors:

66 = Invalid port or baud rate

1.3.81 XRSE - READ SECTOR

Mnemonic:	XRSE	
Value:	$A0C2	
Module:	MPDOSF	
Format:	XRSE	
	<status error return>	
Registers:	In	D0.B = Disk number
		D1.W = Sector number
		(A2) = Buffer pointer

Description: READ SECTOR primitive calls a system-defined, hardware-dependent program which reads 256 bytes of data into a memory buffer pointed to by address register A2. The disk is selected by data register D0. Register D1 specifies the logical sector number to be read.

See also: XISE - INITIALIZE SECTOR
XRSZ - READ SECTOR ZERO
XWSE - WRITE SECTOR

Possible Errors:

Disk errors

1.3.82 XRSR - READ STATUS REGISTER

Mnemonic:	XRSR
Value:	$A042
Module:	MPDOSK1
Format:	XRSR

Registers: Out D0.W = 68000 status register

Description: READ STATUS REGISTER primitive allows you to read the 68000 status register. Of course, this is equivalent to the 'MOVE.W SR,Dx' instruction on the 68000. However, this instruction is privileged on the 68010 and 68020. Hence, it is advisable to use the XRSR primitive to read the status register to make software upward compatible.

Possible Errors: None

1.3.83 XRST - RESET DISK

Mnemonic:	XRST
Value:	$A0B4
Module:	MPDOSF
Format:	XRST

Registers: In D1.W = -1.... Reset by task
>=0... Reset by disk

Description: RESET DISK primitive closes all open files either by task or disk number. The primitive also clears the assigned input file ID. If register D1 equals -1, then all files associated with the current task are closed. Otherwise, register D1 specifies a disk and all files opened on that disk are closed.

XRST has no error return and as such, closes all files even though errors occur in the close process. This is necessary to allow for recovery from previous errors.

See also: XCFA - CLOSE FILE W/ATTRIBUTE
XCLF - CLOSE FILE

Possible Errors: None

1.3.84 XRSZ - READ SECTOR ZERO

Mnemonic:	XRSZ
Value:	$A0C4
Module:	MPDOSF
Format:	XRSZ <status error return>

Registers:	In	D0.B = Disk number
	Out	D1.L = 0
		(A2) = User buffer pointer (A6)

Description: READ SECTOR ZERO primitive is a system-defined, hardware-dependent program which reads 256 bytes of data into the user memory buffer (usually pointed to by address register A6). The disk is selected by data register D0.W. Register D1.L is cleared and logical sector zero is read.

See also: XISE - INITIALIZE SECTOR
XRSE - READ SECTOR
XWSE - WRITE SECTOR

Possible Errors:

Disk errors

1.3.85 XRTE - RETURN FROM INTERRUPT

Mnemonic:	XRTE
Value:	$A044
Module:	MPDOSK1
Format:	XRTE

Registers: In SSP = Status register.W
Program counter.L

Description: RETURN FROM INTERRUPT primitive is used to return from an interrupt process routine with a context switch. This allows an immediate rescheduling of the highest priority ready task which may be suspended pending the occurrence of an event set by the interrupt routine.

If the interrupted system is locked when the XRTE primitive is executed, then the reschedule flag (RFLG.(A5)) is cleared and a return from exception instruction (RTE) is executed. When the system clears the task lock, RFLG. is tested and set (TAS) and a rescheduling occurs at that time.

Possible Errors: None

1.3.86 XRTM - READ TIME

Mnemonic:	XRTM
Value:	$A05E
Module:	MPDOSK3
Format:	XRTM

Registers:	Out	(A1) = 'HR:MN:SC'<null>
		10(A1).W = Tics/second (B.TPS)
		12(A1).L = Tics (TICS.)

Description: READ TIME primitive returns the current time as a nine-character string. The format is 'HR:MN:SC' followed by a null. Address register A1 points to the string in the monitor work buffer.

See also:
XFTD - FIX TIME & DATE
XPAD - PACK ASCII DATE
XRDT - READ DATE
XUAD - UNPACK ASCII DATE
XUDT - UNPACK DATE
XUTM - UNPACK TIME

Possible Errors: None

1.3.87 XRTP - READ TIME PARAMETERS

Mnemonic:	XRTP
Value:	$A034
Module:	MPDOSK1
Format:	XRTP

Registers: Out D0.L = TICS.
D1.L = MONTH/DAY/YEAR/0
D2.L = HOURS/MINUTES/SECONDS/0
D3.L = B.TPS

Description: READ TIME PARAMETERS primitive returns the current time parameters. Data register D0 returns with the current tic count (TICS.(A5)). Register D1.L returns with the current date and register D2.L the current time. Both are three bytes that are left-justified. Finally, data register D3.L returns with the number of clock tics per second.

See also: XFTD - FIX TIME & DATE
XPAD - PACK ASCII DATE
XRDT - READ DATE
XRTM - READ TIME
XUAD - UNPACK ASCII DATE
XUDT - UNPACK DATE
XUTM - UNPACK TIME

Possible Errors: None

1.3.88 XRTS - READ TASK STATUS

Mnemonic:	XRTS
Value:	$A012
Module:	MPDOSK1
Format:	XRTS
	<status return>

Registers:	In	D0.W	= Task number
	Out	D1.L	= 0 - Not executing
			= +N - Time slice
			= -N - (Event #1/Event #2)
		A0.L	= TLST entry (IF -D0: A0=TLST.)
		SR	= Status of D1.L

Note: If D0.W=-1, then the current task number is returned in D1.L.

Description: READ TASK STATUS primitive returns in register D1 and the status register returns the time parameter of the task specified by register D0. The time reflects the execution mode of the task. If D1 returns zero, then the task is not in the task list. If D1 returns a value greater than zero, then the task is in the run state (executing). If D1 returns a negative value, then the task is suspended pending event -(D1).

The task number is returned from the CREATE TASK BLOCK (XCTB) primitive. It can also be obtained by setting data register D0 equal to a minus one. In this case, register D1.L is returned with the current task number.

See also: XSTP - SET/READ TASK PRIORITY

Possible Errors: None

1.3.89 XRWF - REWIND FILE

Mnemonic:	XRWF
Value:	$A0EA
Module:	MPDOSF
Format:	XRWF <status error return>
Registers:	In D1.W = File ID
Description:	REWIND FILE primitive positions the file specified by the file ID in register D1, to byte position zero.
See also:	XPSF - POSITION FILE XRFP - READ FILE POSITION

Possible Errors:

52 = File not open
59 = Invalid slot #
70 = Position error
Disk errors

1.3.90 XSEF - SET EVENT FLAG W/SWAP

Mnemonic:	XSEF
Value:	$A018
Module:	MPDOSK1
Format:	XSEF <status return>

Registers:	In	D1.B	=	Event (+=Set, -=Reset)
	Out	SR	=	NE....Set EQ....Reset

Note: An XSWP is automatically executed after the event is set or reset. Event 128 is local to each task.

If D1.B is positive, then the event is set.
If D1.B is negative, then the event is reset.

Description: SET EVENT FLAG WITH SWAP primitive sets or resets an event flag bit. The event number is specified in data register D1.B and is module 128. If the content of register D1.B is positive, then the event bit is set to 1. Otherwise, the bit is reset to 0. Event 128 can only be set. (It is cleared by the task scheduler.)

The status of the event bit prior to changing the event is returned in the status register. If the event was 0, then the 'EQ' status is returned. Also, an immediate context switch occurs thus scheduling any higher priority task pending on that event.

Events are summarized as follows:

1-63	= Software events
64-80	= Software resetting events
81-95	= Output port events
96-111	= Input port events
112	= 1/5 second event
113	= 1 second event
114	= 10 second event
115	= 20 second event
116	= TTA active
117	= LPT active

See also: XDEV - DELAY SET/RESET EVENT
XSEV - SET EVENT FLAG
XSUI - SUSPEND UNTIL INTERRUPT
XTEF - TEST EVENT FLAG

Possible Errors: None

1.3.91 XSEV - SET EVENT FLAG

Mnemonic:	XSEV
Value:	$A046
Module:	MPDOSK1
Format:	XSEV <status return>

Registers:	In	D1.B	=	Event (+=Set, -=Reset)
	Out	SR	=	NE....Set
				EQ....Reset

Note: Event 128 is local to each task.

If D1.B is positive, then the event is set.
If D1.B is negative, then the event is reset.

Description: SET EVENT FLAG primitive sets or resets an event flag bit. The event number is specified in data register D1.B and is module 128. If the content of register D1.B is positive, then the event bit is set to 1. Otherwise, the bit is reset to 0. Event 128 can only be set. (It is cleared by the task scheduler.)

The status of the event bit prior to changing the event is returned in the status register. If the event was 0, then the 'EQ' status is returned. A context switch DOES NOT occur with this call making it useful for interrupt routines outside the PDOS system.

Events are summarized as follows:

1-63 =	Software events
64-80 =	Software resetting events
81-95 =	Output port events
96-111 =	Input port events
112 =	1/5 second event
113 =	1 second event
114 =	10 second event
115 =	20 second event
116 =	TTA active
117 =	LPT active

See also: XDEV - DELAY SET/RESET EVENT
XSEV - SET EVENT FLAG
XSUI - SUSPEND UNTIL INTERRUPT
XTEF - TEST EVENT FLAG

Possible Errors: None

1.3.92 XSMP - SEND MESSAGE POINTER

Mnemonic:	XSMP
Value:	$A002
Module:	MPDOSK1
Format:	XSMP <status return>

Registers:	In	D0.B	=	Message slot number (0..15)
		(A1)	=	Message
	Out	SR	=	EQ....Message sent (Event[64+slot #]=1)
				NE....No message sent

Description: SEND MESSAGE POINTER primitive sends a 32-bit message to the message slot specified by data register D0.B. Address register A1 contains the message. If there is still a message pending, then the primitive immediately returns with status set 'Not Equal' and D0.L equal to 83. Otherwise, the message is taken by PDOS event (64 + message slot number) is set to one indicating a message is ready, and status is returned 'Equal'.

The primitive XSMP is only valid for message slots 0 through 15. (This is because of current event limitations.)

See also:
XGMP - GET MESSAGE POINTER
XGTM - GET TASK MESSAGE
XKTM - KILL TASK MESSAGE
XSTM - SEND TASK MESSAGE

Possible Errors:

83 = Message buffer pending

1.3.93 XSOE - SUSPEND ON PHYSICAL EVENT

Mnemonic:	XSOE
Value:	$A112
Module:	MPDOSK1
Format:	XSOE

Registers:	In	D1.L = Event 1 Descriptor.w, Event 0 Descriptor.w
		A0 = Event 0 address (0=no event 0 to suspend on)
		A1 = Event 1 address (0=no event 1 to suspend on)
	Out	D0 = -1 if awaken on event 0;1 if awaken on event 1

Note: This call is the same as XSUI but with physical events.

Description: Allows a task to suspend on one or two events within the system. Tasks that suspend on physical events are listed as suspended on events -1/1. If event 0 is the scheduling event, a -1 is returned; otherwise, a 1 is returned.

The event descriptor is a 16 bit word that defines both the bit number at the specified A0,A1 address and the action to take o n the bit. The following bits are defined:

```
Bit number:   15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
              T  x  x  x  x  x x x S x x x x B B B
```

T = Should the bit be toggled on scheduling?
1 = Yes (toggle), 0 = No (do not toggle)

S = Suspend on event bit clear or set
1 = Suspend on SET, 0 = Suspend on CLEAR

BBB = The 680 x 0 bit number to use as an event
x = Reserved, should be 0

Since the bit number is specified in the lower three bits of the descriptor, you may use the descriptor with the 680x0 BTST,BCLR,BSET instructions.

See also: XDPE - Delay On Physical Event
XTLP - Translate Logical To Physical Event

1.3.94 XSOP - OPEN SEQUENTIAL FILE

Mnemonic:	XSOP
Value:	$A0EC
Module:	MPDOSF
Format:	XSOP
	<status error return>

Registers:	In	(A1) = File name
	Out	D0.W = File attribute
		D1.W = File ID

Note: Uses multiple directory file search.

Description: OPEN SEQUENTIAL FILE primitive opens a file for sequential access by assigning the file to an area of system memory called a file slot and returning a file ID and file type to the calling program. Thereafter, the file is referenced by the file ID and not by the file name.

The file ID (returned in register D1) is a 2-byte number. The left byte is the disk number and the right byte is the file slot index. The file attribute is returned in D0.

The END-OF-FILE marker on a sequential file is changed whenever data is written to the file. All data transfers are buffered through a channel buffer; data movement to and from the disk is by full sectors.

The file slots are allocated beginning with slot 32 down to slot 1.

Possible Errors:

50 = Invalid file name
53 = File not defined
61 = File already open
68 = Not PDOS disk
69 = Not enough file slots
Disk errors

1.3.95 XSPF - SET PORT FLAG

Mnemonic:	XSPF
Value:	$A09A
Module:	MPDOSK2
Format:	XSPF
	<status error return>

Registers:	In	D0.W = Port number
		D1.B = Port flag (fwpi8dcs)
	Out	D1.B = Old port flag

Note: If D0.W=0, then the current port (PRT$(A6)) is used.

Description: SET PORT FLAG primitive stores the port flag passed in data register D1.B in the port flag register as specified by register D0.W. If flag bits 'p', 'i', or '8' change, the BIOS baud port routine is called.

See also: XBCP - BAUD CONSOLE PORT
XRPS - READ PORT STATUS

Possible Errors:

66 = Invalid port or baud rate

1.3.96 XSTM - SEND TASK MESSAGE

Mnemonic:	XSTM
Value:	$A020
Module:	MPDOSK1
Format:	XSTM <status error return>

Registers: In D0.B = TASK NUMBER
(A1) = MESSAGE

Description: SEND TASK MESSAGE primitive places a 64-character message into a PDOS system message buffer. The message is data-independent and is pointed to by address register A1.

Data register D0 specifies the destination of the message. If register D0 is negative, and there is no input port (phantom port), then the message is sent to the parent task. If there is a port, then the message is sent to itself and will appear at the next command line. Otherwise, register D0 specifies the destination task.

The ability to direct a message to a parent task is very useful in background tasking. An assembler need not know from which task it was spawned and can merely direct any diagnostics to the parent task.

If the destination task number equals -1, the task message is moved to the monitor input buffer and parsed as a command line. This feature is used by the CREATE TASK BLOCK primitive to spawn a new task.

See also:
XGMP - GET MESSAGE POINTER
XGTM - GET TASK MESSAGE
XKTM - KILL TASK MESSAGE
XSMP - SEND MESSAGE POINTER
XSTM - SEND TASK MESSAGE

Possible Errors:

78 = Message buffer full

1.3.97 XSTP - SET/READ TASK PRIORITY

Mnemonic:	XSTP
Value:	$A03C
Module:	MPDOSK1
Format:	XSTP <status error return>

Registers:	In	D0.B = Task #
		D1.W = Task time/Task priority
	Out	D1.B = Task priority (If D1.B was 0)

Note: If D0.B=-1, then select current task. If D1.B=0, then read task priority into D1.B.

Description: SET/READ TASK PRIORITY primitive either sets or reads the task priority selected by data register D0.B. If D1.B is nonzero, then the priority is set. Otherwise, it is read and returned in D1.B. If the upper byte of D1.W is nonzero, then the corresponding task time slice is also set.

See also: XRTS - READ TASK STATUS

Possible Errors:

74 = No such task

1.3.98 XSUI - SUSPEND UNTIL INTERRUPT

Mnemonic:	XSUI	
Value:	$A01C	
Module:	MPDOSK1	
Format:	XSUI	
Registers:	In	D1.W = EV1/EV2
	Out	D0.L = Event

Description: SUSPEND UNTIL INTERRUPT primitive suspends the user task until one of the events specified in data register D1 occurs. A task can suspend until an event sets (positive event) or until it resets (negative event). A task can suspend pending two different events. This is useful when combined with timeout counters to prevent system lockups. Data register D0.L is returned with the event which caused the task to be scheduled.

A suspended task does not receive any CPU cycles until one of the event conditions is met. When the event bit is set (or reset), the task begins executing at the next instruction after the XSUI call. The task is scheduled during the normal swapping functions of PDOS according to its priority. Register D0.L is used to determined which event scheduled the task.

A suspended task is indicated in the LIST TASK (LT) command under the 'Event' parameter. Multiple events are separated by a slash.

Events 64 through 128 toggle when they cause a task to move from the suspended state to the ready state. All others must be reset by the event routine.

If a locked task attempts to suspend itself, the call polls the events until a successful return condition is met.

See also:
XDEV - DELAY SET/RESET EVENT
XSEF - SET EVENT FLAG W/SWAP
XSEV - SET EVENT FLAG
XTEF - TEST EVENT FLAG

Possible Errors: None

1.3.99 XSUP - ENTER SUPERVISOR MODE

Mnemonic:	XSUP
Value:	$A02C
Module:	MPDOSK1
Format:	XSUP

Registers: None

Description: ENTER SUPERVISOR MODE primitive moves your current task from user mode to supervisor mode. Care should be taken not to crash the system since you would then be executing off the supervisor stack! This primitive enables programs to access I/O addresses and use privileged instructions.

Exit to user mode by executing a 'ANDI.W #$DFFF,SR' instruction or the XUSP primitive.

See also: XLSR - LOAD STATUS REGISTER
XUSP - RETURN TO USER MODE

Possible Errors: None

1.3.100 XSWP - SWAP TO NEXT TASK

Mnemonic:	XSWP
Value:	$A000
Module:	MPDOSK1
Format:	XSWP

Registers: None

Description: SWAP TO NEXT TASK primitive relinquishes control to the PDOS task scheduler. The next ready task with the highest priority begins executing. (This may be to the same task if there is only one task or the task is the highest priority ready task.)

Possible Errors: None

1.3.101 XSZF - GET DISK SIZE

Mnemonic:	XSZF	
Value:	$A0B6	
Module:	MPDOSF	
Format:	XSZF	
	<status error return>	
Registers:	In	D0.B = Disk number
	Out	D5.L = Directory size/# of files
		D6.L = Allotted/Used
		D7.L = Largest/Free

Description: GET DISK SIZE primitive returns disk size parameters in data registers D5 through D7. Data register D5 returns the number of currently defined files in the low word along with the maximum number of files available in the directory in the high word. The low order 16 bits of data register D6 (0-15) returns the total number of sectors used by all files. The high order 16 bits of D6 (16-31) returns the number of sectors allocated for file storage.

The low order 16 bits of data register D7 (0-15) is calculated from the disk sector bit map and reflects the number of sectors available for file allocation. The high order 16 bits of D7 (16-31) is returned with the size of the largest block of contiguous sectors. This is useful in defining large files.

Possible Errors:

68 = Not PDOS disk
Disk errors

1.3.102 XTAB - TAB TO COLUMN

Mnemonic:	XTAB
Value:	$A090
Module:	MPDOSK2
Format:	XTAB <column>

Registers: None

Description: TAB TO COLUMN primitive positions the cursor to the column specified by the number following the call. Spaces are output until the column counter is greater than or equal to the parameter.

The first print column is zero. At least one space character will always be output.

Possible Errors: None

1.3.103 XTEF - TEST EVENT FLAG

Mnemonic:	XTEF
Value:	$A01A
Module:	MPDOSK1
Format:	XTEF <status return>

Registers:	In	D1.B = Event number (+=0-127, -=128)
	Out	SR = NE....Event set (1)
		EQ....Event clear (0)

Description: TEST EVENT FLAG primitive sets the 68000 status word EQUAL or NOT-EQUAL depending upon the zero or nonzero state of the specified event flag. The flag is not altered by this primitive.

The event number is specified in data register D1 and is module 128. Event 128 is local to each task.

See also: XDEV - DELAY SET/RESET EVENT
XSEF - SET EVENT FLAG W/SWAP
XSEV - SET EVENT FLAG
XSUI - SUSPEND UNTIL INTERRUPT

Possible Errors: None

1.3.104 XTLP - TRANSLATE LOGICAL TO PHYSICAL EVENT

Mnemonic:	XTLP
Value:	$A110
Module:	MPDOSK1
Format:	XTLP

Registers:	In	D1.W = Event 1.B,,Event 0.B
	Out	A0 = Event 0 address (0=no event 0 to suspend on)
		A1 = Event 1 address (0=no event 1 to suspend on)
		D1 = Event 1 Descriptor.w,Event 0 Descriptor.w

Description: XTLP takes a VMEPROM logical event number and translates the event into a physical event. This call is used when a program needs to suspend on both a logical and a physical event. The logical event is first translated; then the XSOE call is used to suspend it.

A VMEPROM logical event is one of the 128 events maintained by the VMEPROM system in SYRAM.

Events are summarized as follows:

1 - 63	= Software events
64 - 80	= Software self clearing events
81 - 95	= Output port events
96 -111	= Input port events
112 -115	= Timer events
116 -127	= System control events
128	= Local

The event descriptor is a 16-bit word that defines both the bit number at the specified A0,A1 address and the action to take on the bit. The following bits are defined:

```
Bit number:   15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
               T  x  x  x  x  x x x S x x x x B B B
```

T = Should the bit be toggled on scheduling?
1 = Yes (toggle), 0 = No (do not toggle)

S = Suspend on event bit clear or set
1 = Suspend on SET, 0 = Suspend on CLEAR

BBB = The 680 x 0 bit number to use as an event
x = Reserved, should be 0

Since the bit number is specified in the lower three bits of the descriptor, you may use the descriptor with the 680 x 0 BTST, BCLR, BSET instructions. You may also use the following physical manipulation calls which are macros for single assembly instructions. They are optimal as long as the values have already been placed in the correct registers. Physical events may need synchronization via the XTAS macro to avoid corruption. The macros are defined in the file PESMACS:SR.

XTST -☺Test Physical Event (replaces BTST D1, A0))
XSET - Test and Set Physical Event (replaces BSET D1,(A0))
XCLR - Test and Clear Physical Event (replaces BCLR D1,(A0))

Input:	D1.W - Event descriptor	
	A0 - Event address	
Output:	None	
	Status:	EQ - the bit was clear (0)
		NE - the bit was set (1)

The bottom three bits are evaluated as a bit number. The bit at the address is set and the previous value is returned in the Z bit of the status register.

XTAS - Test and Set Physical Event (Bit 7 atomic)

This macro replaces TAS (A0). The seventh bit at the address is set and the previous value is returned in the N bit of the status register.

Input:	A0 - Event address
Output:	None
Status:	EQ - the bit was clear (0)
	NE - the bit was set (1)

See also:	XDPE - Delay On Physical Event
	XSOE - Suspend On Physical Event

1.3.105 XUAD - UNPACK ASCII DATE

Mnemonic:	XUAD
Value:	$A036
Module:	MPDOSK3
Format:	XUAD

Registers:	In	D1.W = (Year*16+Month)*32+Day
		(YYYY YYYM MMMD DDDD)
	Out	(A1) = 'DY-MON-YR'<null>
		(Outputs ??? for invalid months)

Description: UNPACK ASCII DATE primitive returns a pointer in address register A1 to an ASCII date string. Data register D1.W contains the binary date [(Year*16+Month)*32+Day]. The format of the string is more exact than simple numbers separated by slashed.

Note: XUAD does not check for a valid date and hence, funny looking strings could result. Invalid months are replaced by '???.'

