Debugging Package for Motorola 68K CISC CPUs User's Manual

(Part 2 of 2)

68KBUG2/D3

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Preface

The *Debugging Package for Motorola 68K CISC CPUs User's Manual* provides general information for the onboard firmware package for all Motorola 68000 CISC CPU and MPU VMEmodule boards.

This document is bound in two parts. Part 1 (68KBUG1/D3) contains the Table of Contents and Chapters 1 through 3. Part 2 (68KBUG2/D3, this volume) contains Chapters 4 and 5, Appendices A through I, and the Index.

This manual is intended for anyone who wants to design OEM systems, supply additional capability to an existing compatible system, or work in a lab environment for experimental purposes.

The following firmware packages and boards are covered in this manual:

MVME162	162Bug
MVME172	172Bug
MVME166	166Bug
MVME167	167Bug
MVME176	176Bug
MVME177	177Bug

The firmware packages are referred to as *16XBug* in this manual. The boards are referred to as *MVME16X*.

This manual describes the debugger, the debugger command set, the one-line assembler/disassembler, and system calls. These functional elements are common to all firmware packages.

Installation, start-up, diagnostics tests, and environmental parameters are described in the diagnostic manuals for each of the firmware packages.

A basic knowledge of computers and digital logic is assumed.

Related Documentation

The following publications are applicable to Motorola 68K CISC CPU debugging packages and may provide additional helpful information. If not shipped with this product, they may be purchased by contacting your local Motorola sales office. Non-Motorola documents may be obtained from the sources listed following the table.

Document Title	Motorola Publication Number
M68040 Microprocessors User's Manual	M68040UM/AD
M68060 Microprocessors User's Manual	M68060UM/AD
MVME050 System Controller Module User's Manual	MVME050/D
MVME162 Programmer's Reference Guide	MVME162PG/D
MVME162FX Programmer's Reference Guide	MVME162LXPG/D
MVME162LX Programmer's Reference Guide	V162FXA/PG
MVME172 Programmer's Reference Guide	VME172A/PG
Single Board Computers Programmer's Reference Guide	VMESBCA1/PG and VMESBCA2/PG
162Bug Diagnostics User's Manual	V162DIAA/UM
167Bug Debugging Package User's Manual	MVME167BUG/D
172Bug Diagnostics User's Manual	V172DIAA/UM
177Bug Diagnostics User's Manual	V177DIAA/UM
MVME320B VMEbus Disk Controller Module User's Manual	MVME320B/D
MVME323 ESDI Disk Controller User's Manual	MVME323/D
MVME327A VMEbus to SCSI Bus Adapter and MVME717 Transition Module User's Manual	MVME327A/D
MVME327A Firmware User's Manual	MVME327AFW/D
MVME328 VMEbus Dual SCSI Host Adapter User's Manual	MVME328/D
MVME335 Serial and Parallel I/O Module User's Manual	MVME335/D
MVME350 Streaming Tape Controller VMEmodule User's Manual	MVME350/D
MVME350 IPC Firmware User's Guide	MVME350FW/D
MVME374 Multi-Protocol Ethernet Interface Module User's Manual	MVME374/D
MVME376 Ethernet Communication Controller User's Manual	MVME376/D

Note Although not shown in the above list, each Motorola Computer Group manual publication number is suffixed with the revision level of the document, such as “2” (the second revision of a manual); a supplement bears the same number as a manual but has a suffix such as "2A1" (the first supplement to the second revision of the manual).

The following publications are available from the sources indicated.

ANSI Small Computer System Interface-2 (SCSI-2), Draft Document X3.131-198X, Revision 10c; Global Engineering Documents, P.O. Box 19539, Irvine, CA 92714.

Versatile Backplane Bus: VMEbus, ANSI/IEEE Std. 1014-1987, The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017 (VMEbus Specification). This is also available as *Microprocessor system bus for 1 to 4 byte data, IEC 821 BUS*, Bureau Central de la Commission Electrotechnique Internationale; 3, rue de Varembé, Geneva, Switzerland.

Manual Terminology

Throughout this manual, a convention has been maintained whereby data and address parameters are preceded by a character which specifies the numeric format as follows:

$	hexadecimal character
%	binary number
&	decimal number

Unless otherwise specified, all address references are in hexadecimal throughout this manual.

An asterisk (*) following the signal name for signals which are *level significant* denotes that the signal is *true* or valid when the signal is low.

An asterisk (*) following the signal name for signals which are *edge significant* denotes that the actions initiated by that signal occur on high to low transition.

In this manual, *assertion* and *negation* are used to specify forcing a signal to a particular state. In particular, *assertion* and *assert* refer to a signal that is active or *true*; *negation* and *negate* indicate a signal that is inactive or *false*. These terms are used independently of the voltage level (high or low) that they represent.

Data and address sizes are defined as follows:

- A *byte* is eight bits, numbered 0 through 7, with bit 0 being the least significant.
- A *word* is 16 bits, numbered 0 through 15, with bit 0 being the least significant.
- A *longword* is 32 bits, numbered 0 through 31, with bit 0 being the least significant.

Conventions

The following conventions are used in this document:

bold	is used for user input that you type just as it appears. Bold is also used for commands, options and arguments to commands, and names of programs, directories, and files.
italic	is used for names of variables to which you assign values. Italic is also used for comments in screen displays and examples.
`courier`	is used for system output (e.g., screen displays, reports), examples, and system prompts.
<**RETURN**> or <**CR**>	represents the carriage return or Enter key.
CTRL or **^**	represents the Control key. Execute control characters by pressing the **CTRL** key and the letter simultaneously, e.g., **CTRL-d**.

Safety Summary
Safety Depends On You

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Motorola, Inc. assumes no liability for the customer's failure to comply with these requirements.

The safety precautions listed below represent warnings of certain dangers of which Motorola is aware. You, as the user of the product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

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To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical ground. The equipment is supplied with a three-conductor ac power cable. The power cable must be plugged into an approved three-contact electrical outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

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Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

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Operating personnel must not remove equipment covers. Only Factory Authorized Service Personnel or other qualified maintenance personnel may remove equipment covers for internal subassembly or component replacement or any internal adjustment. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

Do Not Service or Adjust Alone.

Do not attempt internal service or adjustment unless another person capable of rendering first aid and resuscitation is present.

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Do Not Substitute Parts or Modify Equipment.

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Dangerous Procedure Warnings.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed. You should also employ all other safety precautions which you deem necessary for the operation of the equipment in your operating environment.

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WARNING

This equipment generates, uses, and can radiate electro-magnetic energy. It may cause or be susceptible to electro-magnetic interference (EMI) if not installed and used in a cabinet with adequate EMI protection.

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Using the One-Line Assembler/Disassembler 1

Introduction

Included as part of the 16XBug firmware is an assembler/disassembler function. The assembler is an interactive assembler/editor in which the source program is not saved. Each source line is translated into the proper MC68040 or MC68060 machine language code and is stored in memory on a line-by-line basis at the time of entry. In order to display an instruction, the machine code is disassembled, and the instruction mnemonic and operands are displayed. All valid MC68040 and MC68060 instructions are translated.

The 16XBug assembler is effectively a subset of the MC68040 and MC68060 resident structured assemblers. It has some limitations as compared with the resident assembler, such as not allowing line numbers and labels; however, it is a powerful tool for creating, modifying, and debugging MC68040 or MC68060 code.

MC68040 and MC68060 Assembly Language

The symbolic language used to code source programs for processing by the assembler is MC68040/MC68060 assembly language. This language is a collection of mnemonics representing:

- Operations

  -MC68040/MC68060 machine-instruction operation codes
  -Directives (pseudo-ops)

- Operators
- Special symbols

Machine-Instruction Operation Codes

That part of the assembly language that provides the mnemonic machine- instruction operation codes for the MPU machine instructions is described in the appropriate microprocessor user's manual. See the *Related Documentation* section in the Preface. Refer to this manual for any question concerning operation codes.

Directives

Normally, assembly language can contain mnemonic directives which specify auxiliary actions to be performed by the assembler.