See also: XFTD - FIX TIME & DATE
XPAD - PACK ASCII DATE
XRDT - READ DATE
XRTM - READ TIME
XUDT - UNPACK DATE
XUTM - UNPACK TIME

Possible Errors: None

1.3.106 XUDT - UNPACK DATE

Mnemonic:	XUDT
Value:	$A060
Module:	MPDOSK3
Format:	XUDT

Registers:	In	D1.W = (Year * 16 + Month) * 32 + Day
	Out	(A1) = 'MN/DY/YR'<null>

Description: UNPACK DATE primitive converts a one-word encoded date into an eight- character string terminated by a null (nine characters total). Data register D1 contains the encoded date and returns with a pointer to the formatted string in address register A1. The output of the FIX TIME & DATE (XFTD) primitive is valid input to this primitive.

See also: XFTD - FIX TIME & DATE
XPAD - PACK ASCII DATE
XRDT - READ DATE
XRTM - READ TIME
XUAD - UNPACK ASCII DATE
XUTM - UNPACK TIME

Possible Errors: None

1.3.107 XULF - UNLOCK FILE

Mnemonic:	XULF
Value:	$A0EE
Module:	MPDOSF
Format:	XULF <status error return>

Registers: In D1.W = File ID

Description: UNLOCK FILE primitive unlocks a locked file for access by any other task. The file is specified by the file ID in data register D1.

See also: XLKF - LOCK FILE

Possible Errors:

52 = File not open
59 = Invalid slot #
Disk errors

1.3.108 XULT - UNLOCK TASK

Mnemonic:	XULT
Value:	$A016
Module:	MPDOSK1
Format:	XULT

Registers: None

Description: UNLOCK TASK primitive unlocks the current task by clearing the swap lock variable in system RAM. This allows other tasks to be scheduled and receive CPU time.

See also: XLKT - LOCK TASK

Possible Errors: None

1.3.109 XUSP - RETURN TO USER MODE

Mnemonic:	XUSP
Value:	$A008
Module:	MPDOSK1
Format:	XUSP

Registers: None

Description: RETURN TO USER MODE primitive moves your current task from supervisor mode to user mode. Executing an 'ANDI.W #$DFFF,SR'' instruction also returns you to user mode, but must be executed in supervisor mode. The XUSP primitive can be executed in either mode.

See also: XLSR - LOAD STATUS REGISTER
XSUP - ENTER SUPERVISOR MODE

Possible errors: None

1.3.110 XUTM - UNPACK TIME

Mnemonic:	XUTM
Value:	$A062
Module:	MPDOSK3
Format:	XUTM

Registers:	In	D1.W = HOUR*256+MINUTE (HHHH HHHH MMMM MMMM)
	Out	(A1) = HR:MN<null>

Description: UNPACK TIME primitive converts a one word encoded date into a five character string terminated by a null (six characters total). Data register D1 contains the encoded time and returns a pointer to the formatted string in address register A1. The output of the FIX TIME & DATE (XFTD) primitive is valid input to this primitive.

See also:
XFTD - FIX TIME & DATE
XPAD - PACK ASCII DATE
XRDT - READ DATE
XRTM - READ TIME
XUAD - UNPACK ASCII DATE
XUDT - UNPACK DATE

Possible Errors: None

1.3.111 XVEC - SET/READ EXCEPTION VECTOR

Mnemonic:	XVEC
Value:	$A116
Module:	MPDOSK1
Format:	XVEC

Registers:	In	D0.W	= Exception number (#2-255)
		(A0)	= New exception service routine (0=read only)
	Out	(A0)	= Old service routine

Description: Sets and/or reads the execution vector for the system. The old service routine address is returned so that you may change a routine and then restore the former routine under program control.

See also: XDTV - Define Trap Vectors

Possible Errors: None

1.3.112 XWBF - WRITE BYTES TO FILE

Mnemonic:	XWBF
Value:	$A0F0
Module:	MPDOSF
Format:	XWBF <status error return>

Registers: In D0.L = Byte count - must be positive
D1.W = File ID
(A2) = Buffer address

Description: WRITE BYTES TO FILE primitive writes from a memory buffer, pointed to by address register A2, to a disk file specified by the file ID in register D1. Register D0 specifies the number of bytes to be written. If the channel buffer has been rolled to disk, the least-used buffer is freed and the buffer is restored to memory. The file slot ID is placed on the top of the last-access queue.

The write is independent of the data content. The buffer pointer in register A2 may be on any byte boundary. The write operation is not terminated with a null character.

A byte count of zero in register D0 results in no data being written to the file.

If it is necessary for the file to be extended, PDOS first uses sectors already linked to the file. If a null or end link is found, a new sector obtained from the disk sector bit map is linked to the end of the file. If this makes the file non-contiguous, it is retyped as a non-contiguous file.

See also: XRBF - READ BYTES FROM FILE
XRLF - READ LINE FROM FILE
XWLF - WRITE LINE TO FILE

Possible Errors:

52 = File not open
58 = File delete or write protected
59 = Invalid slot #
60 = File space full
Disk errors

1.3.113 XWDT - WRITE DATE

Mnemonic:	XWDT
Value:	$A064
Module:	MPDOSK3
Format:	XWDT

Registers:	In	D0.B = Month (1-12)
		D1.B = Day (1-31)
		D2.B = Year (0-99)

Description: WRITE DATE primitive sets the system date counters. Register D0 specifies the month and ranges from 1 to 12. Register D1 specifies the day of month and ranges from 1 to 31. Register D2 is the last 2 digits of the year.

No check is made for a valid date.

Possible Errors: None

1.3.114 XWFA - WRITE FILE ATTRIBUTES

Mnemonic:	XWFA
Value:	$A0F2
Module:	MPDOSF
Format:	XWFA <status error return>

Registers: In (A1) = File name
(A2) = ASCII file attributes

Note: (A2)=0 clears all attributes.

Description: WRITE FILE ATTRIBUTES primitive sets the attributes of the file specified by the file name pointed to by register A1. Register A2 points to an ASCII string containing the new file attributes followed by a null character. The format is:

(A2) = {file type}{protection}

{file type} =	AC - Procedure file
	BN - Binary file
	OB - 68000 object file
	SY - 68000 memory image
	BX - BASIC binary token file
	EX - BASIC ASCII file
	TX - Text file
	DR - System I/O driver

{protection} =	* - Delete protect
	** - Delete and Write protect

If register A2 points to a zero byte, then all flags, with the exception of the contiguous flag, are cleared.

See also: XCFA - CLOSE FILE W/ATTRIBUTE
XRFA - READ FILE ATTRIBUTES
XWFP - WRITE FILE PARAMETERS

Possible Errors:

50 = Invalid file name
53 = File not defined
54 = Invalid file type
Disk errors

1.3.115 XWFP - WRITE FILE PARAMETERS

Mnemonic:	XWFP
Value:	$A0FC
Module:	MPDOSF
Format:	XWFP <status error return>

Registers: In (A1) = File name
D0.L = Sector index of EOF/Bytes in last sector
D1.L = Time/Date created
D2.L = Time/Date last accessed
D3.W = OR'd status (less contiguous bit)

Description: WRITE FILE PARAMETERS primitive updates the end-of-file and date parameters of the file specified by the name pointed to by address register A1 in the disk directory.

See also: XCFA - CLOSE FILE W/ATTRIBUTE
XRFA - READ FILE ATTRIBUTES
XWFA - WRITE FILE ATTRIBUTES

Possible Errors:

50 = Invalid file name
53 = File not defined
Disk errors

1.3.116 XWLF - WRITE LINE TO FILE

Mnemonic:	XWLF
Value:	$A0F4
Module:	MPDOSF
Format:	XWLF <status error return>

Registers: In D1.W = File ID
(A2) = Buffer address

Description: WRITE LINE TO FILE primitive writes a line delimited by a null character to the disk file specified by the file ID in register D1. Address register A2 points to the string to be written. If the channel buffer has been rolled to disk, the least-used buffer is freed and the buffer is restored to memory. The file slot ID is placed on the top of the last-access queue.

The write line primitive is independent of the data content, with the exception that a null character terminates the string. The buffer pointer in register A2 may be on any byte boundary. A single write operation continues until a null character is found.

If it is necessary for the file to be extended, PDOS first uses sectors already linked to the file. If a null link is found, a new sector obtained from the disk sector bit map is linked to the end of the file. If this makes the file non-contiguous, it is retyped as a non-contiguous file.

See also: XRBF - READ BYTES FROM FILE
XRLF - READ LINE FROM FILE
XWBF - WRITE BYTES TO FILE

Possible Errors:

52 = File not open
58 = File delete or write protected
59 = Invalid slot #
60 = File space full
Disk errors

1.3.117 XWSE - WRITE SECTOR

Mnemonic:	XWSE	
Value:	$A0C6	
Module:	MPDOSF	
Format:	XWSE	
	<status error return>	
Registers:	In	D0.B = Disk number
		D1.W = Sector number
		(A2) = Buffer address

Description: WRITE SECTOR primitive is a system-defined, hardware-dependent program which writes 256 bytes of data from a buffer, pointed to by address register A2, to the logical sector and disk device specified by data registers D1 and D0 respectively.

See also: CHAPTER 8 BIOS
XISE - INITIALIZE SECTOR
XRSE - READ SECTOR
XRSZ - READ SECTOR ZERO

Possible Errors:

Disk errors

1.3.118 XWTM - WRITE TIME

Mnemonic:	XWTM
Value:	$A066
Module:	MPDOSK3
Format:	XWTM

Registers: In D0.B = Hours (0-23)
D1.B = Minutes (0-59)
D2.B = Seconds (0-60)

Description: WRITE TIME primitive sets the system clock time. Register D0 specifies the hour and ranges from 0 to 23. Register D1 specifies the minutes and register D2, the seconds. The latter two range from 0 to 59.

There is no check made for a valid time.

Possible Errors: None

1.3.119 XZFL - ZERO FILE

Mnemonic:	XZFL
Value:	$A0F6
Module:	MPDOSF
Format:	XZFL <status error return>

Registers: In (A1) = File name

Description: ZERO FILE primitive clears a file of any data. If the file is defined, then the end-of-file marker is placed at the beginning of the file. If the file is not defined, it is defined with no data.

See also: XDFL - DEFINE FILE
XDLF - DELETE FILE

Possible errors:

50 = Invalid file name
61 = File already open
68 = Not PDOS disk
Disk errors

APPENDIX

APPENDIX A

A. VMEbus Board Setup

This appendix summarizes the changes to be made to the default setup of additional VMEbus boards so that they are VMEPROM compatible. Appendices A.2 through A.6 are available in EPROM, but are not installed. All drivers may be installed with the INSTALL command. When INSTALL followed by a question mark is entered, the following will appear:[1]

? INSTALL ?

THE FOLLOWING UARTS AND DISK DRIVERS ARE ALREADY IN EPROM:

```
DISK DRIVER    FORCE ISCSI-1           ADDR: $FF007300
DISK DRIVER    FORCE IBC/ME            ADDR: $FF004CC0
DISK DRIVER    FORCE EAGLE/ME          ADDR: $FF004E30
UART DRIVER    FORCE CPU-39/DUSCC      ADDR: $FF004500
UART DRIVER    FORCE SIO-1/2           ADDR: $FF004800
UART DRIVER    FORCE ISIO-1/2          ADDR: $FF004C00
UART DRIVER    FORCE IBC/ME            ADDR: $FF008410
UART DRIVER    FORCE EAGLE/ME          ADDR: $FF008610
UART DRIVER    FORCE UNIX MAIL         ADDR: $FF005100
UART DRIVER    FORCE IBC RAM port      ADDR: $FF00EE7C
```

By typing in: **INSTALL <file>,<address><cr>**, a specific driver may be loaded in the system. The addressed file should be located in EPROM.

A1. VMEbus Memory

In general, every FORCE memory board can be used together with VMEPROM. The base address must be set correctly in order to use the board within the tasking memory of VMEPROM. The board base addresses of any additional memory boards must be set to be contiguous to the on-board memory. It is strongly recommended that only 32 bit memory boards are used because of speed purposes.

[1] Please note that the printed UART and Disk Driver addresses are only examples. They may change according to software versions.

A2. SYS68K/SIO-1/SIO-2

These two serial I/O boards are set to the base address $B00000 by default. VMEPROM expects the first SIO-1/SIO-2 boards at $FCB00000. This is in the standard VME address range (A24, D16, D8) with the address $B00000. The address modifier decoder (AM-Decoder) of the SIO-1/2 boards must be set to:

Standard Privileged Data Access
Standard Nonpriviledged Data Access

Please refer to the SIO User's Manual for setup. If a second SIO-1/2 board will be used, the base address must be set to FCB00200. The AM-decoder setup described above must again be used. Please refer to the User's Manual of your SIO board for the address setup of the second SIO board. Before using the driver for the SIO-1/2 board, the driver must be installed by using the INSTALL command. The following must be entered:

```
? INSTALL U2,$FF004800
```

In order to install one of the ports of the SIO boards in VMEPROM, the BP command can be used. The SIO-1/2 boards use the driver type 2. To install the first port of a SIO board with a 9600 baud rate, the following command line can be used:

```
? BP 4, 9600, 2, $FCB00000
```

The port can then be used as port number 4. Please note that the hardware configuration must be detected before a port can be installed. This can be done with the CONFIG command. Please refer to the command description in the VMEPROM User's Manual for a detailed description of the CONFIG and BP commands. The base addresses of all ports of a SIO-1/2 board which must be specified with the BP command is as follows:

SIO port #	Address
1 (first SIO board)	$FCB00000
2	$FCB00040
3	$FCB00080
4	$FCB000C0
5	$FCB00100
6	$FCB00140
1 (second SIO board)	$FCB00200
2	$FCB00240
3	$FCB00280
4	$FCB002C0
5	$FCB00300
6	$FCB00340

VMEPROM supports up to two serial I/O boards. These can be either the SIO-1/2 board, the ISIO-1/2 board, or a mixture of both. Please note that the first board of every type must be set to the first base address. In using one SIO-1 board and one ISIO-1 board, the base address of the boards must to be set to:

SIO-1	**$FCB00000**
ISIO-1	**$FC960000**

A3. SYS68K/ISIO-1/2

These serial I/O boards are set to the address $960000 in the standard VME address range by default. VMEPROM awaits this board at this address; no changes need to be made to the default setup. An optional second board may be used. When used, the address must be set to $980000. Read the SYS68K/ ISIO-1/2 User's Manual for a description of the base address setup. Before using the driver for the ISIO-1/2 board, the driver must be installed by using the INSTALL command. The following must be entered:

```
? INSTALL U3,$FF004C00
```

In order to install one of the ports of an ISIO board in VMEPROM, the BP command can be used. The ISIO-1/2 boards are driver type 3. In order to install the first port of an ISIO board with a 9600 baud rate, the following command line can be used:

```
? BP 4, 9600, 3, $FC968000
```

The port number is four. The hardware configuration must be detected before a port can be installed. This is done with the CONFIG command. Read the command description in the VMEPROM User's Manual for a description of the CONFIG and BP commands. The base address of all ISIO-1/2 ports, specified by the BP command, is as follows:

ISIO port #	Address
1 (first ISIO board)	$FC968000
2	$FC968020
3	$FC968040
4	$FC968060
5	$FC968080
6	$FC9680A0
7	$FC9680C0
8	$FC9680E0
1 (second ISIO board)	$FC988000
2	$FC988020
3	$FC988040
4	$FC988060
5	$FC988080
6	$FC9880A0
7	$FC9880C0
8	$FC9880E0

VMEPROM supports two serial I/O boards. These can be the SIO-1/2 or ISIO-1/2 board or mixture of both. The first board of each type must be set to the first base address. When using one SIO-1 and one ISIO-1 board, the base address of the boards must be set to:

SIO-1	**$FCB00000**
ISIO-1	**$FC960000**

A4. SYS68K/ISCSI-1 Disk Controller

VMEPROM supports up to two floppy disk drives and three Winchester disk drives together with the ISCSI-1 disk controller. The floppy drives must be jumpered to drive select 3 and 4 and can be accessed as disk number 0 and 1 out of VMEPROM. The floppy drives are installed automatically when a ISCSI-1 controller is detected by the CONFIG command. Usable floppy drives must support 80 tracks/side, and must be double sided/double density. The step rate used is 3 ms. The Winchester drives are not installed automatically. The VMEPROM FRMT command must be used for defining the following factors:

- The physical structure of the drive (i.e. number of heads, number of cylinders, drive select number, etc.)
- The bad block of the Winchester drive
- The partitions to be used

If this setup is done once for a particular drive, the data is stored in the first sector of the Winchester and is loaded automatically when the disk controller is installed in VMEPROM. The driver for the ISCSI-1 may be installed by using the INSTALL command. The following must be entered:

? INSTALL W,$FF007300

The default base address of the ISCSI-1 controller is $A00000 in the standard VME address range. This is the address $FCA00000 for the CPU board and no changes have to be made to this setup. The ISCSI-1 driver uses interrupts by default. This cannot be disabled. Please make sure that the interrupt daisy chain is closed so that the controller can work properly.

A5. Boards providing the Application Command Interface (ACI)

Four drivers are included in VMEPROM which manage the communication through the ACI, two disk drivers and two UART drivers. Two of each type are necessary because one controls the onboard EAGLE module(s) and the other controls offboard modules. The driver for offboard modules searches for every board in the system (except itself) and installs as many devices as the driver can handle. To ensure that the driver can find all IBC boards in system, their base addresses must be set according to the following table.

Slot #	Base Address
1	$80000000
2	$84000000
3	$88000000
4	$8C000000
. . .	. . .
21	$D0000000

A5.1 UART Driver

A5.1.1 Onboard EAGLE Module

To install the UART driver, type:

```
? INSTALL U7,$FF008610
```

The UART driver can handle up to 64 serial ports. However, the kernel only allows up to 15 ports. To select a specific port use the BP command. The BP command expects a UART base address. This address is a logical address starting with $1 for the first serial device. The second serial device gets a logical address $2 and so on. For example, when an EAGLE module has 3 serial channels their logical addresses are $1, $2 and $3. To inform the kernel about the second channel, type:

```
? BP $1905,1,7,$2
```

Now port 5 is connected to the second serial device on the EAGLE module. The baud rate is set to 9600 baud. The handshake is set to XON/XOFF.

A5.1.2 Offboard EAGLE Modules

To install the UART driver, type:

```
? INSTALL U8,$FF008410
```

Now the driver searches for up to 21 boards in the system if they provide the ACI. Every serial device is installed. Additionally, the RAM port of every board with an ACI is installed.

The UART driver can handle up to 64 serial ports. However, the kernel only allows up to 15 ports. To select a specific port use the BP command. The BP command expects a UART base address. This address is a logical address, $1 for the first physical serial device, $2 for the second and so on. The logical address of the RAM port is always the base address of the currently installed board.

The following is an example where a system contains 3 IBC-20 cards.

The first IBC-20 has an EAGLE with 3 serial channels; the IBC-20 base address is $84000000. The second has no serial device; the IBC-20 base address is $B4000000. The third has two EAGLE modules with 6 serial channels; the IBC-20 base address is $B8000000.

After the INSTALL command the driver knows 12 serial channels.

Logical Address	UART
$84000000	RAM port of the first IBC-20
$00000001	The first serial channel of the first IBC
$00000002	The second serial channel of the first IBC-20
$00000003	The third serial channel of the first IBC-20
$B4000000	RAM port of the second IBC-20
$B8000000	RAM port of the third IBC-20
$00000004	The first serial channel of the third IBC-20
$00000005	The second serial channel of the third IBC-20
$00000006	The third serial channel of the third IBC-20
$00000007	The fourth serial channel of the third IBC-20
$00000008	The fifth serial channel of the third IBC-20
$00000009	The sixth serial channel of the third IBC-20

To inform the kernel about the second channel of the third IBC-20, type:

```
? BP $1905,1,8,$5
```

Now port 5 is connected to the second serial device on the EAGLE module. The baud rate is set to 9600 baud. The handshake is set to XON/XOFF.

A6.2 Disk Driver

VMEPROM supports up to two floppy disk drives and up to four hard disk drives per driver. The first floppy controller and every hard disk controller which is found on the EAGLE Module(s) are installed (up to the limit of four hard disk drives). Hard disks must have a valid partition table on the first physical block. If none is found a default partition table is used. The VMEPROM FRMT command must be used to define the partitions.

Depending on the device driver task the disk access can be cached. Therefore, not every data which is written to the disk from VMEPROM must be written to the hard disk. The FLUSH command of VMEPROM is used to be sure that all data is written to every hard disk.

The driver for onboard EAGLE Modules automatically is installed after power up, while the offboard driver must be installed with the command:

```
? INSTALL W,$FF004CC0
```

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APPENDIX B

B. S-Record Formats

B1. S-Record Types

Eight types of S-records have been defined to accommodate the needs of the encoding, transportation and decoding functions. VMEPROM supports S0, S1, S2, S3, S7, S8 and S9 records (S7 and S8 on load only).

An S-record format module may contain S-records of the following types:

S0	The header record for each block of S-records.
S1	A record containing code/data and the 2-byte address at which the code/data is to reside.
S2	A record containing code/data and the 3-byte address at which the code/data is to reside.
S3	A record containing code/data and the 4-byte address at which the code/data is to reside.
S5	A record containing the number of S1, S2 and S3 records transmitted in a particular block. The count appears in the address field. There is no code/data field. Not supported by VMEPROM.
S7	A termination record for a block of S3 records. The address field may optionally contain the 4-byte address of the instruction to which control is to be passed. There is no code/data field.
S8	A termination record for a block of S2 records. The address field may optionally contain the 3-byte address of the instruction to which control is to be passed. There is no code/data field.
S9	A termination record for a block of S1 records. The address field may optionally contain the 2-byte address of the instruction to which control is to be passed.

Only one termination record is used for each block of S-records. S7 and S8 records are usually used only when control is to be passed to a 3 or 4 byte address. Normally, only one header record is used, although it is possible for multiple header records to occur.

B2. S-Record Example

```
S2140200000000044400020146600000CB241F8044CB1
S214020010203C0000020E428110C1538066FA487AE4
S21402002000 1021DF0008487A001221DF000C4E750E
S21402003021FC42555320003060 0821FC41444452C2
```

```
                                               XX.-  Check-sum
         XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX--------  Data
   0200XX--------------------------------------  24 bit Address
  14-------------------------------------------  Byte Count
S2---------------------------------------------  Record Type
```

```
S9030000FC
```

```
       FC--------------------------------------  Check-sum
   0000----------------------------------------  Data
  03-------------------------------------------  Byte Count
S9---------------------------------------------  Record Type
```

APPENDIX C

C. System RAM Definitions

```
/* SYRAM:H -- DEFINITION OF SYRAM BLOCK OF MEMORY
   05-Jan-88  Revised to correspond to PDOS 3.3
   BRIAN C. COOPER, EYRING RESEARCH INSTITUTE, INC.
   Copyright 1985-1988
*/
#define  NT   64            /* number of tasks                  */
#define  NM   ((NT+3)&0xFC) /* number of task messages          */
#define  NP   16            /* number of task message pointers  */
#define  ND   ((NT+3)&0xFC) /* number of delay events           */
#define  NC   8             /* number of active channel buffers */
#define  NF   64            /* number of file slots             */
#define  NU   15            /* number of I/O UART ports         */
#define  IZ   6             /* input buffer size (2^p2p.        */
#define  MZ   0x4000000     /* maximum memory size              */
#define  TZ   64            /* task message size                */

#define  NTB  NT
#define  NTM  NM
#define  NTP  NP
#define  NCB  NC
#define  NFS  NF
#define  NEV  ND
#define  NIE  (ND/2)
#define  NPS  (NU+1)
#define  P2P  IZ
#define  MMZ  MZ
#define  TMZ  TZ

#define  IMK  (0xFF>>(8-P2P))/* input buffer wrap around mask    */
#define  NCP  ((1<<P2P)+2)  /* (# characters/port) + 2          */
#define  MPZ  2048          /* memory page size                 */
#define  MBZ  (MMZ/MPZ)     /* memory bitmap size               */
#define  NMB  (MBZ/8)       /* number of map bytes              */
#define  FSS  38            /* file slot size                   */
#define  TQB  2             /* TCB index                        */
#define  TQM  (TQB+4)       /* map index                        */
#define  TQE  (TQM+2)       /* event #1 / event #2              */
#define  TQS  (TQE+2)       /* scheduled event                  */
#define  TBZ  (TQS+2+4)     /* TASK entry size                  */
#define  BPS  256           /* bytes per sector                 */
#define  NRD  4             /* number of RAM disks              */

struct SYRAM{
/*000*/ char *_bios;        /* address of bios rom              */
/*004*/ char *_mail;        /* *mail array address              */
/*008*/ unsigned int _rdkn; /* *ram disk #                      */
/*00A*/ unsigned int _rdks; /* *ram disk size                   */
/*00C*/ char *_rdka;        /* *ram disk address                */
/*010*/ char _bflg;         /* basic present flag               */
/*011*/ char _dflg;         /* directory flag                   */
/*012*/ int  _f681;         /* 68000/68010 flag                 */
/*014*/ char *_sram;      /* run module B$SRAM                  */
/*018*/ int spare1;       /* reserved for expansion             */
/*01A*/ int  _fcnt;       /* fine counter                       */
/*01C*/ long _tics;       /* 32 bit counter                     */
/*020*/ unsigned char _smon;   /* month                         */
/*021*/ unsigned char _sday;   /* day                           */
/*022*/ unsigned char _syrs[2];/* year                          */
/*024*/ unsigned char _shrs;   /* hours                         */
/*025*/ unsigned char _smin;   /* minutes                       */
/*026*/ unsigned char _ssec[2];/* seconds                       */
/*028*/ char _patb[16];   /* input port allocation table        */
/*038*/ char _brkf[16];   /* input break flags                  */
/*048*/ char _f8bt[16];   /* port flag bits                     */
/*058*/ char _utyp[16];   /* port uart type                     */
/*068*/ char _urat[16];   /* port rate table                    */
```

C. System RAM Definitions (cont’d)

```
/*078*/ char _evtb[10];   /* 0-79 event table                 */
/*082*/ char _evto[2];    /* 80-95 output events              */
/*084*/ char _evti[2];    /* 96-111 input events              */
/*086*/ char _evts[2];    /* 112-127 system events            */
/*088*/ char _ev128[16];  /* task 128 events                  */
/*098*/ long _evtm[4];    /* events 112-115 timers            */
/*0A8*/ long _bclk;       /* clock adjust constant            */
/*0AC*/ char *_tltp;      /* task list pointer                */
/*0B0*/ char *_utcb;      /* user tcb ptr                     */
/*0B4*/ int  _suim;       /* supervisor interrupt mask        */
/*0B6*/ int  _usim;       /* user interrupt mask              */
/*0B8*/ char _sptn;       /* spawn task no. (** must be even **)*/
/*0B9*/ char _utim;       /* user task time                   */
/*0BA*/ char _tpry;       /* task priority (** must be even **) */
/*0BB*/ char _tskn;       /* current task number              */
/*0BC*/ char spare2;      /* reserved                         */
/*0BD*/ char _tqux;       /* task queue offset flag/no        */
/*0BE*/ char _tlck[2];    /* task lock/reschedule flags       */
/*0C0*/ char _e122;       /* batch task #                     */
/*0C1*/ char _e123;       /* spooler task #                   */
/*0C2*/ char _e124;
/*0C3*/ char _e125;
/*0C4*/ long _cksm;       /* system checksum                  */
/*0C8*/ int  _pnod;       /* pnet node #                      */
/*0CA*/ char bser[6];     /* bus error vector                 */
/*0D0*/ char iler[6];     /* illegal vector                   */
/*0D6*/ char ccnt[16];    /* control C count                  */
/*0E6*/ char *_wind;      /* window id’s                      */
/*0EA*/ char *_wadr;      /* window addresses                 */
/*0EE*/ char *_chin;      /* input stream                     */
/*0F2*/ char *_chot;      /* output stream                    */
/*0F6*/ char *_iord;      /* i/o redirect                     */
/*0FA*/ char _fect;       /* file expand count                */
/*0FB*/ char _pidn;       /* processor ident byte             */
/*0FC*/ long *_begn;      /* abs addr of K1$BEGN table        */
/*100*/ int  _rwcl[14];   /* port row/col 1..15               */
/*11C*/ char *_opip[15];  /* output port pointers 1..15       */
/*158*/ char *_uart[16];  /* uart base addresses 1..15        */
/*198*/ long _mapb;       /* memory map bias                  */
/*                                                            */
/*  the following change with different configurations:*/
/*  configuration for VMEPROM is defined to:*/
/*    NT = 64, NF = 64, MZ = $400000*/
/**/
/*  NOTE: the offset on top of each line is calculated only for this */
/*        configuration                              */
/*                                                          */
/*019C*/ char _maps[NMB];        /* system memory bitmap      */
/*119C*/ char _port[(NPS-1)*NCP];/* character input buffers   */
/*157A*/ char _iout[(NPS-1)*NCP];/* character output buffers  */
/*1958*/ char rdtb[16];          /* redirect table            */
/*1968*/ int  _tque[NTB+1];      /* task queue                */
/*19EA*/ char _tlst[NTB*TBZ];    /* task list                 */
/*1DEA*/ char _tsev[NTB*32];     /* task schedule event table */
/*25EA*/ long _tmtf[NTM];        /* to/from/INDEX.W           */
/*26EA*/ char _tmbf[TMZ*NTM];    /* task message buffers      */
/*36EA*/ char _tmsp[NTP*6];      /* task message pointers     */
/*374A*/ char _deiq[2+8+NIE*10]; /* delay event insert queue  */
/*3894*/ char _devt[2+NEV*10];   /* delay events              */
/*3B16*/ int  _bsct[32];         /* basic screen command table*/
/*3B56*/ int  _xchi[NCB];        /* channel buffer queue      */
/*3B66*/ char _xchb[NCB*BPS];    /* channel buffers           */
/*4366*/ char _xfsl[NFS*FSS];    /* file slots                */
/*4CE6*/ char _l2lk;   /* level 2 lock (file prims, evnt 120)*/
/*4CE7*/ char _l3lk;   /* level 3 lock (disk prims, evnt 121)*/
/*4CE8*/ long _drvl;   /* driver link list entry point       */
/*4CEC*/ long _utll;   /* utility link list entry point      */
/*4CF0*/ int  _rdkl[NRD*4 + 1];  /* RAM disk list             */
};
```

APPENDIX D

D. Task Control Block Definitions

```
#define MAXARG     10    /* max argument count of the cmd line  */
#define MAXBP      10    /* max 10 breakpoints                  */
#define MAXNAME     5    /* max 5 names in name buffer          */
#define TMAX       64    /* Max number of tasks                 */
#define ARGLEN     20    /* maximum argument length             */

/* special system flags for VMEPROM                             */

#define SOMEREG 0x0001   /* display only PC,A7,A6,A5            */
#define T_DISP  0x0002   /* no register display during trace(TC>1)*/
#define T_SUB   0x0004   /* trace over subroutine set           */
#define T_ASUB  0x0008   /* trace over subroutine active        */
#define T_RANG  0x0010   /* trace over range set                */
#define REG_INI 0x0020   /* no register initialization if set   */
#define RE_DIR  0x0040   /* output redirection into file and    */
                         /* console at the same time            */

/* the registers are stored in the following order:             */
#define VBR     0
#define SFC     1
#define DFC     2
#define CACR    4
#define PC      5
#define SR      6
#define USTACK  7
#define SSTACK  8
#define MSTACK  9
#define D0      10       /*  10-17  =  D0-D7                    */
#define A0      18       /*  18-24  =  A0-A6                    */

#define N_REGS  25

#define BYTE    unsigned char
#define WORD    unsigned int
#define LWORD   unsigned long

struct TCB{

/*000*/ char _ubuf[256]; /* 256 byte user buffer                */
/*100*/ char _clb[80];   /* 80 byte monitor command line buffer */
/*150*/ char _mwb[32];   /* 32 byte monitor parameter buffer    */
/*170*/ char _mpb[60];   /* monitor parameter buffer            */
/*1AC*/ char _cob[8];    /* character out buffer                */
/*1B4*/ char _swb[508];  /* system work buffer/task pdos stack  */
/*3B0*/ char *_tsp;      /* task stack pointer                  */
/*3B4*/ char *_kil;      /* kill self pointer                   */
/*3B8*/ long _sfp;       /* RESERVED FOR INTERNAL PDOS USE      */
/*3BC*/ char _svf;       /* save flag -- 68881 support (x881)   */
/*3BD*/ char _iff;       /* RESERVED FOR INTERNAL PDOS USE      */
/*3BE*/ long _trp[16];   /* user TRAP vectors                   */
/*3FE*/ long _zdv;       /* zero divide trap                    */
/*402*/ long _chk;       /* CHCK instruction trap               */
/*406*/ long _trv;       /* TRAPV Instruction trap              */
```

D. Task Control Block Definitions (cont'd)

```
/*40A*/ long _trc;              /* trace vector                       */
/*40E*/ long _fpa[2];           /* floating point accumulator         */
/*416*/ long *_fpe;             /* fp error processor address         */
/*41A*/ char *_clp;             /* command line pointer               */
/*41E*/ char *_bum;             /* beginning of user memory           */
/*422*/ char *_eum;             /* end user memory                    */
/*426*/ char *_ead;             /* entry address                      */
/*42A*/ char *_imp;             /* internal memory pointer            */
/*42E*/ int  _aci;              /* assigned input file ID             */
/*430*/ int  _aci2;             /* assigned input file ID's           */
/*432*/ int  _len;              /* last error number                  */
/*434*/ int  _sfi;              /* spool file id                      */
/*436*/ BYTE _flg;              /* task flags (bit 8=command line echo)*/
/*437*/ BYTE _slv;              /* directory level                    */
/*438*/ char _fec;              /* file expansion count               */
/*439*/ char  _spare1;          /* reserved for future use            */
/*43A*/ char _csc[2];           /* clear screen characters            */
/*43C*/ char _psc[2];           /* position cursor characters         */
/*43E*/ char _sds[3];           /* alternate system disks             */
/*441*/ BYTE _sdk;              /* system disk                        */
/*442*/ char *_ext;             /* XEXT address                       */
/*446*/ char *_err;             /* XERR address                       */
/*44A*/ char _cmd;              /* command line delimiter             */
/*44B*/ BYTE _tid;              /* task id                            */
/*44C*/ char _ecf;              /* echo flag                          */
/*44D*/ char _cnt;              /* output column counter              */
/*44E*/ char _mmf;              /* memory modified flag               */
/*44F*/ char _prt;              /* input port #                       */
/*450*/ char _spu;              /* spooling unit mask                 */
/*451*/ BYTE _unt;              /* output unit mask                   */
/*452*/ char _u1p;              /* unit 1 port #                      */
/*453*/ char _u2p;              /* unit 2 port #                      */
/*454*/ char _u4p;              /* unit 4 port #                      */
/*455*/ char _u8p;              /* unit 8 port #                      */
/*456*/ char _spare2[26];       /* reserved for system use            */

/************************************************************************************************/
/*      VMEPROM variable area                                                                  */
/************************************************************************************************/

/*470*/ char  linebuf[82];      /* command line buffer                */
/*4C2*/ char  alinebuf[82];     /* alternate line buffer              */
/*514*/ char  cmdline[82];      /* alternate cmdline for XGNP         */
/*566*/ int   allargs, gotargs; /* argc save and count for XGNP       */
/*56A*/ int   argc;             /* argument counter                   */
/*56C*/ char  *argv[MAXARG];    /* pointer to arguments of the cmd line*/
/*594*/ char  *odir, *idir;     /* I/O redirection args from cmd line */
/*59C*/ int   iport,oport;      /* I/O port assignments               */
/*5A0*/ char  *ladr;            /* holds pointer to line in_mwb       */
/*5A4*/ LWORD offset;           /* base memory pointer                */
/*5A8*/ int   bpcnt;            /* num of defined breakpoints         */
/*5AA*/ LWORD bpadr[MAXBP];     /* breakpoint address                 */
/*5D2*/ WORD  bpinst[MAXBP];    /* breakpoint instruction             */
/*5E6*/ char  bpcmd[MAXBP][11]; /* breakpoint command                 */
```

D. Task Control Block Definitions (cont'd)

```
/*654*/ WORD  bpocc[MAXBP];  /* # of times the breakpoint should be*/
                             /* skipped                           */
/*668*/ WORD  bpcocc[MAXBP]; /* # of times the breakpoint is already*/
                             /* skipped                           */
/*67C*/ LWORD bptadr;        /* temp. breakpoint address          */
/*680*/ WORD  bptinst;       /* temp. breakpoint instruction      */
/*682*/ WORD  bptocc;        /* # of times the temp. breakpoint should*/
                             /* be skipped                        */
/*684*/ WORD  bptcocc;       /* # of times the temp. breakpoint is */
                             /* already skipped                   */
/*686*/ char  bptcmd[11];    /* temp. breakpoint command          */
/*691*/ char  outflag;       /* output messages (yes=1,no=0)      */
/*692*/ char  namebn[MAXNAME][8];  /* Name buffer, name           */
/*6BA*/ char  namebd[MAXNAME][40]; /* Name buffer, data           */
/*782*/ WORD  errcnt;        /* error counter for test ..         */
/*784*/ LWORD times,timee;   /* start/end time                    */
/*78C*/ LWORD pregs[N_REGS]; /* storage area of processor regs    */
/*7F0*/ WORD  tflag;         /* trace active flag                 */
/*7F2*/ WORD  tcount;        /* trace count                       */
/*7F4*/ WORD  tacount;       /* active trace count                */
/*7F6*/ WORD  bpact;         /* break point active flag           */
/*7F8*/ LWORD savesp;        /* save VMEprom stack during GO/T etc */
/*7FC*/ char  VMEMSP[202];   /* Master stack, handle w/ care      */
/*8C6*/ char  VMESSP[802];   /* supervisor stack, handle w/ care  */
/*BE8*/ char  VMEPUSP[802];  /* vmeprom internal user stack       */
/*F0A*/ LWORD f_fpreg[3*8];  /* floating point data regs          */
/*F6A*/ LWORD f_fpcr;        /* FPCR reg                          */
/*F6E*/ LWORD f_fpsr;        /* FPSR reg                          */
/*F72*/ LWORD f_fpiar;       /* FPIAR reg                         */
/*F76*/ BYTE  f_save[0x3c];  /* FPSAVE for null and idle          */
/*FB2*/ BYTE  cleos[2];      /* clear to end of screen parameter  */
/*FB4*/ BYTE  cleol[2];      /* clear to end of line parameters   */
/*FB6*/ char  u_prompt[10];  /* user defined prompt sign          */
/*FC0*/ long  c_save;        /* save Cache control register       */
/*FC4*/ long  exe_cnt;       /* execution count                   */
/*FC8*/ BYTE  nokill;        /* kill task with no input port      */
/*FC9*/ BYTE  u_mask;        /* unit mask for echo                */
/*FCA*/ WORD  sysflg;        /* system flags used by VMEPROM      */
                             /* bit 0: display registers short form*/
                             /* bit 1: trace without reg. display  */
                             /* bit 2: trace over subroutine      */
                             /* bit 3: trace over subroutine active*/
                             /* bit 4: trace over range           */
                             /* bit 5: no register initialization  */
                             /* bit 6: output redirection into file*/
                             /*        and console at the same time*/
/*FCC*/ LWORD t_range[2];    /* start/stop PC for trace over range */
/*FD4*/ LWORD ex_regs;       /* pointer to area for saved regs    */
/*FD8*/ BYTE  sparend[0x1000-0xFD8];/* make tcb size $1000 bytes  */
        char _tbe[0];        /* task beginning                    */
};
```

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APPENDIX E

E. Interrupt Vector Table of VMEPROM

Vector Number/s	Vector HEX	Assignment
0	000	Reset: Initial Interrupt Stack Pointer
1	004	Reset: Initial Program Counter
2	008	Bus Error
3	00C	Address Error
4	010	Illegal Instruction
5	014	Zero Divide
6	018	CHK, CHK2 Instruction
7	01C	FTRAPcc, TRAPcc, TRAPV Instructions
8	020	Privilege Violation
9	024	Trace
10	028	VMEPROM System Calls
11	02C	Coprocessor Instructions
12	030	(Unassigned, Reserved)
13	034	Not used
14	038	Format Error
15	03C	Uninitialized Interrupt
16 THROUGH 23	040 05C	(Unassigned, Reserved)
24	060	Spurious Interrupt
25	064	AV1
26	068	AV2
27	06C	AV3
28	070	AV4
29	074	AV5
30	078	AV6
31	07C	AV7
32 THROUGH 47	080 OBC	TRAP #0-15 Instruction Vectors
48	0C0	FPCP Branch or Set on Unordered Condition
49	0C4	FPCP Inexact Result
50	0C8	FPCP Divide by Zero
51	0CC	FPCP Underflow
52	0D0	FPCP Operand Error
53	0D4	FPCP Overflow
54	0D8	FPCP Signaling NAN
55	0DC	FPCP Unimplemented Data Type
56	0E0	PMMU Configuration
57	0E4	PMMU Illegal Operation
58	0E8	PMMU Access Level Violation
59 THROUGH 63	0EC 0FC	Unassigned, Reserved
64 THROUGH 159	100 27C	Vector numbers reserved for up to 12 FC68165s

The Interrupt Vector Table of VMEPROM is continued on the next page.

Interrupt Vector Table of VMEPROM (Continued)

Vector Number/s	Vector HEX	Assignment
160	280	Disk Interrupt Vector
161	284	┐
THROUGH		├▸ ISIO-1/2 Interrupt Vector
168	2A0	┘
169	2A4	┐
THROUGH		├▸ SIO-1/2 Interrupt Vectors
181	2D4	┘
182	2D8	┐
THROUGH		├▸ Reserved
191	2FC	┘
192	300	Mailbox 0 (Used by the ACI)
193	304	Mailbox 1
194	308	Mailbox 2
195	30C	Mailbox 3 (Reserved)
196	310	Mailbox 4 (Used from the EAGLE UART driver)
197	314	Mailbox 5 (Used from the IBC UART driver)
198	318	Mailbox 6 (Used from the EAGLE disk driver)
199	31C	Mailbox 7 (Used from the IBC disk driver)
200	320	┐
THROUGH		├▸ Reserved
223	37C	┘
224	380	Timer
225	384	Reserved
226	388	Reserved
227	38C	Reserved
228	390	FMB1 Refused
229	394	FMB0 Refused
230	398	FMB1 Message
231	39C	FMB0 Message
232	3A0	ABORT
233	3A4	ACFAIL*
234	3A8	SYSFAIL*
235	3AC	DMA Error
236	3B0	DMA Normal
237	3B4	PARITY Error
238	3B8	Reserved
239	3BC	Reserved
240	3C0	LOCAL1
241	3C4	LOCAL2
242	3C8	LOCAL3
243	3CC	LOCAL4
244	3D0	LOCAL5
245	3D4	LOCAL6
246	3D8	LOCAL7
247	3DC	LOCAL8
248	3E0	┐
THROUGH		├▸ Reserved
254	3F4	┘
255	3FC	Empty Interrupt

APPENDIX F

F. Benchmark Source Code

```
***************************************************************
** Module name: Assembler benchmarks   Version: 1.0          **
** date started: 20-Apr-87 M.S. last update: 23-Apr-87  M.S. **
**      Copyright (c) 1986/87 FORCE Computers GmbH Munich    **
***************************************************************
*
       section 0
        opt     alt,P=68020,P=68881
        xdef    .benchex
        xdef    .BEN1BEG,.BEN1END
        xdef    .BEN2BEG,.BEN2END
        xdef    .BEN3BEG,.BEN3END
        xdef    .BEN4BEG,.BEN4END
        xdef    .BEN5BEG,.BEN5END
        xdef    .BEN6BEG,.BEN6END
        xdef    .BEN7BEG,.BEN7END
        xdef    .BEN8BEG,.BEN8END
        xdef    .BEN9BEG,.BEN9END
        xdef    .BEN10BEG,.BEN10END
        xdef    .BEN11BEG,.BEN11END
        xdef    .BEN12BEG,.BEN12END
        xdef    .BEN13BEG,.BEN13END
        xdef    .BEN14BEG,.BEN14END
        page
*
* benchmark execution: benchex(address)
*
        movem.l d1-a6,-(a7)
        move.l  15*4(a7),a0
        jsr     (a0)
        movem.l (a7)+,d1-a6
        rts
*
* BENCH #1: DECREMENT LONG WORD IN MEMORY 10.000.000 TIMES
*
        LEA.L   @010(PC),A0
        MOVE.L  #10000000,(A0)
@020    SUBQ.L  #1,(A0)
        BNE.S   @020
        RTS
@010    DS.L    1

*
* BENCH #2: PSEUDO DMA 1K BYTES 50.000 TIMES
*
        MOVE.L  #50000,D2     ; DO 50000 TRANSFERS
@001    MOVE.W  #$FF,D3       ; EACH IS 1K BYTES
        LEA.L   @010(PC),A1   ; A1 POINTS TO SOURCE AND DESTINATION
@002    MOVE.L  (A1),(A1)+
        DBRA    D3,@002
        SUBQ.L  #1,D2
        BNE.S   @001
        RTS
        NOP
@010    NOP
        PAGE
```

(cont'd)

```
*
* BENCH #3: SUBSTRING CHARACTER SEARCH 100.000 TIMES TAKEN FROM EDN 08/08/85
*
*
        MOVE.L  #100000,D4
@002    MOVE.L  #15,D0
        MOVE.L  #120,D1
        LEA.L   EDN1DAT(PC),A1
        LEA.L   EDN1DAT1(PC),A0
        BSR.S   EDN1
        SUBQ.L  #1,D4
        BNE.S   @002
        RTS
*
****** BEGIN EDN BENCH #1 *******
EDN1    MOVEM.L D3/D4/A2/A3,-(A7)
        SUB.W   D0,D1
        MOVE.W  D1,D2
        SUBQ.W  #2,D0
        MOVE.B  (A0)+,D3
@010    CMP.B   (A1)+,D3
@012    DBEQ    D1,@010
        BNE.S   @090
        MOVE.L  A0,A2
        MOVE.L  A1,A3
        MOVE.W  D0,D4
        BMI.S   @030
@020    CMP.B   (A2)+,(A3)+
        DBNE    D4,@020
        BNE.S   @012
@030    SUB.W   D1,D2
@032    MOVEM.L (A7)+,D3/D4/A2/A3
        RTS
@090    MOVEQ.L #-1,D2
        BRA.S   @032

******* END EDN BENCH #1 *******
EDN1DAT  DC.B    '000000000000000000000000000000'
         DC.B    '000000000000000000000000000000'
EDN1DAT1 DC.B    'HERE IS A MATCH000000000000000'
         PAGE

*
* BENCH #4: BIT TEST/SET/RESET 100.000 TIMES TAKEN FROM EDN 08/08/85
*
        MOVE.L  #100000,D4
        LEA.L   EDN2DAT(PC),A0
@010    MOVEQ.L #1,D0           ; TEST
        MOVEQ.L #10,D1
        BSR.S   EDN2
        MOVEQ.L #1,D0
        MOVEQ.L #11,D1
        BSR.S   EDN2
        MOVEQ.L #1,D0
        MOVE.W  #123,D1
        BSR.S   EDN2
        MOVEQ.L #2,D0           ; SET
        MOVEQ.L #10,D1
        BSR.S   EDN2
```