The 16XBug assembler recognizes only two directives called define constant (DC.W) and SYSCALL. These directives are used to define data within the program, and to make calls on 16XBug utilities. Refer to the sections on *DC.W Define Constant Directive* and on *SYSCALL System Call Directive*, respectively, for further details.

Comparison with MC68040 and MC68060 Assemblers

There are several major differences between the 16XBug assembler and the MC68040/MC68060 resident structured assembler. The resident assembler is a two-pass assembler that processes an entire program as a unit, while the 16XBug assembler processes each line of a program as an individual unit. Due mainly to this basic functional difference, the capabilities of the 16XBug assembler are more restricted:

- Label and line numbers are not used. Labels are used to reference other lines and locations in a program. The one-line assembler has no knowledge of other lines and, therefore, cannot make the required association between a label and the label definition located on a separate line.
- Source lines are not saved. In order to read back a program after it has been entered, the machine code is disassembled and then displayed as mnemonic and operands.
- Only two directives (DC.W and SYSCALL) are accepted.

- No macro operation capability is included.
- No conditional assembly is used.
- Several symbols recognized by the resident assembler are not included in the 16XBug assembler character set. These symbols include > and <. Three other symbols have multiple meanings to the resident assembler, depending on the context (refer to the section on *Addressing Modes*). These are:

  Asterisk (*)

  Multiplication operator *or* current value of the program counter.

  Slash (/)

  Division operator *or* delimiter in a register list.

  Ampersand (&)

  Logical operator AND *or* a decimal number prefix.

  Although functional differences exist between the two assemblers, the one-line assembler is a true subset of the resident assembler. The format and syntax used with the 16XBug assembler are acceptable to the resident assembler except as described above.

Source Program Coding

A source program is a sequence of source statements arranged in a logical way to perform a predetermined task. Each source statement occupies a line and must be either an executable instruction, a DC.W directive, or a SYSCALL assembler directive. Each source statement follows a consistent source line format.

Source Line Format

Each source statement is a combination of operation and, as required, operand fields. Line numbers, labels, and comments are *not* used.

Operation Field

Because there is no label field, the operation field may begin in the first available column. It may also follow one or more spaces. Entries can consist of one of three categories:

1. Operation codes which correspond to the MC68040/MC68060 instruction set.
2. Define Constant directive: DC.W is recognized to define a constant in a word location.
3. System Call directive: SYSCALL is used to call 16XBug system utilities.

The size of the data field affected by an instruction is determined by the data size codes. Some instructions and directives can operate on more than one data size. For these operations, the data size code must be specified or a default size applicable to that instruction is assumed. The size code need not be specified if only one data size is permitted by the operation.

The data size code is specified by a period (.), appended to the operation field, am followed by B, W, or L, where:

B = Byte (8-bit data)

W = Word (the usual default size; 16-bit data)

L = Longword (32-bit data).

The data size code is not permitted, however, when the instruction or directive does not have a data size attribute.

Examples (legal):

`LEA`	`(A0),A1`	Longword size is assumed (**.b**, **.w** not allowed); this instruction loads the effective address of the first operand into A1.
`ADD.B`	`(A0),D0`	This instruction adds the byte whose address is (A0) to the lowest order byte in D0.
`ADD`	`D1,D2`	This instruction adds the low order word of D1 to the low order word of D2. (**w** is the default size code.)
`ADD.L`	`A3,D3`	This instruction adds the entire 32-bit (longword) contents of A3 to D3.

Example (illegal):

`SUBA.B`	`#5,A1`	Illegal size specification (**.b** not allowed on SUBA). This instruction would have subtracted the value 5 from the low order byte of A1; byte operations on address registers are not allowed.

Operand Field

If present, the operand field follows the operation field and is separated from the operation field by at least one space. When two or more operand subfields appear within a statement, they must be separated by a comma.

In an instruction like "`ADD D1,D2`", the first subfield (D1) is called the source effective address field, and the second subfield (D2) is called the destination <EA> field. Thus, the contents on D1 are added to the contents of D2 and the result is saved in register D2.