(cont’d)

```
        MOVEQ.L #1,D0
        MOVEQ.L #11,D1
        BSR.S   EDN2
        MOVEQ.L #1,D0
        MOVE.W  #123,D1
        BSR.S   EDN2
        MOVEQ.L #3,D0           ; RESET
        MOVEQ.L #10,D1
        BSR.S   EDN2
        MOVEQ.L #1,D0
        MOVEQ.L #11,D1
        BSR.S   EDN2
        MOVEQ.L #1,D0
        MOVE.W  #123,D1
        BSR.S   EDN2
        SUBQ.L  #1,D4
        BNE.S   @010
        RTS
*
EDN2    SUB.W   #2,D0
        BEQ.S   @020
        SUBQ.W  #1,D0
        BEQ.S   @030

@010
*       BFTST   (A0){D1:1}
        DC.W    $E8D0
        DC.W    $0841
        SNE     D2
        RTS



@020
*       BFSET   (A0){D1:1}
        DC.W    $EED0
        DC.W    $0841
        SNE     D2
        RTS
@030
*       BFTST   (A0){D1:1}
        DC.W    $E8D0
        DC.W    $0841
        SNE     D2
        RTS
EDN2DAT DC.L    0,0,0,0
        PAGE
*
* BENCH #5: BIT MATRIX TRANSPOSITION 100.000 TIMES
*           TAKEN FROM EDN 08/08/85
*
        MOVE.L  #100000,D4
        LEA.L   EDN3DAT(PC),A0
@002    MOVE.L  #7,D0
        MOVEQ.L #0,D1
        BSR.S   EDN3
        SUBQ.L  #1,D4
        BNE.S   @002
        RTS
```

(cont’d)

```
*
EDN3    MOVEM.L D1-D7,-(A7)
        MOVE.L  D1,D2
        MOVE.W  D0,D7
        SUBQ.W  #2,D7
@010    ADDQ.L  #1,D1
        MOVE.L  D1,D3
        ADD.L   D0,D2
        MOVE.L  D2,D4
@020
        BFEXTU  (A0){D3:1},D5
        BFEXTU  (A0){D4:1},D6
        BFINS   D5,(A0){D4:1}
        BFINS   D6,(A0){D3:1}
        ADD.L   D0,D3
        ADDQ.L  #1,D4
        CMP.L   D3,D4
        BNE.S   @020
        DBRA    D7,@010
       MOVEM.L (A7)+,D1-D7
        RTS
EDN3DAT DC.B    %01001001
        DC.B    %01011100
        DC.B    %10001110
        DC.B    %10100101
        DC.B    %00000001
        DC.B    %01110010
        DC.B    %10000000
        EVEN
        PAGE
*
* BENCH #6: CACHE TEST - 128KB PROGRAM IS EXECUTED 1000 TIMES
*           CAUTION: THIS BENCHMARK NEEDS 128 KBYTE MEMORY
*
        LEA.L   @010(PC),A2
        MOVE.L  #$203A0000,D1        ; OPCODE FOR MOVE.L ($0,PC),D0
        MOVE.L  #$20000/4,D2         ; LENGTH IS 128 KBYTE
@004    MOVE.L  D1,(A2)+             ; LOAD OPCODE TO MEMORY
        SUBQ.L  #1,D2
        BNE.S   @004
        MOVE.W  #$4E75,(A2)          ; APPEND RTS
* PROGRAM IS NOW LOADED -- START 1000 TIMES
        MOVE.L  #1000,D3
@008    BSR.S   @010
        SUBQ.L  #1,D3
        BNE.S   @008
        RTS
*
@010    DC.L    0                    ; PROGRAM WILL START HERE
        PAGE
*
* BENCH #7: FLOATING POINT 1.000.000 ADDITIONS
*
        MOVE.L  #1000000,D5
        FMOVE.L #0,FP0
        FMOVE.L #1,FP1
@010    FADD.X  FP0,FP1
        SUBQ.L  #1,D5
        BNE.S   @010
        RTS
```

(cont’d)

```
*
* BENCH #8: FLOATING POINT 1.000.000 SINUS
*
        MOVE.L  #1000000,D5
        FMOVE.L #1,FP1
@010    FSIN.X  FP1
        SUBQ.L  #1,D5
        BNE.S   @010
        RTS
        PAGE
*
* BENCH #9: FLOATING POINT 1.000.000 MULTIPLICATIONS
*
        MOVE.L  #1000000,D5
        FMOVE.L #1,FP0
        FMOVE.L #1,FP1
@010    FMUL.X  FP0,FP1
        SUBQ.L  #1,D5
        BNE.S   @010
        RTS
        page

*
* PDOS BENCHMARK #1: CONTEXT SWITCHES
*
        MOVE.L  #100000,D6
@000    XSWP                        ;CONTEXT SWITCH
        SUBQ.L  #1,D6               ;DONE?
          BGT.S @000                ;N
        RTS
        PAGE
*
* PDOS BENCHMARK #2: EVENT SET
*
        MOVEQ.L #32,D1              ;SELECT EVENT 32
        MOVE.L  #100000,D6
*
@000    XSEV                        ;SET EVENT
        SUBQ.L  #1,D6               ;DONE?
          BGT.S @000                ;N
        RTS
        PAGE
*
* PDOS BENCHMARK #3: CHANGE TASK PRIORITY
*
        MOVEQ.L #-1,D0              ;SELECT CURRENT TASK
        MOVEQ.L #64,D1              ;SET PRIORITY TO 64
        MOVE.L  #100000,D6
*
@000    XSTP                        ;SET PRIORITY
        SUBQ.L  #1,D6               ;DONE?
          BGT.S @000                ;N
        RTS
```

(cont’d)

```
*
* PDOS BENCHMARK #4: SEND TASK MESSAGE
*
        CLR.L   D0              ;SELECT TASK #0
        LEA.L   MES01(PC),A1    ;POINT TO MESSAGE
        MOVE.L  #100000,D6
*
@000    XSTM                    ;SEND MESSAGE
        XKTM                    ;READ MESSAGE BACK
        SUBQ.L  #1,D6           ;DONE?
          BGT.S @000            ;N
        RTS
MES01   DC.B    ’BENCH #13’,0
        EVEN
        PAGE

*
* PDOS BENCHMARK #5: READ TIME OF DAY
*
        MOVE.L  #100000,D6
@000    EQU     *
        XRTP
        SUBQ.L  #1,D6           ;DONE?
        BGT.S @000              ;N
        RTS
        end
```

APPENDIX G

G. Special Locations

The following table describes some special locations in the EPROM. These locations define the default setup of the name of the startup file, user program location and RAM disk addresses.

The locations shown in the table can be changed by the user to adapt VMEPROM to every environment. To make the necessary changes, please conduct the following steps:

1. Read the EPROMs with an EPROM programmer

2. Modify the code

3. Burn new EPROMs and keep the old ones in a safe location

4. Insert the new EPROMs in the CPU board and verify the changes

G1. VMEPROM Configuration Table

The Configuration Table or **User Alterable Memory Locations** contains several entries which can be altered in order to modify the VMEPROM environment to meet the requirements of a customer. The base address of the table can be obtained by invoking the VMEPROM command **info**.

```
? info

FORCE IBC-20 REV 2.10 with Gate Array FGA-002 at $FFD00000
VMEPROM Version 3.00 at $FFE1001C
Processor is a MC68020
...
Addresses to customize VMEPROM
  Configuration table                          at $FFE1B180 (base address of configuration table)
  ...
```

The structure of the configuration table is shown on the next page and the entries are described in the following pages.

Table 1: Structure of the User Alterable Memory Locations

The following table is provided by the VMEPROM.

Offset	Size	Contents	Description
0_{16}	22	"SY$STRT"	NUL terminated string containing the name of the startup file
16_{16}	2 2 4	8_{10} 2048_{10} 40800000_{16}	Disk number of the first RAM disk entry Size of the RAM disk in 256 byte sectors Base address of the RAM disk
	2 2 4	8_{10} 2048_{10} 40700000_{16}	Disk number of the second RAM disk entry Size of the RAM disk in 256 byte sectors Base address of the RAM disk
	2 2 4	8_{10} 256_{10} $FFC800000_{16}$	Disk number of the third RAM disk entry Size of the RAM disk in 256 byte sectors Base address of the RAM disk
$2E_{16}$	18	"SY$DSK"	NUL terminated string containing the default RAM disk name to be used when the RAM disk is being initialized
40_{16}	4 4 4 4	40800000_{16} $FF000000_{16}$ $FFC80000_{16}$ Address of VMEPROM	These four entries contain addresses where execution continues after the VMEPROM kernel has been initialized
50_{16}	4	"USER"	Identification used by disk drivers
54_{16}	1	03_{16}	WAITFLAG
55_{16}	1	01_{16}	MEDMA
56_{16}	1	07_{16}	Reserved
57_{16}	5	FF_{16}	Reserved
$5C_{16}$	2	16_{10}	Reserved (number of hashing buffers: not supported)
$5E_{16}$	4	00000000_{16}	Reserved (amount of memory dedicated to the MEtask: not supported)
62_{16}	1	$B0_{16}$	RDSKSEL
63_{16}	1	01_{16}	RDSKLSZ
64_{16}	1	$0F_{16}$	Reserved

Offset 0_{16}: Startup Filename

This entry contains the ASCII encoded name of the startup file to be executed by the VMEPROM shell when bit 1 of the lower rotary switch is cleared (0).

The name of the startup file must be a valid VMEPROM file name, must be terminated by a NUL character, should not be longer than 19 characters, and must be left justified. In the case of a name shorter than 19 characters, the unused characters must be filled with NUL characters.
By default, the entry contains the string "SY$STRT".

Offset 40_{16}: Program Start Table

This table contains four addresses where execution continues after the VMEPROM kernel has been initialized. Depending on the state of the bits 2 and 3 of the **lower** rotary switch, one of the four entries is fetched to continue execution at the particular address.

Offset 50_{16}:

This entry contains the string "USER" which indicates the validity of the data in the following entries.

Offset 54_{16}: Wait Flag

The least significant bits (bits 0 and 1) are used to control whether VMEPROM waits for the availability of the hard disk.

The state of the first bit (bit 0) is only considered when the second bit (bit 1) is set (1). VMEPROM waits for the availability of the hard disk when bit 1 is set (1) and does not wait when the bit is cleared (0). In the former case, VMEPROM evaluates the state of the least significant bit. If bit 0 is set, then VMEPROM notifies the user that it is waiting for the hard disk to become available by displaying a message on the console. Otherwise, bit 0 is cleared and VMEPROM works in silent mode. In the latter case, VMEPROM does not wait until the hard disks are ready.

Offset 55_{16}: Start DMA Task

The least significant bit (bit 0) of this entry specifies whether the DMA task will be started by the Application Command Interface. If this bit is set (1), then the ACI starts the DMA task after reset; otherwise, when this bit is cleared (0), the ACI does not start the DMA task.
All other bits (bits 1 to 7) must be cleared.

Offset 56_{16}:

This entry is reserved and should not be altered!

Offset 57_{16}:

This entry is reserved and should not be altered!

Offset $5C_{16}$:

The following two bytes are reserved and should not be altered!

Offset $5E_{16}$:

The following four bytes are reserved and should not be altered!

The following four entries in the configuration table relate to the configuration of RAM disks provided by the VMEPROM:

Offset 62_{16}: RDSKSEL

The state of this entry specifies at which physical address the RAM disk has to be located. The bits 4 and 5 are used to select one of four possibilities, which are listed in the following table.

RDSKSEL		**Base Address**	**Size**
Bit 5	**Bit 4**		
0	0	40800000_{16}	512KB
0	1	40700000_{16}	512KB
1	0	$FFC80000_{16}$	64KB
1	1	*top-of-memory*	32KB/64KB/96KB/128KB depends on the state of the entry RDSKLSZ

All parameters of the RAM disk -- size, base address, and the proper disk number -- are obtained from the RAM disk table, beginning at offset 16_{16} within the configuration table, depending on the state of bits 4 and 5.

However, if the RDSKSEL does not specify location of the RAM disk at *top-of-memory,* then the VMEPROM always allocates 32 KB of memory on the *top-of-memory*, which is to be used for an on-board RAM disk but does not initialize the RAM disk.

The most significant bit (bit 7) of the entry RDSKSEL specifies whether the RAM disk has to be initialized. If the most significant bit is set (1), then the RAM disk is not initialized. In the case that the most significant bit is cleared (0), the RAM disk is being initialized by the firmware. In the latter case, all data in the RAM disk are lost!

Offset 63_{16}: RDSKSEL

In case of an on-board RAM disk (RDSKSEL = $XX11XXXX_2$), the size of such a RAM disk can be customized by this entry. It specifies the number of 32KB pages the RAM disk consists of, but should not exceed the number of four 32KB pages. If this entry specifies more than four pages, then the firmware automatically limits the number of pages to four. When no page is specified (RDSKLSZ = 0), then the firmware assumes 32KB of memory is to be allocated for the RAM disk.

Offset 16_{16}: RAM Disk Table

The RAM disk table contains the description of three RAM disks which are evaluated by the VMEPROM depending on the state of the bits 4 and 5 of the entry RDSKSEL. Each RAM disk descriptor consists of the following:

1. The disk number assigned to the RAM disk,

2. The size of the RAM disk specified in 256 byte sectors, and

3. The address where to locate the RAM disk.

The parameters of the RAM disk, which are located on *top-of-memory*, are defined by the entry RDSKLSZ in the configuration table (size), and the other parameters are known by VMEPROM during the startup phase.

Offset $2E_{16}$: RAM Disk Name

This entry includes the ASCII encoded name of the RAM disk selected by the bits 4 and 5 of the entry RDSKSEL. The name is assigned to the particular RAM disk only when the most significant bit (bit 7) of the entry RDSKSEL is cleared (0).
The name has to be terminated by a NUL character, should not be longer than 16 characters, and has to be left justified. In case of a name shorter than 16 characters, the unused bytes have to be filled with NUL characters.
By default, the entry contains the string "SY$DSK".

Offset 64_{16}: RAM Disk Name

This entry is reserved and should not be altered!

APPENDIX H

H. Minimum Demands for Device Driver Tasks in Order to Run with VMEPROM

H.1 Device Driver Tasks for Serial Devices

The following commands have to be supported in order that VMEPROM works properly with the device driver task:

OPEN

VMEPROM executes the OPEN command with a data exchange mode of $C0000000. Therefore, the device driver task has to support Direct Memory Access. Furthermore, it has to have the possibility to transfer the data directly into the applications (VMEPROMs) memory.

Positive return values indicate a successful OPEN.

READ

VMEPROM always tries to read exactly 1 character. The read mode is set to $00000002. The WAIT bit is cleared. Therefore, the device driver task is not allowed to wait until the character is available.

Any return value except 0 indicates a READ error.

WRITE

VMEPROM always tries to write exactly 1 character. The write mode is set to $00000002. The WAIT bit is cleared. Therefore, the device driver task is not allowed to wait until the character can be sent.

Any return value except 0 indicates a WRITE error.

CLOSE

The CLOSE command is executed without any additional parameter.

The return value is not used.

SERVICE

Service codes from -1024 to -2047 are reserved for serial drivers; the codes from -1024 to -1279 are reserved for VMEPROM.
Only one service code is used from VMEPROM. It is service number -1026. It has to set the UART parameter.

The following service parameters have to be supported:

service parameter[0]: to define the baudrate used

VALUE	BAUDRATE
2	150
3	300
4	600
5	1200
6	2400
7	4800
8	9600
9	19200
10	38400

service_parameter[1]: to define the number of data bits per character

VALUE	NUMBER OF DATA BITS PER CHARATER
0	7
1	8

service_parameter[2]: to define the number of stop bits

VALUE	NUMBER OF STOP BITS
0	1
1	2

service_parameter[3]: to define the parity to be used

VALUE	PARITY
0	no
1	even
2	odd

service_parameter[4]: to define the flow control to be used

VALUE	FLOW CONTROL
0	no handshake
1	XON/XOFF
2	RTS/CTS
3	DTR/DSR/DCD

Any return value except 0 indicates that the device driver task is not able to set the requested parameter.

H.2 Device Driver Tasks for Block Devices

H.2.1 Floppy Devices

The following commands have to be supported in order that VMEPROM works properly with the device driver task:

OPEN

VMEPROM executes the OPEN command with a data exchange mode of $C0000000. Therefore, the device driver task has to support Direct Memory Access. Furthermore, it has to have the possibility to transfer the data directly into the applications (VMEPROMs) memory.

Positive return values are indicating a successful OPEN.

READ

The READ command is executed with a read mode of $80000000. Because of this the device driver task has to wait until the data is read.

The parameters used are:

_remnant[0]: the drive number (0 or 1)

_remnant[1]: reserved (any value should be ignored)

The following return values are allowed:

VALUE	DESCRIPTION
0	Read successfully completed
-32	Record not found
-33	Address mark not found
-34	Write protect error
-35	Sector not found
-36	Overrun error
-37	CRC error on the disk
-38	Illegal sector
-39	Parameters wrong
-40	Format error
-41 . . . -49	Timeout

WRITE

The WRITE command is executed with a write mode of $80000000. Because of this the device driver task has to wait until the data is written.

The parameters used are:

_remnant[0]: the drive number (0 or 1)

_remnant[1]: reserved (any value should be ignored)

The following return values are allowed:

VALUE	DESCRIPTION
0	Write successfully completed
-32	Record not found
-33	Address mark not found
-34	Write protect error
-35	Sector not found
-36	Overrun error
-37	CRC error on the disk
-38	Illegal sector
-39	Parameters wrong
-40	Format error
-41 . . . -49	Timeout

CLOSE

The CLOSE command is executed without any additional parameter.

The return value is not used.

SERVICE

Service codes from -2048 to -3071 are reserved for floppy drivers; the codes from -2048 to -2303 are reserved for VMEPROM.

The following services have to be supported from the device driver task:

SERVICE CODE	DESCRIPTION
-2049	Set Floppy Parameter
-2050	Format Floppy

The possible return values are listed in the READ/WRITE command description.

Parameters for the set floppy parameter service:

- service parameter[0]: drive number (0 or 1)
- service parameter[1]: number of cylinders (80)
- service parameter[2]: sectors/cylinder (32)
- service parameter[3]: bytes/sector (coded) (1)

VALUE	Bytes/Sector
1	256
2	512
3	1024
4	2048
5	4096

- service parameter[4]: number of heads (2)
- service parameter[5]: RW gap ($20)
- service parameter[6]: format gap ($36)
- service parameter[7]: density (1)

VALUE	Density
0	High Density
1	Double Density

- service parameter[8]: step rate (1)

Parameters for the format floppy service:

- service parameter[0]: drive number (0 or 1)

- service parameter[1]: address of an interleave table

  The interleave table must have as many entries as the floppy has sectors/track, i.e. the following table has an interleave of 0

  1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16

  while the next one has an interleave of 1.

  1,9,2,10,3,11,4,12,5,13,6,14,7,15,8,16

  Both have 16 sectors/track. The size of every entry is 1 byte.

H.2.2 SCSI Devices

The following commands have to be supported in order that VMEPROM works properly with the device driver task.

OPEN

VMEPROM executes the OPEN command with a data exchange mode of $C0000000. Therefore, the device driver task has to support Direct Memory Access. Furthermore, it has to have the possibility to transfer the data directly into the applications (VMEPROMs) memory.

The parameters used are:

_remnant[0]: Buffer count

If the device driver task is able to cache data this entry defines how many buffers should be used.

_remnant[1]: Buffer size

If the device driver task is able to cache data this entry defines the size of each buffer in Bytes.

_remnant[2]: Controller SCSI ID

This entry defines which SCSI ID the controller should have.
Positive return values indicate a successful OPEN.

READ

The READ command is executed with a read mode of $80000000. Because of this the device driver task has to wait until the data is read.

The parameters used are:

_remnant[0]: SCSI bus ID as returned from the get device list service.

_remnant[1]: Logical block size
VMEPROM uses a block size of 256 bytes.

The following return values are allowed:

VALUE	DESCRIPTION
0	Read successfully completed
-50	SCSI error
-51	Illegal SCSI bus phase
-52	Illegal SCSI command
-53	Timeout
-54	Illegal drive ID

WRITE

The WRITE command is executed with a write mode of $80000000. Because of this the device driver task has to wait until the data is written.

The parameters used are:

_remnant[0]: SCSI bus ID as returned from the get device list service

_remnant[1]: Logical block size
VMEPROM uses a block size of 256 bytes.

The following return values are allowed:

VALUE	DESCRIPTION
0	Read successfully completed
-50	SCSI error
-51	Illegal SCSI bus phase
-52	Illegal SCSI command
-53	Timeout
-54	Illegal drive ID

CLOSE

The CLOSE command is executed without any additional parameter.

The return value is not used.

SERVICE

Service codes from -3072 to -4095 are reserved for floppy drivers; the codes from -3072 to -3327 are reserved for VMEPROM.

The following services have to be supported from the device driver task:

SERVICE CODE	DESCRIPTION
-3073	Get Device List
-3074	Flush All Hashing Buffers
-3092	Transparent Mode
-3097	Format Disk

Any return value except 0 indicates an error.

Parameters for the Get Device List service:

input parameter:

service_parameter[0]: address of a buffer for the returned data

service_parameter[1]: maximum length of the buffer

returned data: status

Structure of the returned data:

```
typedef struct SCSI_CTRL
{
unsigned char  id;             /* SCSI bus ID of the device */
unsigned char  lun;            /* logical unit number          */
unsigned char  dev_type;       /* device type as returned     */
                               /* by the INQUIRY command*/
unsigned char flags;
unsigned long last_block;      /* last logical block of the device */
unsigned long  blocksize;      /* physical blocksize of the device */
char  dev_name[24];            /* vendor and product information    */
} SCSI_CONTROL;

struct  { unsigned long dev_count;
        SCSI_CONTROL  scntrl[6];
        } GDL_PAR;
```

Parameters for the flush service:

input parameter:

nothing

returned data: status

Parameters for the transparent mode service:

input parameter:

service_parameter[0]: SCSI bus ID as returned from the get device list service
service_parameter[1]: SCSI command (byte 0-3)
service_parameter[2]: SCSI command (byte 4-7)
service_parameter[3]: SCSI command (byte 8-11)
service_parameter[4]: pointer to data buffer
service_parameter[5]: transfer count

returned data: data returned from the SCSI device/status

Parameters for the format disk service:

input parameter:

service_parameter[0]: SCSI bus ID as returned from the get device list service

returned data: status

THE APPLICATION COMMAND INTERFACE PROGRAMMING GUIDE

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1. Introduction

Each base board equipped with one or more EAGLE module slots provides a unique software interface - called the Application Command Interface (ACI) - through which the application communicates with specific devices on the EAGLE modules. Furthermore, the interface offers the capability to gain various information about the EAGLE modules and the particular devices on the modules.

All communication through the Application Command Interface is done by the use of special data packets named Command Control Buffers (CCB). These Command Control Buffers are provided and managed by the Application Command Interface. Depending on the contents of such a Command Control Buffer, issued through the Application Command Interface, the underlying software processes the Command Control Buffer and carries out the requested command.
The Application Command Interface provides the following five commands:

1. The OPEN command to establish a logical connection between the application and a specific device.

2. The CLOSE command to release an existing logical connection between the application and a specific device.

3./4. The READ and WRITE commands used to initiate data exchanges via an existing logical connection between the application and a device.

5. The SERVICE command to gain generic information about the devices accessible through the Application Command Interface. This command is also used to modify device parameters, to get use of special services provided by a logical group of devices; or to control the operating mode of a certain device driver dealing with a particular device.

The status information about the command issued through the Application Command Interface is passed to the application through the same Command Control Buffer used to send the command through the interface.

A command is "issued" through the Application Command Interface by generating a MAILBOX 0 interrupt on the board providing the Application Command Interface. When the attention of the Application Command Interface has been gained by such an interrupt, then the underlying software verifies the consistency of the contents of the issued Command Control Buffer; passes the packet to the entity dealing with the processing of the command; and finally the entity returns all status information through the processed Command Control Buffer to report the course of the command execution to the application. In general, the entity "returning" the Command Control Buffer through the Application Command Interface uses certain semaphores within the Command Control Buffer to indicate the completion of the issued command, and depending on the state of certain parameters, it probably gains the attention of the application by generating an interrupt described by corresponding parameters.

As mentioned above the application accesses devices on an EAGLE module via a logical connection, rather than directly. Therefore, each device accessible through the Application Command Interface is identified by a unique logical device number which is provided by the interface.

A base board providing the Application Command Interface deposits the NUL terminated string "ACI" beginning at offset $0 of the board's main memory accessible from the VMEbus; and the VMEbus address of the first Command Control Buffer (CCB 0), provided by the Application Command Interface, is loaded into the long word at offset $4. Thus, the application intending to communicate with devices through the Application Command Interface, or to get generic information about available devices, has to look for the "ACI" identifier within the VMEbus' standard (A24) and extended (A32) address range.

Any application has to verify whether the base board the application is running on provides the Application Command Interface, too.

If the application has found a board providing the interface, it has to use the first Command Control Buffer, addressed by the content of the long word at offset $4 of the board's memory, either to issue the SERVICE command to get information about the available devices or other information about the EAGLE modules; or to issue the OPEN command to establish a logical connection between the application and a specific device.

However, before the application uses the first Command Control Buffer to issue a command through the Application Command Interface it has to gain the ownership of the first Command Control Buffer.

The detailed structure of a Command Control Buffer is described in the subsection "The Command Control Buffers".

The Command Control Buffer contains some semaphores to be used to control the access to the buffer, and to indicate various states of the Command Control Buffer. To gain the ownership of the Command Control Buffer a semaphore has to be set to indicate that the buffer is already in use by an application. Due to this fact, the application has to verify the state of this semaphore, and if the semaphore is cleared, that means the Command Control Buffer is available, the application has to set it to prevent the Command Control Buffer from being acquired by another application.

When the application has the ownership of the first Command Control Buffer, it has to prepare the buffer to issue the particular command. The application can only issue the OPEN command or the SERVICE command, to get generic information, through the Application Command Interface. All other commands (CLOSE, READ, and WRITE) are refused by the Application Command Interface because no logical connection between the application and a device exists.

Depending on the command to be issued, the application has to prepare the first Command Control Buffer and has to set another semaphore that indicates that the Command Control Buffer is ready to be passed through the Application Command Interface. To inform the Application Command Interface about the readiness of the first Command Control Buffer used to issue the particular command (OPEN or SERVICE), the application has to generate the MAILBOX 0 interrupt on the appropriate base board.

Now the application has to verify cyclically (polling) the state of the semaphore indicating the readiness of the Command Control Buffer to issue a command, to determine that the command has been carried out by the underlying software. When the command has been carried out, the underlying software returns all status information through the first Command Control Buffer and clears the semaphore, indicating the completion of the issued command. The semaphore described acts as a "BUSY" semaphore set by the application, to indicate that the Command Control Buffer is "passed" to the Application Command Interface in order to be processed, and cleared by the Application Command Interface, to signal that the Command Control Buffer has been processed and is "returned" to the application.

If the OPEN command has been issued through the Application Command Interface, then the first Command Control Buffer contains the address of a Command Control Buffer allocated by the Application Command Interface which is associated with the logical connection between the application and the appropriate device. The application has to use this Command Control Buffer to issue subsequent commands through the Application Command Interface (READ, WRITE, CLOSE, and SERVICE).

In case of the SERVICE command the Command Control Buffer contains further information, depending upon the requested service. Of course, the READ and WRITE commands also need additional parameters.

Independent from the issued command, the first Command Control Buffer has to be released by the application by clearing the semaphore which indicates that the buffer is already in use, to allow other applications to gain the ownership of the first Command Control Buffer and to issue commands through the Application Command Interface.

1.1 The Logical Devices

The devices on available EAGLE modules cannot be accessed from the VMEbus directly, but the Application Command Interface provides a method to access devices on a "higher logical" level. Each device accessible through the Application Command Interface is identified by an unique "logical device number" that has been assigned to the device by the Application Command Interface. Such a logical device number consists of a major device number and a minor device number. The major device number packs up a number of devices with the same characteristics, and the minor device number identifies each device in such a group of devices packed up under the major device number.

In general, devices are divided into two classes: the first class represents devices which can be shared among a number of applications (SHARABLE devices), which means that multiple applications can access the device simultaneously (e.g. SCSI Controller, FD Controller, Ethernet Controller, etc.). Logical connections to a SHARABLE device can be established by multiple applications simultaneously. The second class contains devices which cannot be shared among applications (NON_SHARABLE devices), and only one application can establish a logical connection to such a device.

The device classes can be distinguished by the minor device number assigned to the corresponding device: a minor device number in the range 0 to 31 identifies a NON-SHARABLE device (which means up to 32 devices are packed up under one single major device number); and the minor device number -1 specifies a SHARABLE device.

Furthermore, devices in the classes are divided into groups of devices with the same characteristics (device type): devices which allow communication via a serial communication line (e.g. ethernet, FDDI, RS-232, etc.), devices which communicate via a parallel "bus" (e.g. ordinary parallel I/O peripheral, IEEE-488 Controller, etc.), devices which are attached to mass storage devices (e.g. SCSI Controller, FD Controller, etc.). Thus the Application Command Interface offers accesses to generic SERIAL-, PARALLEL-, and MASS STORAGE devices.

To establish a logical connection to a device the application has to issue the OPEN command through the Application Command Interface with the appropriate logical device number of the device the application wants to communicate with. The Application Command Interface returns a Command Control Buffer associated with the particular device to the application and the application has to use this Command Control Buffer to issue subsequent commands to the "device".

1.2 The Command Control Buffers

As mentioned previously the Command Control Buffer is the basic data structure to issue commands through the Application Command Interface. This data structure of 256 bytes size consists of two logical parts.

The first part (44 bytes) is used to store global information for the device driver dealing with the device the Command Control Buffer is associated with, to control the access to the Command Control Buffer and to reflect the state of a Command Control Buffer.

The second part (212 bytes) is exclusively used to specify the command to be issued through the Application Command Interface, as well as the parameters that accompanies the command. All status information reflecting the course of the processed command are passed through this area to the application.

The generic structure of a Command Control Buffer is described below (using the C programming language elements):

```
typedef struct  _ccb
  {
    unsigned long  _access_control_flags;
    long           ( *ME_system_call ) ( );
    struct   _ccb  *ccb_link;
    long           last_command;
    unsigned long  _reserved[ 7 ];
    long           command_or_status;
    unsigned long  remnant[ 52 ];
  } CCB;
```

The first eleven entries in the data structure described above are common to all Command Control Buffers, independent from the command being issued through the Application Command Interface. The structure of the remaining 53 entries depend on the command issued, and whether the Command Control Buffer is "passed" to the Application Command Interface or "returned" to the application through the Application Command Interface.

unsigned long _access_control_flags

This entry represents the Access Control Field consisting of semaphores to control the access to the Command Control Buffer and to reflect the state of the Command Control Buffer.

The semaphores depicted in Figure 1 are defined and described in the following.

- The ALLOCATE semaphore indicates whether a Command Control Buffer is already acquired. If the ALLOCATE semaphore is cleared then the application may gain the ownership of the Command Control Buffer by setting this semaphore. When the semaphore is set it marks the Command Control Buffer as already allocated by another application.

- The BUSY semaphore indicates whether the Command Control Buffer is ready to be processed by the Application Command Interface. The application has to set this semaphore to signal the readiness of the Command Control Buffer to be issued through the Application Command Interface.
  The BUSY semaphore is cleared when the command has been carried out and the Command Control Buffer is "returned" to the application. Thus, the application may get use of the BUSY semaphore to detect the completion of a command.

- The FINAL semaphore marks the last Command Control Buffer available in the list of Command Control Buffers managed by the Application Command Interface. This semaphore has not to be affected by the application.

- The PROCESS semaphore is used by the Application Command Interface for internal purpose and signal that the command issued through the Application Command Interface has been accepted by the interface, but the command has not been completed (in-service). When the Command Control Buffer is "returned" to the application the semaphore is cleared. Because this semaphore is exclusively used by the Application Command Interface for its own purpose, it should never be affected by an application.

Figure 1: The Access Control Flags of the Command Control Buffer

31	30	29	28	27		0
Allocate	Busy	Process	Final	Reserved	•••	Reserved

long (*ME_system_call) ( )

This entry contains the address of a routine supplied by the Application Command Interface which provides specific services. This address is exclusively used by a device driver dealing with the device associated with the Command Control Buffer, and should not be altered by the application!

struct _ccb *ccb_link

This entry addresses a Command Control Buffer chained to this Command Control Buffer. If no Command Control Buffer is chained then this entry contains the value zero.

The application may issue a command to cause to chain up a certain number of Command Control Buffers to this Command Control Buffer. If the application likes to get rid of the Command Control Buffers chained to this Command Control Buffer it has to issue a command to release all Command Control Buffers chained to the Command Control Buffer.

The application should not affect this entry!

long last_command

This entry contains the command code of the last command issued through the Application Command Interface.

The application should not affect this entry!

unsigned long _remnant[7]

These entries are reserved for future use and should not be affected by the application.

long command_or_status

This entry is used by the application to specify the command to be "passed" through the Application Command Interface (the type of the Command Control Buffer); and the entries _remnant[0] to _remnant[51] contain further command parameters. When the Command Control Buffer is "returned" through the Application Command Interface this entry contains the status and the entries _remnant[0] to remnant[51] contain further status information.

In general, the zero integer value (OK) indicates that the command has been completed successfully, whereas a negative integer value reports an error. The values -1 to -31 are dedicated exclusively to the Application Command Interface to indicate common errors. All other values beginning with the value -32 are returned by the device driver dealing with the device the Command Control Buffer is associated with.

2. The Complete Description of All Commands Provided by The Application Command Interface

The following subsections describe each command provided by the Application Command Interface in detail and discuss the appropriate structure of the Command Control Buffers to issue the particular command through the Application Interface, as well as the structure of the Command Control Buffer "returned" through the interface to the application.

2.1 The OPEN Command

The OPEN command requests to establish a logical connection between the application and a physical device; the appropriate Command Control Buffer is structured as presented below.

Whenever an OPEN command is issued through the Application Command Interface the underlying software verifies whether it is necessary to initialize the specific physical device. If a physical device can be owned by more than one application, like floppy disk controllers, or SCSI controllers, the certain device is being initialized only on the receipt of the very first OPEN command. In contrast, a physical device, which may be owned by only one single application, like a serial channel of a serial communication controller, is initialized upon the receipt of every OPEN command.

```
typedef struct  _ccb_open_command
  {
     unsigned long  _access_control_flags;
     long           ( *ME_system_call ) ( );
     CCB            *ccb_link;
     long           last_command;
     unsigned long  _reserved[ 7 ];
     long           command;
     unsigned long  logical_device_number;
     unsigned long  inquiry_mode;
     unsigned long  response_mode;
     unsigned long  data_exchange_mode;
     unsigned long  response_mode_address;
     unsigned long  _remnant[ 47 ];
  } CCB_OPEN_COMMAND;
```

_access_control_flags:

The BUSY semaphore has to be set to indicate the readiness of the Command Control Buffer to be processed; all other semaphores within the Access Control Field have to be left unaffected.

command:

The value $00 indicates that the Command Control Buffer is used to issue the OPEN command through the Application Command Interface.

logical_device_number:

The logical device code denotes the device the application likes to communicate with. The Application Command Interface translates this code using all information provided by the EAGLE Module Software Interface to determine the appropriate physical device. The application can obtain a list of logical device numbers, relating to a group of physical devices with the same functional characteristics using the SERVICE command GET LOGICAL DEVICE NUMBER.

inquiry_mode:

The inquiry mode describes the way the application prefers to gain the attention of the Application Command Interface when it will issue subsequent commands. Virtually, the Application Command Interface's attention is gained by the generation of a specific interrupt on the corresponding base board which may be one of the following interrupts:

- one of the seven VMEbus interrupts, or
- one of the two FORCE Message Broadcast interrupts, or
- one of the eight Mailbox interrupts.

The least significant eight bits of the inquiry mode contain the major interrupt number and the minor interrupt number as shown in Figure 2. The major interrupt number specifies the interrupt class - one of the interrupts listed above -, whereas the minor interrupt number specifies which of the interrupts in the class is being used. Refer to Table 1 for a list of the different major and minor interrupt numbers.

Figure 2: The inquiry and response mode

31 24	23 16	15 8	7 4	3 0
Reserved	Vector Number	IRQ Level	Major Interrupt Number	Minor Interrupt Number

The interrupt request level to be assigned to the particular interrupt is contained by bits 8 through 15 and has to be one of the MC680XX interrupt request levels. The Application Command Interface uses this value to set the corresponding Interrupt Control Register of the FORCE Gate Array-002 on the base board.

If one of the VMEbus interrupts is specified to gain the attention of the Application Command Interface then bits 16 through 23 have to contain the exception vector number provided by the VMEbus interrupter during the interrupt cycle. The most significant eight bits of the inquiry mode are reserved and should be cleared.

response_mode:

The response mode describes the way the application prefers to be informed about the completion of a command and may identify one of the following four modes:

- The POLLING mode where the application has to verify the state of the BUSY semaphore within the Access Control Field of the certain Command Control Buffer to detect the completion of a command.
- The MAILBOX interrupt mode where the Application Command Interface generates one of the eight mailbox interrupts on the board on which the application is running. Obviously, this mode can be selected only if a FORCE Gate Array FGA-002A is on the board where the application runs.
- The VMEbus interrupt mode where the Application Command Interface initiates an interrupt cycle on the VMEbus to inform the application about the completion of a command.
- The FORCE Message Broadcast interrupt mode where the Application Command Interface executes a FMB cycle on the VMEbus to inform the application about the completion of a command. Obviously, this mode can be selected only if a FORCE Gate Array FGA-002A is on the board where the application runs.

Table 1: The inquiry mode major and minor interrupt numbers

Major Interrupt Number	Minor Interrupt Number	Interrupt Source
$1	$0	VMEbus interrupt 1
	$1	VMEbus interrupt 2
	$2	VMEbus interrupt 3
	$3	VMEbus interrupt 4
	$4	VMEbus interrupt 5
	$5	VMEbus interrupt 6
	$6	VMEbus interrupt 7
$2	$0	FMB channel 0
	$1	FMB channel 1
$3	$0	Mailbox 0
	$1	Mailbox 1
	$2	Mailbox 2
	$3	Mailbox 3
	$4	Mailbox 4
	$5	Mailbox 5
	$6	Mailbox 6
	$7	Mailbox 7

The least significant eight bits of the response mode contain the major interrupt number and the minor interrupt number as shown in Figure 2. The major interrupt number specifies the interrupt class - one of the interrupts listed above -, whereas the minor interrupt number specifies which of the interrupts in the class is being used. Refer to table 2 for a list of the different major and minor interrupt numbers.

In contrast to the inquiry mode it is possible to specify the POLL mode; in this case the application has to detect the completion of a command upon the state of the BUSY semaphore within the Access Control Field of the particular Command Control Buffer.

The interrupt request level is reserved for the response mode and should be cleared.

If one of the VMEbus interrupts is specified to inform the application about the completion of a command then bits 16 through 23 have to contain the exception vector number provided by the VMEbus interrupter during the interrupt cycle. The most significant eight bits of the response mode are reserved and should be cleared.

Table 2: The response mode major and minor interrupt numbers

Major Interrupt Number	Minor Interrupt Number	Interrupt Source
$0	$0	No interrupt, POLL mode
$1	$0	VMEbus interrupt 1
	$1	VMEbus interrupt 2
	$2	VMEbus interrupt 3
	$3	VMEbus interrupt 4
	$4	VMEbus interrupt 5
	$5	VMEbus interrupt 6
	$6	VMEbus interrupt 7
$2	$0	FMB channel 0
	$1	FMB channel 1
$3	$0	Mailbox 0
	$1	Mailbox 1
	$2	Mailbox 2
	$3	Mailbox 3
	$4	Mailbox 4
	$5	Mailbox 5
	$6	Mailbox 6
	$7	Mailbox 7

data_exchange_mode:

The data exchange mode defines the way the data has to be interchanged between the application and a physical device and describes the location of the data to be transferred. As shown in Figure 3 below, the most significant two bits specify the data exchange mode: the DMA semaphore specifies whether the data has to be transferred by Direct Memory Access or by the Microprocessor; and the GLOBAL semaphore identifies whether to transfer data via the VMEbus to, or from a buffer provided by the application, or via the local data paths to, or from a buffer offered by the device driver.

In particular, if the GLOBAL semaphore is set then the data is transferred via the VMEbus by either the Direct Memory Access Controller or by the Microprocessor according to the state of the DMA flag. If the DMA flag is set then the Direct Memory Access Controller transfers the data, otherwise the microprocessor carries out the data transfer. The direction of the data transfer depends on the data transfer command - READ or WRITE -initiated by the application. If the GLOBAL flag is cleared then the application assumes that the device driver provides a buffer used to accumulate the data received from a physical device or to store the data to be transferred to a physical device. Thus, in this case the data transfer between the application and a physical device proceeds in the two steps: in the first step the application has to lead the Application Command Interface to supply an internal buffer used to store the data to be transferred to a physical device, or to accumulate the data received from a physical device. Depending upon the data transfer to be carried out, the application has to move the data from its own buffer to the internal buffer at the beginning of the WRITE command; or it has to copy the data from the internal buffer to its private buffer at the end of the READ command.

Figure 3: The data exchange mode

31	30	29	28	27		0
DMA CPU	LOCAL GLOBAL	RESERVED	RESERVED	RESERVED	•••	RESERVED

response_mode_address:

If the response mode either specifies one of the mailbox interrupts or one of the FMB interrupts to be used to inform the application about the completion of a command then the response mode address has to contain the address of the particular mailbox or FMB channel to be accessed from the VMEbus to gain the application's attention.

_remnant:

This data area may be used by the device driver for additional parameters. For further information please refer to the detailed description of the device driver.

When the OPEN command has been carried out the status of the completion of the command is returned through the same Command Control Buffer used to issue the command. The structure of the corresponding Command Control Buffer is structured as described below.

```
typedef struct  _ccb_open_status
  {
      unsigned long       _access_control_flags;
      long                ( *ME_system_call ) ( );
      CCB                 *ccb_link;
      long                last_command;
      unsigned long       _reserved[ 7 ];
      long                status;
      CCB                 *ccb;
      long                ccb_number;
      unsigned long       ACI_inquiry_address;
      unsigned long       _remnant[ 49 ];
  } CCB_OPEN_STATUS;
```

_access_control_flags:

The BUSY and the PROCESS semaphore are both cleared to signal the completion of the command. All other semaphores are unaffected.

status:

The status reports the course of the command and indicates one of the following cases:

ACI_OK:

Indicates the successful termination of the command and the other entries within the Command Control Buffer contain further information.

ACI_E_ILLEGAL_COMMAND:

An illegal command code has been specified.

ACI_E_INCONSISTENT_COMMAND_CHAIN:

Inconsistent command chain.

ACI_E_BUS_ERROR:

A BUS / ADDRESS ERROR occurred within a device driver.

ACI_E_OPEN_CCB_ALREADY_IN_USE:

An attempt to establish a logical connection to a physical device is refused by the Application Command Interface due to the fact that the Command Control Buffer is already used for a logical connection to a device.

ACI_E_OPEN_ILLEGAL_INQUIRY_MODE:

An illegal inquiry mode has been specified. Probably, an invalid major or minor interrupt number, or an illegal Interrupt Request Level has been specified, or an illegal Exception Vector Number has been specified. The value is also returned when the data within the inquiry mode are not consistent. For example, if the MAILBOX mode is specified but one or more of the most significant 16 bits are set.

ACI_E_OPEN_ILLEGAL_RESPONSE_MODE:

An illegal response mode has been specified. Probably, an invalid major or minor interrupt number, or an illegal Interrupt Request Level has been specified, or an illegal Exception Vector Number has been specified. The value is also returned when the data within the response mode are not consistent. For example, if the MAILBOX mode is specified but one or more of the most significant 16 bits are set.

ACI_E_OPEN_ILLEGAL_DATA_EXCHANGE_MODE:

An illegal data exchange mode has been specified. This status is returned whenever one or more of the least significant 30 bits are set.

ACI_E_OPEN_ILLEGAL_LOGICAL_DEVICE_NUMBER:

An illegal logical device number has been specified which cannot be translated to its corresponding physical device code by the Application Command Interface.

ACI_E_OPEN_INSUFFICIENT_CCBS:

The Application Command Interface is not able to allocate a Command Control Buffer within its internal Command Control Buffer list.

ACI_E_OPEN_DEVICE_ALREADY_IN_USE:

Another application already owns the physical device and no other can gain the ownership of this device until the certain application releases the logical connection to the device.

ACI_E_OPEN_INSUFFICIENT_MEMORY:

The Application Command Interface cannot allocate the memory required by a device driver when the device driver has to be activated upon the receipt of an OPEN.

ACI_E_OPEN_CANNOT_ACTIVATE_DEVICE_DRIVER:

The Application Command Interface cannot activate the device driver dealing with the physical device.

***ccb:**

Addresses the Command Control Buffer allocated by the Application Command Interface. The assigned Control Buffer has to be used by the application to issue subsequent commands through the Application Command Interface.

ccb_number:

Contains the number of the assigned Command Control Buffer and has to be used whenever the application will gain the attention of the Application Command Interface by a FORCE Message Broadcast cycle.

ACI_inquiry_address:

If the inquiry mode specifies to gain the attention of the Application Command Interface by either a mailbox interrupt or a FMB interrupt then it contains according to the major and minor interrupt number of the inquiry mode the address of the particular mailbox or FMB channel to be accessed from the VMEbus.

_remnant:

This data area may be used by the device driver for additional parameters. For further information please refer to the detailed description of the device driver.

Because the OPEN command has to be issued through the Command Control Buffer #0, the application has to release the Command Control Buffer after it has gained its own Command Control Buffer by clearing the ALLOCATE semaphore within the Access Control Field. All subsequent commands are issued through the Application Command Interface using the assigned Command Control Buffer.

2.2 The CLOSE Command

The CLOSE command requests to release a logical connection between the application and a physical device, and depending on the type of the physical device to reset the device. After the CLOSE command has been completed the application still owns the Command Control Buffer used to issue commands through the Application Command Interface. To get rid of the Command Control Buffer the application has to clear the ALLOCATE semaphore in the Access Control Field to return the Command Control Buffer to the Application Command Interface.