In the instruction "`MOVE D1,D2`" the first subfield (D1) is the sending field and the second subfield (D2) is the receiving field.

In other words, for most two-operand instructions, the format "*opcode source,destination*" applies.

Disassembled Source Line

The disassembled source line may not look identical to the source line entered. The disassembler makes a decision on how it interprets the numbers used. If the number is an offset from an address register, it is treated as a signed hexadecimal offset. Otherwise, it is treated as a straight unsigned hexadecimal.

For example,

```
MOVE.L      #1234,5678
MOVE.L      FFFFFFFC(A0),5678
```

disassembles to:

```
00003000  21FC0000 12345678    MOVE.L     #$1234,($5678).W
00003008  21E8FFFC 5678        MOVE.L     -$4(A0),($5678).W
```

Also, for some instructions, there are two valid mnemonics for the same opcode, or there is more than one assembly language equivalent. The disassembler may choose a form different from the one originally entered. As examples:

1. BRA is returned for BT
2. DBF is returned for DBRA

Note The assembler recognizes two forms of mnemonics for two branch instructions. The BT form (branch conditionally true) has the same opcode as the BRA instruction. Also, DBRA (decrement and branch always) and DBF (never true, decrement, and branch) mnemonics are different forms for the same instruction. In each case, the assembler accepts both forms.

Mnemonics and Delimiters

The assembler recognizes all MC68040/MC68060 instruction mnemonics. Numbers are recognized as binary, octal, decimal, and hexadecimal, with hexadecimal the default case.

- *Decima*l is a string of decimal digits (0 through 9) preceded by an ampersand (&). For example:

  ```
  &12334
  -&987654321
  ```

- *Hexadecimal* is a string of hexadecimal digits (0 through 9, A through F) preceded by an optional dollar sign ($). For example:

  ```
  $AFE5
  ```


One or more ASCII characters enclosed by apostrophes (' ') constitute an ASCII string. ASCII strings are right-justified and zero-filled (if necessary), whether stored or used as immediate operands.

Example

```
00005000    21FC0000 12345668   MOVE.L   #$1234,($5678).W
00005008    0053                DC.W     'S'
0000500A    223C41424344        MOVE.L   #'ABCD',D1
00005010    3536                DC.W     '56'
```

The following register mnemonics are recognized/referenced by the assembler/ disassembler:

Pseudo-Registers

R0-R7	User Offset Registers

Main Processor Registers

PC	Program Counter. Used only in forcing program counter-relative addressing.
SR	Status Register
CCR	Condition Codes Register (Lower eight bits of SR)
USP	User Stack Pointer

MSP	Master Stack Pointer (MC68040 only)
ISP	Interrupt Stack Pointer (MC68040 only)
SSP	Supervisor Stack Pointer (MC68060 only)
VBR	Vector Base Register
SFC	Source Function Code Register
DFC	Destination Function Code Register
D0-D7	Data Registers
A0-A7	Address Registers. For the MC68040, Address Register A7 represents the active System Stack Pointer, that is, one of USP, MSP, or ISP, as specified by the M and S bits of the Status Register (SR). For the MC68060, Address Register A7 represents the active System Stack Pointer, that is, either USP or SSP, as specified by the S bit in the Status Register.

Floating Point Unit Registers

FPCR	Control Register
FPSR	Status Register
FPIAR	Instruction Address Register
FP0-FP7	Floating Point Data Registers

Instruction and Data Cache Registers

CACR	Cache Control Register

Memory Management Unit Registers

MMUSR	MMU Status Register (MC68040 only)
URP	User Root Pointer
SRP	Supervisor Root Pointer
TC	Translation Control Register
DTT0	Data Transparent Translation Register 0
DTT1	Data Transparent Translation Register 1
ITT0	Instruction Transparent Translation Register 0
ITT1	Instruction Transparent Translation Register 1
BUSCR	Bus Control Register (MC68060 only)

Character Set

The character set recognized by the 16XBug assembler is a subset of ASCII, and these are listed as follows:

- The letters A through Z (uppercase and lowercase)
- The integers 0 through 9
- Arithmetic operators: + - * / << >> ! & % ^
- Parentheses ( )
- Characters used as special prefixes:
  # (pound sign) specifies the immediate form of addressing.
  $ (dollar sign) specifies a hexadecimal number.
  & (ampersand) specifies a decimal number.
  @ (commercial at sign) specifies an octal number.
  % (percent sign) specifies a binary number.
  ' (apostrophe) specifies an ASCII literal character string.
- Five separating characters:
  Space
  , (comma)
  . (period)

/ (slash)
- (dash)

- The character * (asterisk) indicates the current location.