The particular Command Control Buffer is structured as described below.

```
typedef struct  _ccb_close_command
  {
     unsigned long      _access_control_flags;
     long               ( *ME_system_call ) ( );
     CCB                *ccb_link;
     long               last_command;
     unsigned long      _reserved[ 7 ];
     long               command;
     unsigned long      _remnant[ 52 ];
  } CCB_CLOSE_COMMAND;
```

_access_control_flags:
The BUSY semaphore has to be set to indicate the readiness of the Command Control Buffer to be processed; all other semaphores within the Access Control Field have to be left unaffected.

command:
The value $0C indicates that the command control buffer is used to issue the CLOSE command through the Application Command Interface.

_remnant:
This data area may be used by the device driver for additional parameters. For further information please refer to the detailed description of the device driver.

After the CLOSE command has been carried out, the status of the completion of the command is returned through the same Command Control Buffer used to issue the command. The corresponding Command Control Buffer is structured as described below.

```
        typedef struct  _ccb_close_status
          {
              unsigned long    _access_control_flags;
              long             ( *ME_system_call ) ( );
              CCB              *ccb_link;
              long             last_command;
              unsigned long    _reserved[ 7 ];
              long             status;
              unsigned long    _remnant[ 52 ];
          } CCB_CLOSE_STATUS;
```

_access_control_flags:

The BUSY and the PROCESS semaphore are both cleared to signal the completion of the command. All other semaphore are unaffected.

status:

The status reports the course of the command and indicates one of the following cases:

ACI_OK:

Indicates the successful termination of the command

ACI_E_ILLEGAL_COMMAND:

An illegal command code has been specified.

ACI_E_INCONSISTENT_COMMAND_CHAIN:

Inconsistent command chain

ACI_E_BUS_ERROR:

A BUS / ADDRESS ERROR occurred within a device driver.

ACI_E_CLOSE_NO_CONNECTION:

The logical connection to the device is already released

ACI_E_CLOSE_CANNOT_DEACTIVATE_DEVICE_DRIVER:

The Application Command Interface cannot deactivate the device driver.

_remnant:

This data area may be used by the device driver for additional parameters. For further information please refer to the detailed description of the device driver.

2.3 The READ Command

The READ command initiates a data exchange between a device and the application. The data is transferred from a device to the application. If any data have to be read from a block oriented device then blocks of data are transferred; in case of a character oriented device only bytes can be received from the device. The number of blocks or bytes to be read has to be specified too. The Command Control Buffer to issue a READ command is structured as described below.

```
typedef struct  _ccb_read_command
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             command;
      unsigned char    *buffer;
      unsigned long    count;
      unsigned long    block_number;
      unsigned long    read_mode;
      unsigned long    _remnant[ 48 ];
  } CCB_READ_COMMAND;
```

_access_control_flags:

The BUSY semaphore has to be set to indicate the readiness of the Command Control Buffer to be processed; all other semaphores within the Access Control Field have to be left unaffected.

command:

The value $04 indicates that the command control buffer is used to issue the READ command through the Application Command Interface.

***buffer:**

Addresses the buffer where the data read from the device have to be stored.

count:

Specifies either the number of blocks to be read from a block oriented device or specifies the number of bytes to be read from a character oriented device.

block_number:

If any data have to be read from a block oriented device then this entry specifies the number of the block where to start reading the number of blocks specified by count. In case of a character oriented device this entry is negligible.

In particular, the entry block_number is interpreted in different ways depending on the certain device driver: a device driver dealing with a block oriented device will use this entry to determine the block number where to start reading the number of blocks specified by the entry count. In contrast to the mentioned above, a device driver dealing with a character oriented device will only consider the information contained by the entry count.

read_mode:

The read mode specifies the conditions under which the READ command has to be carried out. As shown in Figure 4 it contains one flag to specify the mode of operation. This flag is valid for all device drivers. The usage of all reserved flags is device driver dependent. For further information please refer to the detailed description of the device driver.

The WAIT flag controls whether the READ command has to be carried out either in the wait or the status mode. If this flag is set, the wait mode is selected. In this case the corresponding device driver does not inform the application about the completion of the command until all data blocks or bytes have been read properly or a fail state causes to terminate the operation before all required data have been transferred.

In the status mode - the WAIT flag is cleared - the device driver reports the successful completion of the command only if just as much blocks or bytes are already available as specified by count and transfers the data to the specified buffer. If the number of available data blocks or bytes is less than the required number, the device driver reports an error but enters the number of the data blocks or bytes currently available into the entry count of the Command Control Buffer used to issue the READ command to the device driver. Thus, the application can use this information to read all available data by a subsequent READ command.

Figure 4: The read mode

31	30	29	28	27		0
WAIT	RESERVE D	RESERVED	RESERVED	RESERVED	•••	RESERVED

_remnant:

This data area may be used by the device driver for additional parameters. For further information please refer to the detailed description of the device driver.

When the READ command has been carried out by the device driver the completion status is returned through the same Command Control Buffer used to issue the command. The structure of the corresponding Command Control Buffer is described below.

```
typedef struct  _ccb_read_status
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             status;
      unsigned char    *buffer;
      unsigned long    count;
      unsigned long    block_number;
      unsigned long    read_mode;
      unsigned long    _remnant[ 48 ];
  } CCB_READ_STATUS;
```

_access_control_flags:

The BUSY and the PROCESS semaphore are both cleared to signal the command completion. All other semaphores are unaffected.

status:

The status reports the state of the completion of the command and either indicates the successful completion or the termination of the command due to the recognition of an error. In the former case a zero is returned; in the latter case a negative value is returned. The following error codes are returned by the Application Command Interface directly.

ACI_OK:

Indicates the successful termination of the command

ACI_E_ILLEGAL_COMMAND:

An illegal command code has been specified.

ACI_E_INCONSISTENT_COMMAND_CHAIN:
Inconsistent command chain

ACI_E_BUS_ERROR:
A BUS / ADDRESS ERROR occurred within a device driver.

ACI_E_READ_NO_CONNECTION:
The logical connection to a device does not exist

For device driver dependent error codes please refer to the detailed description of the particular device driver.

***buffer:**
This entry is not affected by the device driver and still addresses the beginning of the buffer where the data read from the device have been stored.

count:
Contains the number of data blocks and bytes read from the device. In case of any error detected by the device driver the number of bytes may be less than the number specified by the application.

read_mode:
This entry is not affected by the device driver and still contains the read mode as specified by the application.

_remnant:
This data area may be used by the device driver for additional parameters. For further information please refer to the detailed description of the device driver.

2.4 The WRITE Command

The WRITE command initiates a data exchange between a device and the application. The data is transferred from the application to a device. If any data have to be written to a block oriented device then blocks of data are transferred; in case of a character oriented device only bytes can be transmitted to the device. The number of blocks or bytes to be written have to be specified too. The Command Control Buffer to issue a WRITE command is structured as described below.

```
typedef struct  _ccb_write_command
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             command;
      unsigned char    *buffer;
      unsigned long    count;
      unsigned long    block_number;
      unsigned long    write_mode;
      unsigned long    _remnant[ 48 ];
  } CCB_WRITE_COMMAND;
```

_access_control_flags:
The BUSY semaphore has to be set to indicate the readiness of the Command Control Buffer to be processed; all other semaphores within the Access Control Field have to be left unaffected.

command:
The value $08 indicates that the command control buffer is used to issue the WRITE command through the Application Command Interface.

***buffer:**
Addresses the buffer which contains the data to be written to the device.

count:
Specifies either the number of blocks to be written to a block oriented device or specifies the number of bytes to be written to a character oriented device.

block_number:

If any data have to be written to a block oriented device then this entry specifies the number of the block where to start writing the number of blocks specified by count. In case of a character oriented device this entry is negligible.

In particular, the entry block_number is interpreted in different ways depending on the certain device driver: a device driver dealing with a block oriented device will use this entry to determine the block number where to start writing the number of blocks specified by the entry count. In contrast to the mentioned above, a device driver dealing with a character oriented device will only consider the information contained by the entry count.

write_mode:

The write mode specifies the conditions under which the WRITE command has to be carried out. As shown in Figure 5 it contains one flag to specify the mode of operation. This flag is valid for all device drivers. The usage of all reserved flags is device driver dependent. For further information please refer to the detailed description of the device driver.

The WAIT flag controls whether the WRITE command has to be carried out either in the wait or the status mode. If this flag is set, the wait mode is selected. In this case the corresponding device driver does not inform the application about the completion of the command until all data blocks or bytes have been written properly or a fail state causes to terminate the operation before all required data have been transferred. In the status mode - the WAIT flag is cleared - the device driver reports the successful completion of the command only if just as much blocks or bytes can be written to the device as specified by count and transfers the data to the specific device from the buffer. If the number of data blocks or bytes which can be written to the device is less than the required number, the device driver reports an error but enters the number of the data blocks or bytes, that could be written to the device, into the entry count of the Command Control Buffer used to issue the WRITE command to the device driver. Thus, the application can use this information to write the possible amount of data to the device by a subsequent WRITE command.

Figure 5 The write mode

31	30	29	28	27		0
WAIT	RESERVED	RESERVED	RESERVED	RESERVED	•••	RESERVED

_remnant:

This data area may be used by the device driver for additional parameters. For further information please refer to the detailed description of the device driver.

When the WRITE command has been carried out by the device driver the status of the completion of the command is returned through the same Command Control Buffer used to issue the command. The structure of the corresponding Command Control Buffer is described below.

```
typedef struct  _ccb_write_status
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             status;
      unsigned char    *buffer;
      unsigned long    count;
      unsigned long    block_number;
      unsigned long    write_mode;
      unsigned long    _remnant[ 48 ];
  } CCB_WRITE_STATUS;
```

_access_control_flags:

The BUSY and the PROCESS semaphore are both cleared to signal the completion of the command. All other semaphores are unaffected.

status:

The status reports the state of the completion of the command and either indicates the successful completion or the termination of the command due to the recognition of an error. In the former case a zero is returned; in the latter case a negative value is returned. The following error codes are returned by the Application Command Interface directly.

ACI_OK:

Indicates the successful termination of the command

ACI_E_ILLEGAL_COMMAND:

An illegal command code has been specified.

ACI_E_INCONSISTENT_COMMAND_CHAIN:
Inconsistent command chain

ACI_E_BUS_ERROR:
A BUS / ADDRESS ERROR occurred within a device driver.

ACI_E_WRITE_NO_CONNECTION:
The logical connection to a device does not exist.

For device driver dependent error codes please refer to the detailed description of the particular device driver.

***buffer:**
This entry is not affected by the device driver and still addresses the beginning of the buffer containing the data which have been written to the device.

count:
Contains the number of data blocks and bytes written to the device. In case of any error detected by the device driver the number of bytes may be less than the number specified by the application.

write_mode:
This entry is not affected by the device driver and still contains the write mode as specified by the application.

_remnant:
This data area may be used by the device driver for additional parameters. For further information please refer to the detailed description of the device driver.

2.5 The SERVICE Command

The SERVICE command requests special services provided by the Application Command Interface and a specific device driver. The Application Command Interface provides services to control the device driver's parameter, such as task priority etc., or to allocate additional memory which is dedicated to a logical connection; and a device driver provides services to modify the hardware parameter of a peripheral (changing the transmission rate of a serial communication controller, to enable or disable special functions implemented in the peripheral, like timers, counters, etc.) or to change the operating mode of the device driver. The structure of the Command Control Buffer to issue a SERVICE command is described below.

```
typedef struct  _ccb_service_command
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             command;
      long             service;
      unsigned long    service_parameter[ 51 ];
  } CCB_SERVICE_COMMAND;
```

_access_control_flags:

The BUSY semaphore has to be set to indicate the readiness of the Command Control Buffer to be processed; all other semaphores within the Access Control Field have to be left unaffected.

command:

The value $10 indicates that the command control buffer is used to issue the SERVICE command through the Application Command Interface.

service:

Specifies the proper service to be carried out by the Application Command Interface or the appropriate device driver. A positive value identifies a service required of the Application Command Interface, whereas a negative value designates a service to be provided by the device driver. (Please refer to the appropriate "EAGLE Module's Firmware User's Manual" to get detailed information about the services provided by the device drivers dealing with the devices on the particular EAGLE module.)

The services listed in the table below are provided by the Application Command Interface and the appropriate code has to be specified in the entry "service" to issue the particular service request to the Application Command Interface.

Service	**Code**
Get Logical Device Numbers	1

Services provided by the Application Command Interface.

service_parameter:

Depending on the required service further parameters are defined by this entry. The number and type of these parameters depend on the specific device driver.

```
typedef struct  _ccb_service_status
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             status;
      unsigned long    service_parameter[ 52 ];
   } CCB_SERVICE_STATUS;
```

_access_control_flags:

The BUSY and the PROCESS semaphore are both cleared to signal the completion of the command. All other semaphores are unaffected.

status:

The status reports the state of the completion of the command and either indicates the successful completion or the termination of the command due to the recognition of an error. In the former case a zero is returned; in the latter case a negative value is returned.

The following error codes are returned by the Application Command Interface directly.

ACI_OK:

Indicates the successful termination of the command.

ACI_E_ILLEGAL_COMMAND:

An illegal command code has been specified.

ACI_E_INCONSISTENT_COMMAND_CHAIN:

Inconsistent command chain.

ACI_E_BUS_ERROR:

A BUS / ADDRESS ERROR occurred within a device driver.

ACI_E_SERVICE_NO_CONNECTION:
The logical connection to a device does not exist.

ACI_E_SERVICE_NOT_SUPPORTED:
Indicates that the specific device driver does not support any SERVICE command.

ACI_SERVICE_UNKNOWN_SERVICE:
Unknown service requested.

For device driver dependent error codes please refer to the detailed description of the particular device driver.

service_parameter:
Depending on the required service further information is returned to the application through this area of the Command Control Buffer. The number of parameters and their meaning depends on the specific device driver. (Please, refer to the detailed description of the particular device driver).

The Application Command Interface provides services to get generic information about devices on available EAGLE modules. These services are described in the following subsection in detail, as well as the information returned by the Application Command Interface.

2.5.1 The Get Logical Device Number Service

The application has to issue the **Get Logical Device Number** service command to obtain a list of logical device numbers of devices of a particular type (e.g. a device that exchanges data via serial communication lines, a device that exchanges data through a parallel interface, etc.).The Application Command Interface returns a list of logical device numbers identifying all devices on the available EAGLE modules that are of the same type as specified by a parameter of the issued SERVICE command. (For a detailed description of these bits, refer to the "EAGLE Module Specification.")

The Application Command Interface returns a table of logical device numbers to the application, and each logical device number consists of two bytes. The most significant byte represents the major device number assigned to device and the least significant byte specifies the maximum number of minor devices packed up under the major device number.

Assuming the Application Command Interface has returned a logical device number $0203 (major device number = 2, minor device numbers are ranging from 0 to 3), then this value has to be interpreted in the following way: the most significant byte of this value represents the major device number (in this case 2) which corresponds to a device on an available EAGLE module that is of the same type as specified by a parameter of the SERVICE command. The least significant byte (in this case 3) indicates the minor device number of the "last" device packed up under the major device number. Thus, four devices are packed up under one major device number; the minor device number 0 corresponds to the first minor device, the minor device number 1 corresponds to the second minor device, the minor device number 2 corresponds to the third minor device, and last but not least the minor device number 3 corresponds to the fourth minor device packed up under the major device number.
The end of the table is indicated by the value $0000 (major device number = 0, minor device number = 0).

Further parameters have to be passed to the Application Command Interface through the parameter area of the certain Command Control Buffer as described below:

unsigned long parameter[0]
Contains the type of device. (For a detailed description of these bits, refer to the "EAGLE Module Specification.")

unsigned long parameter[1]
Addresses a location within the VMEbus address space where the table of logical device numbers has to be placed by the Application Command Interface. If this entry is cleared, then the Application Command Interface places the logical device numbers within the same Command Control Buffer beginning at the location parameter[1].

3. Command Chaining

The Application Command Interface supports the capability to issue a sequence of commands through the interface which are executed in successive order. The commands are passed through the Application Command Interface in a chain of Command Control Buffers and each Command Control Buffer is used to issue a single command. The Application Command Interface informs the application about the completion of all commands in the chain only until the last command has been executed successfully, or it informs the application about the abnormal termination of a command when a fail state has been detected.

A command chain is built up when the application issues the CCB_ALLOCATE command through the Application Command Interface via an already existing logical connection to a device. The CCB_ALLOCATE leads the Application Command Interface to allocate a given number of Command Control Buffers and to chain these buffers to the Command Control Buffer associated with the logical connection.

The entry [ccb_link] within the first part of each Command Control Buffer addresses the following Command Control Buffer and the NULL pointer identifies the last Command Control Buffer in the chain (A 'single' Command Control Buffer is always the first and last Command Control Buffer in a 'chain' consisting of only one Command Control Buffer).

To get rid of the Command Control Buffers chained to a Command Control Buffer associated with the logical connection the application has to issue the CCB_FREE command to 'return' the occupied Command Control Buffers to the Application Command Interface.

The following constraints apply to the command chains:

1. Only READ and WRITE commands are allowed within the command chain. SERVICE commands which affect the device driver only can be issued through the Application Command Interface within a command chain.

2. Only the first Command Control Buffer of the chain can be used to issue the CCB_FREE command.

3. The CCB_ALLOCATED command can be used only if the application already has issued an OPEN command through the Application Command Interface and received its own Command Control Buffer associated with the logical connection.

Therefore, the following steps are recommended to build up a command chain:

1. First, a logical connection has to be established between the application and a specific device using the OPEN command.

2. When the application has established a logical connection, and has received its own Command Control Buffer through the Application Command Interface, it can issue the CCB_ALLOCATE command to acquire a specific number of Command Control Buffers.

3. The application must have prepared all Command Control Buffers in the chain - according to the rules mentioned above - before the chain is passed through the Application Command Interface.

4. Once the completion of all commands in the chain has been indicated, the application has to verify the status of each issued command, and then may release the Command Control Buffers in the chain by issuing a CCB_FREE command through the first Command Control Buffer of the chain.

5. The application has to issue the CLOSE command using the remaining Command Control Buffer to release the logical connection to the device.

3.1 The CCB_ALLOCATE Command

The CCB_ALLOCATE command is used to acquire a specific number of Command Control Buffers which will be chained to the Command Control Buffer associated with the logical connection.

The particular Command Control Buffer is structured as described below.

```
typedef struct  _ccb_allocate_command
  {
      unsigned long      _access_control_flags;
      long               ( *ME_system_call ) ( );
      CCB                *ccb_link;
      long               last_command;
      unsigned long      _reserved[ 7 ];
      long               command;
      long               ccb_number;
      unsigned long      reserved[ 50 ];
  } CCB_ALLOCATE_COMMAND;
```

_access_control_flags:

The BUSY flag has to be set to indicate the readiness of the Command Control Buffer to be processed; all other flags within the Access Control Field have to be left unaffected.

command:

The value $18 indicates that the command control buffer is used to issue the CCB_ALLOCATE command through the Application Command Interface.

ccb_number:

Number of Command Control Buffers to be allocated and linked up to a chain.

After the CCB_ALLOCATE command has been carried out, the status of the completion of the command in the same Command Control Buffer used to issue the command. The corresponding Command Control Buffer is structured as described below.

```
typedef struct  _ccb_allocate_status
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             status;
      long             ccb_number;
      CCB              *chain_head;
      unsigned long    reserved[ 51 ];
  } CCB_ALLOCATE_STATUS;
```

_access_control_flags:

The BUSY and the PROCESS flags are both cleared to signal the completion of the command. All other flags are unaffected.

ccb_link:

On successful completion of the command ccb_link contains a pointer to the next Command Control Buffer in the chain. Otherwise this entry is cleared.

status:

The status reports the course of the command and indicates one of the following cases:

ACI_OK:

Indicates the successful termination of the command.

ACI_E_ILLEGAL_COMMAND:

An illegal command code has been specified.

ACI_E_INCONSISTENT_COMMAND_CHAIN:

Inconsistent command chain.

ACI_E_BUS_ERROR:

Reserved

ACI_E_ALLOCATE_ILLEGAL_NUMBER_OF_CCBS:
An illegal number of Command Control Buffers to be allocated has been specified.

ACI_E_ALLOCATE_INSUFFICIENT_CCBS:
No more Command Control Buffers available.

ccb_number:
Specifies the number of Command Control Buffers which have been allocated.

***chain_head:**
Addresses the Command Control Buffer which is the first CCB in the chain.

3.2 The CCB_FREE Command

The CCB_FREE command is used to release all Command Control Buffers of a chain except the first Command Control Buffer of the chain.

The particular Command Control Buffer is structured as described below.

```
typedef struct  _ccb_free_command
  {
    unsigned long      _access_control_flags;
    long               ( *ME_system_call ) ( );
    CCB                *ccb_link;
    long               last_command;
    unsigned long      _reserved[ 7 ];
    long               command;
    unsigned long      reserved[ 52 ];
  } CCB_FREE_COMMAND;
```

_access_control_flags:
The BUSY flag has to be set to indicate the readiness of the Command Control Buffer to be processed; all other flags within the Access Control Field have to be left unaffected.

command:
The value $1C indicates that the command control buffer is used to issue the CCB_FREE command through the Application Command Interface.

After the CCB_FREE command has been carried out, the status of the completion of the command is returned through the same Command Control Buffer used to issue the command.

The corresponding Command Control Buffer is structured as described below.

```
        typedef struct  _ccb_free_status
          {
              unsigned long    _access_control_flags;
              long             ( *ME_system_call ) ( );
              CCB              *ccb_link;
              long             last_command;
              unsigned long    _reserved[ 7 ];
              long             status;
              unsigned long    reserved[ 52 ];
          } CCB_FREE_STATUS;
```

_access_control_flags:

The BUSY and the PROCESS flags are both cleared to signal the completion of the command. All other flags are unaffected.

status:

The status is always zero and indicates the successful termination of the command.

4. Error Codes

This section lists all error codes which are returned through the Application Command Interface to indicate the fail states detected by the Application Command Interface. All error codes returned by a particular device driver, dealing with a specific device on an EAGLE module, are described in the appropriate "Firmware User’s Manual" of the EAGLE module.

4.1 Common Error Codes

ACI_OK	0
ACI_E_ILLEGAL_COMMAND	-1
ACI_E_INCONSISTENT_COMMAND_CHAIN	-2
ACI_E_BUS_ERROR	-3

4.2 Error Codes Related To The OPEN Command

ACI_E_OPEN_CCB_ALREADY_ASSOCIATED	-5
ACI_E_ILLEGAL_INQUIRY_MODE	-6
ACI_E_ILLEGAL_RESPONSE_MODE	-7
ACI_E_OPEN_ILLEGAL_DATA_EXCHANGE_MODE	-8
ACI_E_OPEN_ILLEGAL_LOGICAL_DEVICE_NUMBER	-9
ACI_E_OPEN_INSUFFICIENT_CCBS	-10
ACI_E_OPEN_DEVICE_ALREADY_IN_USE	-11
ACI_E_OPEN_INSUFFICIENT_MEMORY	-13
ACI_E_OPEN_CANNOT_ACTIVATE_DEVICE_DRIVER	-14

4.3 Error Codes Related To The CLOSE Command

ACI_E_CLOSE_NO_CONNECTION	-5
ACI_E_CLOSE_CANNOT_DEACTIVATE_DEVICE_DRIVER	-6

4.4 Error Code Related To The READ Command

ACI_E_READ_NO_CONNECTION	-5

4.5 Error Code Especially Related To The WRITE Command

ACI_E_WRITE_NO_CONNECTION	-5

4.6 Error Codes Related To The SERVICE Command

ACI_E_SERVICE_NO_CONNECTION	-5
ACI_E_SERVICE_NOT_SUPPORTED	-6
ACI_E_SERVICE_UNKNOWN_SERVICE	-7

4.7 Error Codes Especially Related To The CCB_ALLOCATE Command

ACI_E_ALLOCATE_ILLEGAL_NUMBER_OF_CCBS	-4
ACI_E_ALLOCATE_INSUFFICIENT_CCBS	-5

4.8 Error Codes Especially Related To The CCB_FREE Command

None

5. The following example shows how to communicate with the ACI

NOTE: This example has to run on the same board where the ACI is implemented. The communication with the ACI is done in polled mode. This example is programmed to run in a PDOS environment. It can easily be ported to any operating system.

```
#include "XLIB.h"

#define  MAILBOX                      0xffd80000L
#define  DPR_BASE                     0x80000000L

#define  ACI_IDENTIFIER               0x41434900L

#define  OPEN                         0x00L
#define  READ                         0x04L
#define  WRITE                        0x08L
#define  CLOSE                        0x0CL
#define  SERVICE                      0x10L

#define  ALLOCATE                     31
#define  BUSY                         30

#define  GET_LOGICAL_DEVICE_NUMBER     1L

#define  POLL                         0x00
#define  MBOX0                        0x30
#define  IRQL2                        0x200L

struct _ccb_t
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             command_or_status;
    unsigned long    _remnant[ 52 ];
  };

struct _ccb_open_command
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             command;
    unsigned long    logical_device_number;
    unsigned long    inquiry_mode;
    unsigned long    response_mode;
    unsigned long    data_exchange_mode;
    unsigned long    response_mode_address;
    unsigned long    remnant[ 47 ];
  };
```

```
struct _ccb_sopen_status
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             status;
    struct _ccb_t    *ccb;
    long             ccb_number;
    unsigned long    ACI_inquiry_address;
    unsigned long    remnant[ 49 ];
  };

struct _ccb_close_command
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             command;
    unsigned long    release_state; /*  !!!! always cleared !!!!  */
    unsigned long    _remnant[ 51 ];
  };

struct _ccb_sclose_status
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             status;
    unsigned long    _remnant[ 52 ];
  };

struct _ccb_read_command
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             command;
    unsigned char    *buffer;
    unsigned long    count;
    unsigned long    block_number;
    unsigned long    read_mode;
    unsigned long    _remnant[ 48 ];
  };

struct _ccb_sread_status
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             status;
    unsigned char    *buffer;
    unsigned long    count;
    unsigned long    block_number;
    unsigned long    read_mode;
    unsigned long    _remnant[ 48 ];
  };
```

```
struct _ccb_write_command
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             command;
    unsigned char    *buffer;
    unsigned long    count;
    unsigned long    block_number;
    unsigned long    write_mode;
    unsigned long    _remnant[ 48 ];
  };

struct _ccb_swrite_status
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             status;
    unsigned char    *buffer;
    unsigned long    count;
    unsigned long    block_number;
    unsigned long    write_mode;
    unsigned long    _remnant[ 48 ];
  };

struct _ccb_cservice_command
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    unsigned long    last_command;
    unsigned long    _reserved[ 7 ];
    long             command;
    long             service;
    unsigned long    parameter[ 51 ];
  };

struct _ccb_sservice_status
  {
    unsigned long    _access_control_flags;
    long             ( * _ME_system_call ) ();
    struct _ccb_t    *ccb_link;
    long             last_command;
    unsigned long    _reserved[ 7 ];
    long             status;
    unsigned long    _remnant[ 52 ];
  };

/*

 Forwards

*/
static void          get_ccb();
static void          put_ccb();
static void          do_mbox0();
static void          wait_not_busy();
static unsigned long do_service();
static short         check_device();
static long          open_device();
static unsigned long set_floppy_parameter();
static unsigned long do_me_read();
static unsigned long do_me_write();
static long          close_device();
```

```
/*

 call: main()

 in  : nothing

 out : nothing

 description:
 ’main’ first waits until the ME has written its identifier. Then,
 the address of the first CCB is fetched. With this CCB the ACI is
 asked if there is a floppy device driver task available. If yes,
 this task is opened. Furthermore a service call for the floppy
 device driver task is executed. At the end the first CCB0 is
 released.

 called subroutines: get_ccb(), check_device(), open_device(),
                     set_floppy_parameter(), put_ccb(), do_me_read(),
                     do_me_write(), close_device()

*/
main()
{ short found;
  struct _ccb_open_command *ccb_ptr;
  unsigned long floppy_ccb = 0L;
  char buffer[256];

  while ( *(long *)0L != ACI_IDENTIFIER )
    ;                                  /* wait until ME is ready            */
  ccb_ptr = (struct _ccb_open_command *)(*(long *)0x04L & 0x00ffffff);
                                       /* get address of CCB0               */
  get_ccb(ccb_ptr);                    /* get the first CCB                 */
  if ( (found = check_device(ccb_ptr,2L,0L)) != 0 )
                                       /* check for a floppy controller     */
    if ( open_device(ccb_ptr,found) == 0 )
                                       /* there is one                      */
                                       /* try to open it                    */
      floppy_ccb =   (long)(((struct _ccb_sopen_status *)ccb_ptr)->ccb)
                   & 0x00ffffffL;
                                       /* open was ok, get our CCB          */
  put_ccb(ccb_ptr);                    /* CCB 0 is not longer used          */
  if ( floppy_ccb != 0 )               /* execute only if a floppy device   */
                                       /* is present                        */
  { set_floppy_parameter(floppy_ccb,0L);
                                       /* do a service call to the floppy   */
                                       /* device driver task                */
    do_me_read(floppy_ccb, 100L, buffer, 0L);
                                       /* read block 100 from drive 0       */
    do_me_write(floppy_ccb, 100L, buffer, 0L);
                                       /* write block 100 to drive 0        */
    close_device(floppy_ccb);          /* terminate this connection         */
  }                                    /* end if                            */
}                                      /* end of ’main()’                   */

/*
 call: get_ccb(ccb_ptr)

 in  : ccb_ptr     -> address of CCB which is to use

 out : nothing

 description:
   get_ccb() waits until it gets the requested CCB. This MUST be done
   with an opcode which cannot be interrupted from another processor.

 called subroutines: none

*/
```

```
static void get_ccb(ccb_ptr)
struct _ccb_cservice_command *ccb_ptr;
{ while ( XTAS((char *)&ccb_ptr->_access_control_flags) != 0 )
                                        /* allocating the CCB with a TAS     */
    ;                                   /* instruction                       */
}                                       /* end of 'get_ccb()'                */

/*
 call: put_ccb(ccb_ptr)

 in  : ccb_ptr     -> address of CCB which is no longer used

 out : nothing

 description:
   put_ccb() makes the previous allocated CCB accessible to other
   tasks.

 called subroutines: none

*/
static void put_ccb(ccb_ptr)
struct _ccb_cservice_command *ccb_ptr;
{ ccb_ptr->_access_control_flags &= ~(1L << ALLOCATE);
                                        /* the CCB is free for other         */
}                                       /* end of 'put_ccb()'                */

/*
 call: do_mbox0(ccb_address)

 in  : ccb_address -> CCB address

 out : Nothing

 description:
   do_mbox0() initiates a Mailbox 0 interrupt. If the CCB is onboard
   the interrupt will come to myself. If the CCB is offboard the
   interrupt will be generated at this board.

 called subroutines: none

*/
static void do_mbox0(ccb_address)
register unsigned long ccb_address;
{ if ( ccb_address < DPR_BASE )         /* ME onboard ?                      */
  { while ( *(char *)MAILBOX  < 0 )     /* initiate an onboard Mailbox 0     */
                                        /* interrupt                         */
      ;                                 /* until success                     */
  }                                     /* do not forget this bracket        */
  else                                  /* the CCB is not on this board      */
  { while ( *(char *)(0xfcff0000 | ((ccb_address >> 16) & 0xff00)) < 0 )
                                        /* initiate a VMEbus Mailbox 0       */
                                        /* interrupt                         */
      ;                                 /* until success                     */
  }                                     /* end if                            */
}                                       /* end of 'do_mbox0()'               */

/*
 call: wait_not_busy(ccb_ptr)

 in  : ccb_ptr     -> address of CCB which is used

 out : nothing

 description:
   wait_not_busy() waits until someone (hopefully the ME) clears
   the BUSY bit

 called subroutines: none

*/
```

```
static void wait_not_busy(ccb_ptr)
struct _ccb_cservice_command *ccb_ptr;
{ while ( ccb_ptr->_access_control_flags & (1L << BUSY) )
    ;                                   /* we’re waiting until the ME has    */
                                        /* cleared the BUSY bit              */
}                                       /* end of ’wait_not_busy()’          */

/*
 call: do_service(ccb_ptr, service_number)

 in  : ccb_ptr        -> CCB address
       service_number -> number of the requested service call

 out : error number

 description:

 called subroutines: do_mbox(0), wait_not_busy()

*/
static unsigned long do_service(ccb_ptr, service_number)
register struct _ccb_cservice_command *ccb_ptr;
unsigned long service_number;
{

  ccb_ptr->command = SERVICE;           /* we do a SERVICE call              */
  ccb_ptr->service = service_number;    /* set requested service number      */
  ccb_ptr->_access_control_flags |= 1L << BUSY;
                                        /* we have to set the BUSY bit       */
  do_mbox0(ccb_ptr);                    /* and to initiate a Mailbox 0       */
                                        /* interrupt                         */
  wait_not_busy(ccb_ptr);               /* we’re waiting until the ME has    */
                                        /* done its job                      */
  return(((struct _ccb_sservice_status *)ccb_ptr)->status);
                                        /* return error value                */
}                                       /* end of do_service()               */

/*
 call: check_device(ccb_ptr, device, destination)

 in  : ccb_ptr     -> address of CCB which is to use
       device      -> device mask
       destination -> to where the data is to send

 out : Major/Minor number of the (first) device or 0 if none

 description:
   check_device() checks if the accessed target has I/O device of the
   type requested in ’device’.

 called subroutines: do_mbox0(), wait_not_busy()

*/
```

```
static short check_device(ccb_ptr, device, destination)
register struct _ccb_cservice_command *ccb_ptr;
unsigned long device;
register short *destination;
{ ccb_ptr->command = SERVICE;           /* we do a SERVICE call              */
  ccb_ptr->service = GET_LOGICAL_DEVICE_NUMBER;
                                        /* we want to get logical device     */
                                        /* numbers                           */
  ccb_ptr->parameter[0] = device;       /* of these devices                  */
  ccb_ptr->parameter[1] = (unsigned long)destination;
                                        /* set destination of the list       */
  ccb_ptr->_access_control_flags |= 1L << BUSY;
                                        /* we have to set the BUSY bit       */
  do_mbox0(ccb_ptr);                    /* and to initiate a Mailbox 0       */
                                        /* interrupt                         */
  wait_not_busy(ccb_ptr);               /* we're waiting until the ME has    */
                                        /* done its job                      */
  if ( destination == (short *)0 )      /* is the destination in the CCB ?   */
    destination = (short *)(&(ccb_ptr->parameter[1]));
                                        /* yes, then we have set this address*/
  return(*destination);                 /* return Major/Minor number         */
}                                       /* end of check_device()             */

/*
 call: open_device(ccb_ptr, major_minor)

 in  : ccb_ptr     -> address of CCB which is to use
       major_minor -> Major/Minor number of the device

 out : ME return value in the CCB

 description:
   open_device() tries to open an I/O device. The device number is
   given in 'major_minor'.

 called subroutines: do_mbox0(), wait_not_busy()

*/
static long open_device(ccb_ptr, major_minor)
register struct _ccb_open_command *ccb_ptr;
short major_minor;
{ ccb_ptr->command = OPEN;              /* we do a OPEN call                 */
  ccb_ptr->logical_device_number = (unsigned long)major_minor;
                                        /* set device wanted                 */
  ccb_ptr->inquiry_mode = IRQL2 | MBOX0;
                                        /* interrupt level 2/ Mailbox 0      */
  ccb_ptr->response_mode = POLL;        /* set response mode                 */
  ccb_ptr->data_exchange_mode = 0xc0000000;
                                        /* the device driver task has to     */
                                        /* transfer the data directly with   */
                                        /* DMA                               */
  ccb_ptr->_access_control_flags |= 1L << BUSY;
                                        /* we have to set the BUSY bit       */
  do_mbox0(ccb_ptr);                    /* and to initiate a Mailbox 0       */
                                        /* interrupt                         */
  wait_not_busy(ccb_ptr);               /* we're waiting until the ME has    */
                                        /* done its job                      */
  return(((struct _ccb_sopen_status *)ccb_ptr)->status);
                                        /* return open status                */
}                                       /* end of open_device()              */
```

```
/*
 call: set_floppy_parameter(ccb_ptr, drive)

 in  : ccb_ptr      -> CCB address
       drive        -> floppy drive number

 out : STATUS as returned from the ME in the CCB

 description:
   set_floppy_parameter executes a set floppy parameter service.

 called subroutines: do_service()

*/
static unsigned long set_floppy_parameter(ccb_ptr, drive)
register struct _ccb_cservice_command *ccb_ptr;
unsigned long drive;
{ ccb_ptr->parameter[0] = drive;        /* set drive number                  */
  ccb_ptr->parameter[1] = 80;           /* set number of cylinder            */
  ccb_ptr->parameter[2] = 32;           /* set sectors/cylinder              */
  ccb_ptr->parameter[3] = 1;            /* set bytes/sector (coded)          */
  ccb_ptr->parameter[4] = 2;            /* set number of heads               */
  ccb_ptr->parameter[5] = 0x20;         /* set R/W gap                       */
  ccb_ptr->parameter[6] = 0x36;         /* set format gap                    */
  ccb_ptr->parameter[7] = 1;            /* set density                       */
  ccb_ptr->parameter[8] = 1;            /* set step rate                     */
  return(do_service(ccb_ptr,-2049L));   /* execute service                   */
}                                       /* end of ’set_floppy_parameter()’   */

/*
 call: do_me_read(ccb_ptr, block, buffer, drive)

 in  : ccb_ptr      -> CCB address
       block        -> requested block number
       buffer       -> address of source data
       drive        -> drive number

 out : STATUS as return from the ME in the CCB

 description:
   do_me_read() reads exactly one block from the given drive.
   It waits until the ME has returned a status. The block size is
   fixed to 256Bytes.

 called subroutines: wait_not_busy(), do_mbox0()

*/
```

```
static unsigned long do_me_read(ccb_ptr, block, buffer, drive)
register struct _ccb_read_command *ccb_ptr;
unsigned long block;
unsigned char *buffer;
unsigned long drive;
{ ccb_ptr->command = READ;              /* we do a READ call                 */
  ccb_ptr->buffer = buffer;             /* set read buffer                   */
  ccb_ptr->count = 1;                   /* we want to read 1 block           */
  ccb_ptr->block_number = block;        /* block number to read              */
  ccb_ptr->read_mode = 0x80000000;      /* we want to wait for the data      */
  ccb_ptr->_remnant[0] = drive;         /* set drive number                  */
  ccb_ptr->_remnant[1] = 256L;          /* set block size                    */
  ccb_ptr->_access_control_flags |= 1L << BUSY;
                                        /* we have to set the BUSY bit       */
  do_mbox0(ccb_ptr);                    /* and to initiate a Mailbox 0       */
  wait_not_busy(ccb_ptr);               /* we're waiting until the ME has    */
                                        /* done its job                      */
  return(((struct _ccb_sopen_status *)ccb_ptr)->status);
                                        /* return error value                */
}                                       /* end of do_me_read()               */

/*
 call: do_me_write(ccb_ptr, block, buffer, drive)

 in  : ccb_ptr      -> CCB address
       block        -> requested block number
       buffer       -> address where the data is to store
       drive        -> drive number

 out : STATUS as return from the ME in the CCB

 description:
   do_me_write() writes exactly one block to the given drive.
   It waits until the ME has returned a status. The block size is
   fixed to 256Bytes.

 called subroutines: wait_not_busy(), do_mbox0()

*/
static unsigned long do_me_write(ccb_ptr, block, buffer, drive)
register struct _ccb_write_command *ccb_ptr;
unsigned long block;
unsigned char *buffer;
unsigned long drive;
{ unsigned long error;

  ccb_ptr->command = WRITE;             /* we do a WRITE call                */
  ccb_ptr->buffer = buffer;             /* set write buffer                  */
  ccb_ptr->count = 1;                   /* we want to write 1 block          */
  ccb_ptr->block_number = block;        /* block number to write             */
  ccb_ptr->write_mode = 0x80000000;     /* we want to wait until written     */
  ccb_ptr->_remnant[0] = drive;         /* set drive number                  */
  ccb_ptr->_remnant[1] = 256L;          /* set block size                    */
  ccb_ptr->_access_control_flags |= 1L << BUSY;
                                        /* we have to set the BUSY bit       */
  do_mbox0(ccb_ptr);                    /* and to initiate a Mailbox 0       */
                                        /* interrupt                         */
  wait_not_busy(ccb_ptr);               /* we're waiting until the ME has    */
                                        /* done its job                      */
  return(((struct _ccb_sopen_status *)ccb_ptr)->status);
                                        /* return error value                */
}                                       /* end of do_me_write()              */
```

```
/*
 call: close_device(ccb_ptr)

 in  : ccb_ptr     -> address of CCB which is to use

 out : ME return value in the CCB

 description:
   close_device() simply executes a CLOSE command to the given CCB.
   The response mode is not of interrest because we simply poll the
   answer.

 called subroutines: do_mbox0(), wait_not_busy()

*/
static long close_device(ccb_ptr)
register struct _ccb_close_command *ccb_ptr;
{ unsigned long error;

  ccb_ptr->command = CLOSE;             /* we do a CLOSE call                */
  ccb_ptr->_access_control_flags |= 1L << BUSY;
                                        /* we have to set the BUSY bit       */
  do_mbox0(ccb_ptr);                    /* and to initiate a Mailbox 0       */
                                        /* interrupt                         */
  wait_not_busy(ccb_ptr);               /* we're waiting until the ME has    */
                                        /* done its job                      */
  error = ((struct _ccb_sclose_status *)ccb_ptr)->status;
                                        /* get close status                  */
  put_ccb(ccb_ptr);                     /* this CCB is no longer used        */
  return(error);                        /* return status                     */
}                                       /* end of close_device()             */
```

RAM PORT

TABLE OF CONTENTS

INTRODUCTION

The Application Command Interface (ACI) provides a RAM port that can be used as a *character oriented* input/output port of any VMEPROM task running on the same board as the ACI[1]. Within the VMEPROM environment, the RAM port is assigned to a specific task using one of the appropriate commands offered by VMEPROM. Thus, an application running on another board in the system communicates with the task via the backplane; this means that the application sends VMEPROM commands through the RAM port to the task and receives the responses of the task through the RAM port as well[2].

[1]On the IBC-20 board, the RAM port is either:

- assigned to the task #0 depending on the state of the third bit of the rotary switch on the front panel;
- or assigned to every other task using the appropriate VMEPROM commands (CT, ASSIGN, and so on).

[2] The data passed through RAM port depends on what the certain task expects as input; a VMEPROM task expects proper VMEPROM commands such as **lt**, **md**, etc.; whereas a user-written task interprets the data in another context. Independent of the context any data is exchanged through the RAM port "byte per byte".

1. Accessing the RAM port through the ACI

Before any data can be exchanged through the RAM port, an application has to gain the ownership of the RAM port in the same manner as an application establishes a logical connection between itself and a specific device. First, the application has to issue the **OPEN** command through the ACI specifying the RAM port as the device to be *opened*. If the application has gained the ownership of the RAM port, then it exchanges data between itself and the RAM port using the **READ** and **WRITE** commands provided by the ACI. The number of bytes which can be read from or written to the RAM port using the appropriate commands is limited to one byte, and any attempt to read or write more than one byte will be refused by the ACI. Also, any attempt to issue the **SERVICE** command to the RAM port will be refused by the ACI, because the RAM port *driver* does not support this feature. To release the RAM port the **CLOSE** command has to be issued. In the following subsections all commands to gain the ownership of the RAM port, to exchange data between an application and the RAM port, and to release the RAM port are described in detail.

1.1 Acquire The RAM port

The **OPEN** command requests the establishment of a logical connection between an application and the RAM port; the appropriate CCB is structured as presented in *Figure 1*.

Whenever an **OPEN** command is issued through the Application Command Interface to ’open’ the RAM port, the ACI verifies whether the RAM port is still available and in this case it takes possession of the RAM port. If the RAM port is already owned by another application, the attempt to acquire the RAM port is refused by the ACI.

```
typedef struct  _ccb_open_command
  {
     unsigned long  _access_control_flags;
     long           ( *ME_system_call ) ( );
     CCB            *ccb_link;
     long           last_command;
     unsigned long  _reserved[ 7 ];
     long           command;
     unsigned long  logical_device_number;
     unsigned long  inquiry_mode;
     unsigned long  response_mode;
     unsigned long  data_exchange_mode;
     unsigned long  response_mode_address;
     unsigned long  _remnant[ 47 ];
  } CCB_OPEN_COMMAND;
```

Figure 1: Structure of the CCB used to gain RAM port ownership

_access_control_flags:

The **BUSY** flag has to be set to indicate the readiness of the Command Control Buffer to be processed; all other flags within the Access Control Field have to be left unaffected.

command:

The structure member contains the code $00 to mark the **OPEN** command.

logical_device_code:

Because the RAM port is permanently available through the ACI, the major and minor device number of the RAM port are always the same: both the major device number of $0 and the minor device number -4 ($FC) specify the RAM port. (The ACI keeps track of the major device numbers of all devices available on present EAGLE modules; and due to the fact that the RAM port is managed by the ACI directly and because it is permanently available through the ACI independent of the presence of any EAGLE module, the ACI orders the RAM port at the beginning of its internal device list. Therefore, the major device number assigned to the RAM port by the ACI is $0 and the minor device number -4 denotes the proper RAM port.)

inquiry_mode:

The inquiry mode describes the way an application prefers to gain the attention of the ACI when it issues subsequent commands. Virtually, the ACI’s attention is gained by the generation of a specific interrupt on the corresponding IBC board which may be one of the following interrupts:

- one of the eight Mailbox interrupts,
- one of the seven VMEbus interrupts, or
- one of the two FORCE Message Broadcast interrupts

The least significant eight bit of the *inquiry* mode contain the **major interrupt number** and the **minor interrupt number** as shown in the *Figure 2*. The major interrupt number specifies the interrupt class - *one of the interrupts listed above* - whereas the minor interrupt number specifies which of the interrupts in the class is being used. Refer to *Table 1* which lists the different major and minor interrupt numbers.

The interrupt request level to be assigned to the particular interrupt is contained by bits 8 through 15 and has to be one of the MC680X0 interrupt request levels. The ACI uses this value to set the corresponding Interrupt Control Register.

If one of the VMEbus interrupts is specified to gain the attention of the ACI then bits 16 through 23 have to contain the exception vector number provided by the VMEbus interrupter during the interrupt cycle. The most significant eight bits of the *inquiry* mode are reserved and should be reset.