Addressing Modes

Effective address modes, combined with operation codes, define the particular function to be performed by a given instruction. Effective addressing and data organization are described in detail in the section on *Data Organization and Addressing Capabilities*, of the appropriate microprocessor user's manual. See the *Related Documentation* section in the Preface.

Table 4-1 summarizes the addressing modes of the MC68040 and MC68060 which are accepted by the 16XBug one-line assembler.

Table 1-1. 16XBug Assembler Addressing Modes

Format	Description
D*n*	Data register direct
A*n*	Address register direct
(A*n*)	Address register indirect
(A*n*)+	Address register indirect with post-increment
-(A*n*)	Address register indirect with pre-decrement
d(A*n*)	Address register indirect with displacement
d(A*n*,Xi)	Address register indirect with index, 8-bit displacement
(bd,A*n*,Xi)	Address register indirect with index, base displacement.
([bd,A*n*],Xi,od)	Address register memory indirect post-indexed
([bd,A*n*,Xi],od)	Address register memory indirect pre-indexed
address(PC)	Program counter indirect with displacement

Table 1-1. 16XBug Assembler Addressing Modes

Format	Description
address(PC,Xi)	Program counter indirect with index, 8-bit displacement
(*address*,PC,Xi)	Program counter indirect with index, base displacement
([*address*,PC],Xi,od)	Program counter memory indirect post-indexed
([*address*,PC,Xi],od)	Program counter memory indirect pre-indexed
(*xxxx*).W	Absolute word address
(*xxxx*).L	Absolute long address
#*xxxx*	Immediate data

You may use an expression in any numeric field of these addressing modes. The assembler has a built-in expression evaluator. It supports the following operand types:

Binary numbers	(%10)
Octal numbers	(@765..0)
Decimal numbers	(&987..0)
Hexadecimal numbers	($FED..0)
String literals	('CHAR')
Offset registers	(R0 - R7)
Program counter	(*)

Allowed operators are:

Addition	+	(plus)
Subtraction	-	(minus)
Multiply	*	(asterisk)
Divide	/	(slash)

Shift left	<<	(left angle brackets)
Shift right	>>	(right angle brackets)
Bitwise OR	!	(exclamation mark)
Bitwise AND	&	(ampersand)
Modulus	%	(percent)
Exponentiate	^	(circumflex)
One's Complement	~	(tilde)

The order of evaluation is strictly left to right with no precedence granted to some operators over others. The only exception to this is when you force the order of precedence through the use of parentheses.

Possible points of confusion:

- Keep in mind that where a number is intended and it could be confused with a register, it must be differentiated in some way.

```
CLR     D0      This means CLR.W register D0.
CLR     $D0
CLR     0D0     On the other hand, these all mean CLR.W
CLR     +D0     memory location $D0.
CLR     D0+0
```

- With the use of " * " to represent both multiply and program counter, how does the assembler know when to use which definition?

  For parsing algebraic expressions, the order of parsing is

  operand operator operand operator ...

  with a possible left or right parenthesis.

  Given the above order, the assembler can distinguish by placement which definition to use. For example:

```
***     Means PC  *  PC
*+*     Means PC  +  PC
```

2**	Means 2 * PC
*&&16	Means PC AND &16

When specifying operands, you may skip or omit entries with the following addressing modes.

- Address register indirect with index, base displacement.
- Address register memory indirect post-indexed.
- Address register memory indirect pre-indexed.
- Program counter indirect with index, base displacement.
- Program counter memory indirect post-indexed.
- Program counter memory indirect pre-indexed.