31 24	23 16	15 8	7 4	3 0
reserved	vector number	IRQ level	major	minor

Figure 2: The *inquiry* and *response* mode

response_mode:

The *response* mode describes the way an application prefers to be informed about the completion of a command by the ACI and may identify one of the following four modes:

Major Interrupt Number	Minor Interrupt Number	Interrupt Source
$1	$0	VMEbus interrupt 1
	$1	VMEbus interrupt 2
	$2	VMEbus interrupt 3
	$3	VMEbus interrupt 4
	$4	VMEbus interrupt 5
	$5	VMEbus interrupt 6
	$6	VMEbus interrupt 7
$2	$0	FMB channel 0
	$1	FMB channel 1
$3	$0	Mailbox 0
	$1	Mailbox 1
	$2	Mailbox 2
	$3	Mailbox 3
	$4	Mailbox 4
	$5	Mailbox 5
	$6	Mailbox 6
	$7	Mailbox 7

Table 1: The *inquiry* mode major and minor interrupt numbers

- The **POLLING** mode where an application has to verify the state of the **BUSY** flag within the Access Control Field of the certain Command Control Buffer to detect the completion of a command.
- The **MAILBOX** interrupt mode where the ACI generates one of the eight mailbox interrupts on the board on which the application is running. Obviously, this mode can be selected only if a FORCE Gate Array FGA-002A is on the board where the application runs.
- The **VMEbus interrupt** mode where the ACI initiates an interrupt cycle on the VMEbus to inform an application about the completion of a command.
- The **FORCE Message Broadcast** interrupt mode where the ACI executes a *FMB cycle* on the VMEbus to inform an application about the completion of a command. Obviously, this mode can be selected only if a FGA-002A is on the board where the application runs.

The least significant eight bit of the *response mode* contain the **major** interrupt number and the **minor** interrupt number as shown in the *Figure 2*. The **major interrupt number** specifies the interrupt class - *one of the interrupts listed above* - whereas the **minor interrupt number** specifies which of the interrupts in the class is being used. Refer to *Table 2* which lists the different major and minor interrupt numbers.

In contrast to the *inquiry mode* it is possible to specify the **POLL** mode; in this case the application has to detect the completion of a command upon the state of the **BUSY** flag within the Access Control Field of the particular Command Control Buffer.

The interrupt request level to be assigned to the particular interrupt is contained by the bit 8 through 15 and has to be one of the MC680X0 interrupt request levels. If one of the VMEbus interrupts is specified to inform the application about the completion of a command then bits 16 through 23 have to contain the exception vector number provided by the VMEbus interrupter during the interrupt cycle. The most significant eight bits of the *response mode* are reserved and should be reset.

Major Interrupt Number	Minor Interrupt Number	Interrupt Source
$0	$0	No interrupt, POLL mode
$1	$0	VMEbus interrupt 1
	$1	VMEbus interrupt 2
	$2	VMEbus interrupt 3
	$3	VMEbus interrupt 4
	$4	VMEbus interrupt 5
	$5	VMEbus interrupt 6
	$6	VMEbus interrupt 7
$2	$0	FMB channel 0
	$1	FMB channel 1
$3	$0	Mailbox 0
	$1	Mailbox 1
	$2	Mailbox 2
	$3	Mailbox 3
	$4	Mailbox 4
	$5	Mailbox 5
	$6	Mailbox 6
	$7	Mailbox 7

data_exchange_mode:

The data exchange mode defines the way the data has to be interchanged between the application and a physical device and describes the location of the data to be transferred. As shown in Figure 3 below, the most significant two bits specify the data exchange mode: the DMA semaphore specifies whether the data has to be transferred by Direct Memory Access or by the Microprocessor; and the GLOBAL semaphore identifies whether to transfer data via the VMEbus to, or from a buffer provided by the application, or via the local data paths to, or from a buffer offered by the device driver.

In particular, if the GLOBAL semaphore is set then the data is transferred via the VMEbus by either the Direct Memory Access Controller or by the Microprocessor according to the state of the DMA flag. If the DMA flag is set then the Direct Memory Access Controller transfers the data, otherwise the microprocessor carries out the data transfer. The direction of the data transfer depends on the data transfer command - READ or WRITE -initiated by the application. If the GLOBAL flag is cleared then the application assumes that the device driver provides a buffer used to accumulate the data received from a physical device or to store the data to be transferred to a physical device. Thus, in this case the data transfer between the application and a physical device proceeds in the two steps: in the first step the application has to lead the Application Command Interface to supply an internal buffer used to store the data to be transferred to a physical device, or to accumulate the data received from a physical device. Depending upon the data transfer to be carried out, the application has to move the data from its own buffer to the internal buffer at the beginning of the WRITE command; or it has to copy the data from the internal buffer to its private buffer at the end of the READ command.

31	30	29	28	27		1	0
DMA CPU	LOCAL GLOBAL	reserved	reserved	reserved	• • •	reserved	reserved

Figure 3: The *data exchange* mode

application_address:

If the *response mode* either specifies one of the mailbox or FMB interrupts to be used to inform the application about the completion of a command then the *application address* has to contain the address of the particular mailbox or FMB channel to be accessed from the VMEbus to gain the application’s attention.

When the **OPEN** command has been carried out by the ACI it returns the status of the completion of the command in the same Command Control Buffer used to issue the command. The structure of the corresponding Command Control Buffer is structured as presented in *Figure 4*.

```
typedef struct  _ccb_open_status
  {
     unsigned long      _access_control_flags;
     long               ( *ME_system_call ) ( );
     CCB                *ccb_link;
     long               last_command;
     unsigned long      _reserved[ 7 ];
     long               status;
     CCB                *ccb;
     long               ccb_number;
     unsigned long      ACI_inquiry_address;
     unsigned long      _remnant[ 49 ];
  } CCB_OPEN_STATUS;
```

Figure 4: Structure of the CCB returned through ACI in response to attempt to open RAM port

_access_control_flags:

The **BUSY** and the **PROCESS** flags are both reset to signal the completion of the command. All other flags are unaffected.

status:

The *status* reports the course of the command and indicates one of the following cases:

0: indicates the successful termination of the command and the other entries within the Command Control Buffer contain further information.

-1: indicates that an illegal *command code* has been specified.

-2: inconsistent command chain

-3: a BUS/ADDRESS ERROR occurred withing a DEVICE DRIVER TASK

-4: reserved

-5: is as in **OPEN** of the IBC Programming User's Guide (*Section 6*).

-6: an illegal inquiry mode has been specified. Probably, an invalid major or minor interrupt number, or an illegal *Interrupt Request Level* has been specified, or an illegal *Exception Vector Number* has been specified. The value is also returned when the data within the *inquiry mode* are not consistent. For example, if the *MAILBOX mode* is specified but one or more of the most significant 16 bits are set.

-7: an illegal *response mode* has been specified. Probably, an invalid *major*, or *minor* interrupt number, or an illegal *Interrupt Request Level* has been specified, or an illegal *Exception Vector Number* has been specified. The value is also returned when the data within the *response mode* are not consistent. For example, if the *MAILBOX mode* is specified but one or more of the most significant 16 bits are set.

-8: an illegal *data exchange mode* has been specified. This status is returned whenever one or more of the least significant 29 bits are set.

-9: an illegal *logical device number* has been specified which cannot be translated to its corresponding physical device code by the ACI.

-10: signals that the ACI is not able to allocate a Command Control Buffer within its internal Command Control Buffer list.

-11: indicates that another application already owns the physical device and no other can gain the ownership of this device until the certain application releases the logical connection to the device.

-12: *reserved for internal use*

-13: indicates that the ACI cannot allocate the memory required by a device driver task when the device driver has to be activated upon the receipt of an **OPEN**.

-14: indicates that the ACI cannot create the device driver task.

***ccb:**

Addresses the Command Control Buffer allocated by the ACI. The assigned Control Buffer has to be used by an application to issue subsequent commands through the Application Command Interface.

ccb_number:

contains the number of the assigned Command Control Buffer and has to be used whenever an application will gain the attention of the ACI by a FORCE Message Broadcast cycle.

ACI_inquiry_address:

If the *inquiry mode* specifies to gain the attention of the ACI by either a mailbox interrupt or a FMB interrupt then it contains according to the *major* and *minor* interrupt number of the *inquiry mode* the address of the particular mailbox or FMB channel to be accessed from the VMEbus.

Because the **OPEN** command has to be issued through the Command Control Buffer #0, an application has to release the Command Control Buffer after it has gained its own Command Control Buffer by resetting the **ALLOCATE** flag within the Access Control Field. All subsequent commands are issued through the Application Command Interface using the assigned Command Control Buffer.

1.2 Reading Data From The RAM port

The **READ** command initiates a data exchange between the *character oriented* RAM port and an application and the data is transferred from the RAM port to an application.

The Command Control Buffer to read data from the RAM port is structured as described in *Figure 5*.

```
typedef struct  _ccb_read_command
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             command;
      unsigned char    *buffer;
      unsigned long    count;
      unsigned long    block_number;
      unsigned long    read_mode;
      unsigned long    _remnant[ 48 ];
  } CCB_READ_COMMAND;
```

Figure 5: Structure of CCB used to read data from RAM port

_access_control_flags:
The **BUSY** flag has to be set to indicate the readiness of the Command Control Buffer to be processed; all other flags within the Access Control Field have to be left unaffected.

command:
The structure member contains the code $04 to identify the **READ** command.

***buffer:**
addresses the buffer where the data byte read from the RAM port has to be stored.

count:
The ACI allows only one byte to be read from the RAM port at the time and refuses any attempt to read more or less than one byte. Thus, the **count** has to specify always one byte ($1).

block_number:
Because the RAM port is a character oriented device this entry is not considered and should be cleared.

read_mode:
Each read access to the RAM port is carried out in the *status mode* independent of the state of the **WAIT** flag. Thus, any attempt to read a byte from the RAM port either returns an available data byte, or is refused if no data is available. It is recommendable to clear all bits.

When the **READ** command has been carried out by the ACI the status of the completion of the command is returned within the same Command Control Buffer used to issue the command. The structure of the corresponding Command Control Buffer is presented in Figure 6.

```
typedef struct  _ccb_read_status
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             status;
      unsigned char    *buffer;
      unsigned long    count;
      unsigned long    block_number;
      unsigned long    read_mode;
      unsigned long    _remnant[ 48 ];
  } CCB_READ_STATUS;
```

Figure 6: Structure of CCB returned through ACI in response to attempt to *read data* from RAM port

_access_control_flags:

The **BUSY** and the **PROCESS** flags are both reset to signal the completion of the command. All other flags are unaffected.

status:

The status reports the state of the completion of the command and either indicates the successfull completion or the termination of the command due to the recognition of an error. In the former case the zero value is returned; in the latter case a negative value is returned. The different error codes which may be returned are described below in detail:

0: indicates the successful termination of the command and the other entries within the Command Control Buffer contain further information.

-1: illegal command code.

-2: inconsistent chain.

-3: a BUS/ADDRESS ERROR occurred withing a DEVICE DRIVER TASK

-4: reserved.

-5: indicates an attempt to read a data byte from the RAM port but the RAM port’s internal ’transmit’ buffer does not contain any data.

-6: *reserved for future use.*

-7: indicates an attempt to read more than one data byte or to read less than one data byte from the RAM port at the time.

***buffer:**

This entry is not affected and still addresses the beginning of the buffer where the data byte read from the RAM port has been stored.

count:

contains the number of data bytes read from the RAM port (always one). In case of any error detected by the ACI the number of data bytes may be less than the number of data to be read as specified by the application.

block_number:

This entry is not affected and still contains the *read mode* as specified by the application.

read_mode:

This entry is not affected and still contains the *read mode* as specified by the application.

1.3 Writing Data To The RAM port

The **WRITE** command initiates a data exchange between the *character oriented* RAM port and an application and the data is transferred from the application to the RAM port.

The Command Control Buffer to write data to the RAM port is structured as described in *Figure 7*.

```
typedef struct  _ccb_write_command
  {
      unsigned long    _access_control_flags;
      long             ( *ME_system_call ) ( );
      CCB              *ccb_link;
      long             last_command;
      unsigned long    _reserved[ 7 ];
      long             command;
      unsigned char    *buffer;
      unsigned long    count;
      unsigned long    block_number;
      unsigned long    write_mode;
      unsigned long    _remnant[ 48 ];
  } CCB_WRITE_COMMAND;
```

Figure 7: Structure of CCB used to write data to RAM port

_access_control_flags:
The **BUSY** flag has to be set to indicate the readiness of the Command Control Buffer to be processed; all other flags within the Access Control Field have to be left unaffected.

command:
The structure member contains the code $08 to identify the **WRITE** command.

***buffer:**
Addresses the buffer where the data byte to be written to the RAM port is stored.

count:
The ACI allows only one byte to be written to the RAM port at the time and refuses any attempt to write more or less than one byte. Thus, the **count** has to specify always one byte ($1).

block_number:
Because the RAM port is a character oriented device this entry is not considered and should be cleared.

write_mode:
Each write access to the RAM port is carried out in the *status mode* independent of the state of the **WAIT** flag. Thus, any attempt to write a byte to the RAM port either is accepted, or is refused if no more data can be accumulated by the RAM port. So, it is recommendable to clear all bits.

When the **WRITE** command has been carried out by the ACI the status of the completion of the command is returned within the same Command Control Buffer used to issue the command. The structure of the corresponding Command Control Buffer is presented in *Figure 8*.

```
typedef struct  _ccb_write_status
  {
     unsigned long    _access_control_flags;
     long             ( *ME_system_call ) ( );
     CCB              *ccb_link;
     long             last_command;
     unsigned long    _reserved[ 7 ];
     long             status;
     unsigned char    *buffer;
     unsigned long    count;
     unsigned long    block_number;
     unsigned long    write_mode;
     unsigned long    _remnant[ 48 ];
  } CCB_WRITE_STATUS;
```

Figure 8: Structure of CCB returned through ACI in response to attempt to *write data* to RAM port

_access_control_flags:

The **BUSY** and the **PROCESS** flags are both reset to signal the completion of the command. All other flags are unaffected.

status:

The status reports the state of the completion of the command and either indicates the successfull completion or the termination of the command due to the recognition of an error. In the former case the zero value is returned; in the latter case a negative value is returned. The different error codes which may be returned are described below in detail:

0: indicates the successful termination of the command and the other entries within the Command Control Buffer contain further information.

-1: illegal command code.

-2: inconsistent chain.

-3: a BUS/ADDRESS ERROR occurred withing a DEVICE DRIVER TASK

-4: reserved.

-5: indicates that an attempt to write data bytes to the RAM port has been refused due to the fact that the RAM port has been 'locked'.

-6: indicates that an attempt to write data bytes to the RAM port has been refused due to the fact that the internal 'receive' buffer of the RAM port cannot accumulate further data.

-7: indicates an attempt to write more than one data byte or to write less than one data byte to the RAM port at the time.

***buffer:**

This entry is not affected and still addresses the beginning of the buffer where the data byte read from the RAM port has been stored.

count:

Contains the number of data bytes written to the RAM port (always one). In case of any error detected by the ACI the number of data bytes may be less than the number of data to be written as specified by the application.

block_number:

This entry is not affected and still contains the *read mode* as specified by the application.

write_mode:

This entry is not affected and still contains the *write mode* as specified by the application.

2. Accessing The RAM Port From VMEPROM

VMEPROM is equipped with a UART driver to exchange data via the RAM port and to alter the operating mode of the RAM port[3]. This RAM port UART driver is constructed like all other standard VMEPROM (PDOS) UART drivers and thus provides the same functions.

In contrast to the standard UART drivers the 'port' flags related to the RAM port UART driver affect it in a different way. As shown in Figure 9 the 'port' flags consists of eight bits and the RAM port UART driver considers only the C-flag and the I-flag; all other flags are ignored by the driver. The C-flag is interpreted by the kernel rather than by the RAM port driver. And the kernel determines upon the state of this flag how to treat control characters, like **CTRL-C**, **ESC**, etc.,received via the RAM port. To modify the 'port' flags the VMEPROM command **bp** has to be used and the state of the certain flags are specified as an argument in the argument list of the command. In the following list each flag and its effect on the RAM port UART driver is described in detail:

S: The *control flow* by software flag specifies whether the data flow via the 'serial' data communication line has to be managed by the XON/XOFF protocol. If this flag is set then the XON and XOFF characters are used to control data flow via the serial data communication line; otherwise the XON/XOFF protocol is not used.

C: The *ignore control character flag* either leads the appropriate routine of the VMEPROM kernel dealing with the character input to interprete received control characters, or to pass the control characters through the kernel without any processing. If the flag is set then all received control characters are passed to the application directly; otherwise the kernel interprets the control characters **CTRL-C**, **CTRL-X**, **ESC**.

D: The *control flow* by hardware flag specifies whether the data flow via the 'serial' data communication line has to be managed by the specific hardware handshake signals. If this flag is set then the **DTR** signal is used to control data flow via the serial data communication line; otherwise no hardware handshake protocol is used.

8: The *size of character flag* denotes the number of bits used to represent a character to be received or transmitted via the serial data communication line. If the flag is set then the character's size is eight bits; otherwise seven bits are used to represent a character.

I: The *not interrupt driven input flag* controls whether the receipt of a character is indicated by a hardware interrupt. If this flag is set then the receipt of a character is not indicated by an interrupt; otherwise a hardware interrupt is generated to indicate the receipt of a character.

P: The *even parity* enable flag indicates to generate an even parity bit for each character to be transmitted via the serial data communication line and to check the even parity of each character received via the serial data communication line. If this flag is set then the even parity generation and verification is done for each received and transmitted character; otherwise the parity generation and verification is disabled.

[3]The VMEPROM command "bp' can be used to obtain the port number of the RAM port.

H: reserved for the VMEPROM kernel’s internal purpose

F: reserved for the VMEPROM kernel’s internal purpose

7	6	5	4	3	2	1	0
F	H	P	I	8	D	C	S

Figure 9: RAM Port UART Driver’s ’port’ Flags

3. The Internal Structure Of The RAM Port

The RAM port provided by the ACI consists of an internal 32 bits width semaphore register and two 128 byte width circular buffers - *the 'receive' and 'transmit' buffer* - each equipped with two pointers to manage insertion and removal of data. Both, the RAM port driver of the ACI and the RAM port UART driver provided by VMEPROM have access to the internal flag register, the 'receive' buffer and the 'transmit' buffer of the RAM port as depicted in *Figure 10*.

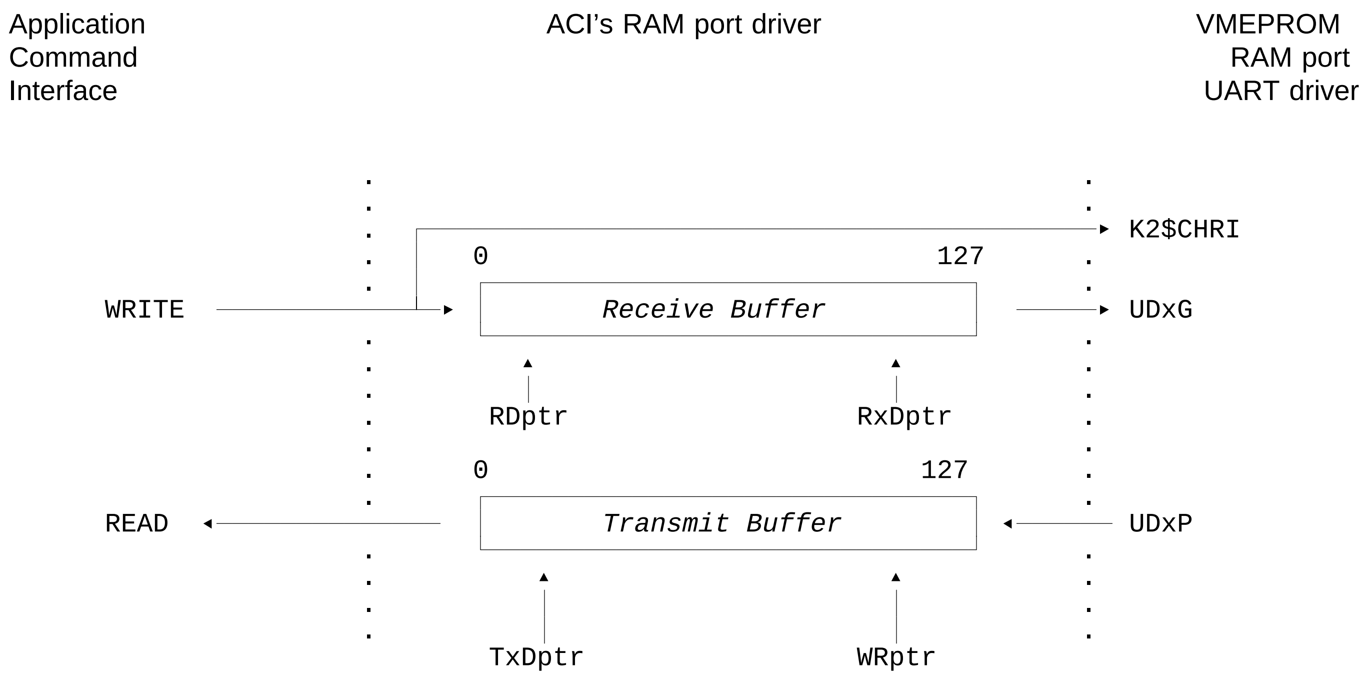

Figure 10: Internal Structure of the RAM port

Within the context of the RAM port the *receive* describes the process of writing data through the Application Command Interface to the RAM port's receive buffer; and the *transmit* relates to the process of reading data through the ACI from the RAM port's transmit buffer.

Every access to the RAM port through the ACI and the RAM port's operating mode are controlled by the specific flags in the internal semaphore register. As shown in *Figure 11* the most significant two bits in this register are in use and described below:

- *The RPINTR flag* either causes to pass direclty a received character to the appropriate routine of the VMEPROM kernel dealing with character input, or to store the received character in the RAM port's internal receive buffer. If the RPINTR flag is <u>cleared</u> then all received data bytes are placed in the receive buffer as long as enough room is available in the buffer. In the case that the RPINTR flag is <u>set</u> then all received characters are passed direcly to the kernel of VMEPROM via a specific call.

  The RPINTR flag is modified upon the state of the I-flag in the RAM port's 'port' flag whenever the routine UxDB of the VMEPROM's RAM port UART driver is called (I-flag = 0 -> RPINTR = 1; I-flag = 1 -> RPINTR = 0;)

- *The RPLOCK flag* is used to refuse any attempt to write further data to the RAM port through the Application Command Interface. If the RPLOCK flag is reset then data bytes can be written to the RAM port; otherwise any attempt to write data to the RAM port is refused by the ACI's RAM port driver. This flag is set by the UxHW routine provided by the VMEPROM RAM port UART driver to cause to refuse an further attempt to write data bytes to the RAM port from the VMEbus side. The RAM port UART driver's routine UxLW <u>resets</u> the RPLOCK flag to enable the receipt of further data via the RAM port[4].

31	30	29	28	27		1	0
RPINTR	RPLOCK	reserved	reserved	reserved	• • •	reserved	reserved

Figure 11: The semaphore register of the RAM port

[4] The routines UxHW (Signal High Water) and UxLW (Signal Low Water) provided by the VMEPROM RAM port UART driver are called by the VMEPROM kernel depending on the state of the internal type-ahead buffer. Please refer to the "PDOS Developer's Reference" for more detailed information.

1. HISTORY OF MANUAL REVISIONS

Revision No.	Description	Date of Last Change
0	This manaual describes the IBC-20 revision 2 firmware.	FEB/05/1993