For modes address register/program counter indirect with index, base displacement, the rules for omission/skipping are as follows:

- You may terminate the operand at any time by specifying ")". For example:

  ```
  CLR     ( )
  ```

  or

  ```
  CLR     (,,)
  ```

  is equivalent to:

  ```
  CLR     (0.N,ZA0,ZD0.W*1)
  ```

- You may skip a field by " stepping past" it with a comma. For example:

  ```
  CLR      (D7)
  ```

  is equivalent to:

  ```
  CLR      ($D7,ZA0,ZD0.W*1)
  ```

  but

  ```
  CLR      (,,D7)
  ```

  is equivalent to:

  ```
  CLR      (0.N,ZA0,D7.W*1)
  ```

- If you do not specify the base register, the default " ZA0" is forced.
- If you do not specify the index register, the default " ZD0.W*1" is forced.
- Any unspecified displacements are defaulted to " 0.N".
- The rules for parsing the memory indirect addressing modes are the same as above with the following additions.
- The subfield that begins with "[" must be terminated with a matching "]".
- If the text given is insufficient to distinguish between the preindexed or postindexed addressing modes, the default is the preindexed form.

DC.W Define Constant Directive

The format for the DC.W directive is:

DC.W *operand*

The function of this directive is to define a constant in memory. The DC.W directive can have only one operand (16-bit value) which can contain the actual value (decimal, hexadecimal, or ASCII). Alternatively, the operand can be an expression which can be assigned a numeric value by the assembler. The constant is aligned on a word boundary as word **.w** is specified. An ASCII string is recognized when characters are enclosed inside single quotes (' '). Each character (seven bits) is assigned to a byte of memory, with the eighth bit (MSB) always equal to zero. If only one byte is entered, the byte is right justified. A maximum of two ASCII characters may be entered for each DC.W directive.

Examples are:

```
00010022    04D2    DC.W    &1234‘      Decimal number
00010024    AAFE    DC.W    AAFE        Hexadecimal number
00010026    4142    DC.W    'AB'        ASCII String
```

```
00010028     5443    DC.W    'TB'+1      Expression
0001002A     0043    DC.W    'C'         ASCII character is
                                         right justified
```

SYSCALL System Call Directive

The function of this directive is to aid you in making the TRAP #15 calls to 16XBug functions as defined in Chapter 5. The format for this directive is:

SYSCALL *function-name*

For example, the following two pieces of code produce identical results.

```
TRAP    #$F
DC.W    0
```

or

```
SYSCALL .INCHR
```

Refer to Chapter 5, *System Calls*, for a complete listing of all the functions provided.

Entering and Modifying Source Programs

User programs are entered into the memory using the one-line assembler/ disassembler. The program is entered in assembly language statements on a line-by-line basis. The source code is not saved as it is converted immediately to machine code upon entry. This imposes several restrictions on the type of source line that can be entered.

Symbols and labels, other than the defined instruction mnemonics, are not allowed. The assembler has no means to store the associated values of the symbols and labels in lookup tables. This forces the programmer to use memory addresses and to enter data directly rather than use labels.

Also, editing is accomplished by retyping the entire new source line. Lines can be added or deleted by moving a block of memory data to free up or delete the appropriate number of locations (refer to the Block Move (**BM**) command).

Invoking the Assembler/Disassembler

The assembler/disassembler is invoked using the **;DI** option of the Memory Modify (**MM**) and Memory Display (**MD**) commands:

MM *address* **;DI**

or

AS *address*

where <**CR**> sequences to next instruction
and .<**CR**> exits command

and

MD[**S**] *address*[:*count* | *address*]**;DI**

or

DS *address*[:*count* | *address*]

The **MM** (**;DI** option), or interchangeably the **AS** command, is used for program entry and modification. When this command is used, the memory contents at the specified location are disassembled and displayed. A new or modified line can be entered if desired. The disassembled line can be an MPU instruction, a SYSCALL, or a DC.W directive. If the disassembler recognizes a valid form of some instruction, the instruction will be returned; if not (random data occurs), the DC.W $XXXX (always hexadecimal) is returned. Because the disassembler gives precedence to instructions, a word of data that corresponds to a valid instruction will be returned as the instruction.

Entering a Source Line

A new source line is entered immediately following the disassembled line, using the format discussed in the section on *Source Line Format*.

```
167-Bug>MM 10000;DI
00010000  2600             MOVE.L  D0,D3 ? ADDQ.L  #1,A3
```

When the carriage return is entered terminating the line, the old source line is erased from the terminal screen, the new line is assembled and displayed, and the next instruction in memory is disassembled and displayed.

```
167Bug>MM 10000;DI
00010000  528B             ADDQ.L  #1,A3
00010002  4282             CLR.L   D2 ?(CR)
```

If a hardcopy terminal is being used, port 0 should be reconfigured for hardcopy mode for proper operation (refer to the **PF** command.) In this case, the above example would look as follows:

```
167Bug>MM 10000;DI
00010000  2600             MOVE.L  D0,D3 ? ADDQ.L #1,A3
00010000  528B             ADDQ.L  #1,A3
00010002  4282             CLR.L   D2 ? <CR>
```

Another program line can now be entered. Program entry continues in like manner until all lines have been entered. A period is used to exit the **MM** or **AS** command.

If an error is encountered during assembly of the new line, the assembler displays the line unassembled with a "^" under the field suspected of causing the error and an error message is displayed. The location being accessed is redisplayed.

```
167Bug>MM 10000;DI
00010000  528B           ADDQ.L  #1,A3 ? LEA.L 5(A0,D8),A4
00010000               LEA.L   5(A0,D8),A4
---------------------------------------^

*** Unknown Field ***
00010000  528B         ADDQ.L  #1,A3 ?(CR)
```

Entering Branch and Jump Addresses

When entering a source line containing a branch instruction (BRA, BGT, BEQ, etc) do not enter the offset to the branch destination in the operand field of the instruction. The offset is calculated by the assembler. You must append the appropriate size extension to the branch instruction.

To reference a current location in an operand expression, the character "*" (asterisk) can be used. Examples are:

```
00030000          60004094              BRA *+$4096
00030000          60FE                  BRA.B *
00030000          4EF90003 0000         JMP *
00030000          4EF00130 00030000     JMP (*,A0,D0)
```

In the case of forward branches or jumps, the absolute address of the destination may not be known as the program is being entered. You may temporarily enter an " * " for branch-to-self in order to reserve space. After the actual address is discovered, the line containing the branch instruction can be re-entered using the correct value.

Note Branch sizes must be entered as .b or .w as opposed to .s or .l.

Assembler Output/Program Listings

A listing of the program is obtained using the Memory Display (**MD**) command with the **;DI** option, or interchangeably the **DS** command. The **MD** command requires both the starting address and the line count to be entered in the command line. When the **;DI** option is invoked, the number of instructions disassembled and displayed is equal to the line count. The **DS** command will also operate with a starting address and an ending address.

To obtain a hardcopy listing of a program, use the Printer Attach (**PA**) command to activate the printer port. An **MD** to the terminal then causes a listing on the terminal and on the printer.

Note again, that the listing may not correspond exactly to the program as entered. As discussed in the section on the *Disassembled Source Line*, the disassembler displays in signed hexadecimal any number it interprets as an offset from a register; all other numbers are displayed in unsigned hexadecimal.

System Calls 2

Introduction

This chapter describes the 16XBug TRAP #15 handler, which allows system calls from user programs. The system calls can be used to access selected functional routines contained within 16XBug, including input and output routines. TRAP #15 may also be used to transfer control to 16XBug at the end of a user program (refer to the **.RETURN** function in this chapter).

In the descriptions of some input and output functions, reference is made to the "default input port" or the "default output port". After power-up or reset, the default input and output port is initialized to be port 0 (the MVME16X debug port). The defaults may be changed, however, using the **.REDIR_I** and **.REDIR_O** functions, as described in this chapter.

Invoking System Calls through TRAP #15

To invoke a system call from a user program, simply insert a TRAP #15 instruction into the source program. The code corresponding to the particular system routine is specified in the word following the TRAP opcode, as shown in the following example.

Format in your program:

`TRAP #15`	System call to 16XBug.
`DC.W $`*xxxx*	Routine being requested (*xxxx* = code).

In some of the examples shown in the following descriptions, a **SYSCALL** macro is used. This macro automatically assembles the TRAP #15 call followed by the Define Constant for the function code. For clarity, the **SYSCALL** macro is as follows:

```
SYSCALL     MACRO
TRAP        #15
DC.W        \1
ENDM
```

Using the **SYSCALL** macro, the system call would appear in your program as follows:

```
SYSCALL     routine name
```


It is, of course, necessary to create an equate file with the routine names equated to their respective codes.

When using the 16XBug one-line assembler/disassembler, the **SYSCALL** macro and the equates are predefined. Simply write in **SYSCALL** followed by a space and the function, then carriage return.

Example

```
167-Bug>M 03000;DI
00003000 00000000          ORI.B #$0,D0? SYSCALL .OUTLN
00003000 4E4F0022          SYSCALL .OUTLN
00003004 00000000          ORI.B #$0,D0? .
167Bug>
```

String Formats for I/O

Within the context of the TRAP #15 handler there are two formats for strings:

Pointer/Pointer Format	The string is defined by a pointer to the first character and a pointer to the last character + 1.
Pointer/Count Format	The string is defined by a pointer to a count byte, which contains the count of characters in the string, followed by the string itself.

A line is defined as a string followed by a carriage return and a line feed: **<CR><LF>**.

System Call Routines

On entry to Firmware System Call routines, the machine state is saved so that a subsequent ABORT or BREAK condition allows you to resume if you wish.

The TRAP #15 functions are summarized in Table 5-1. Refer to the write-ups on the utilities for specific use information.

Table 2-1. 16XBug System Call Routines

Code	Name	Description
$0000	.INCHR	Input character
$0001	.INSTAT	Input serial port status
$0002	.INLN	Input line (pointer/pointer format)
$0003	.READSTR	Input string (pointer/count format)
$0004	.READLN	Input line (pointer/count format)
$0005	.CHKBRK	Check for break
$0010	.DSKRD	Disk read
$0011	.DSKWR	Disk write
$0012	.DSKCFIG	Disk configure
$0014	.DSKFMT	Disk format
$0015	.DSKCTRL	Disk control
$0018	.NETRD	Read/get files from host
$0019	.NETWR	Write/send files to host
$001A	.NETCFIG	Configure network parameters
$001B	.NETFOPN	Open file for reading
$001C	.NETFRD	Retrieve specified file blocks
$001D	.NETCTRL	Implement special control characters
$0020	.OUTCHR	Output character
$0021	.OUTSTR	Output string (pointer/pointer format)

Table 2-1. 16XBug System Call Routines (Continued)

Code	Name	Description
$0022	.OUTLN	Output line (pointer/pointer format)
$0023	.WRITE	Output string (pointer/count format)
$0024	.WRITELN	Output line (pointer/count format)
$0025	.WRITDLN	Output line with data (pointer/count format)
$0026	.PCRLF	Output carriage return and line feed
$0027	.ERASLN	Erase line
$0028	.WRITD	Output string with data (pointer/count format)
$0029	.SNDBRK	Send break
$0043	.DELAY	Timer delay function
$0050	.RTC_TM	Time initialization for RTC
$0051	.RTC_DT	Date initialization for RTC
$0052	.RTC_DSP	Display RTC time and date
$0053	.RTC_RD	Read the RTC Registers
$0060	.REDIR	Redirect I/O of a TRAP #15 function
$0061	.REDIR_I	Redirect input
$0062	.REDIR_O	Redirect output
$0063	.RETURN	Return to 16XBug
$0064	.BINDEC	Convert binary to Binary Coded Decimal (BCD)
$0067	.CHANGEV	Parse value
$0068	.STRCMP	Compare two strings (pointer/count format)
$0069	.MULU32	Multiply two 32-bit unsigned integers
$006A	.DIVU32	Divide two 32-bit unsigned integers
$006B	.CHK_SUM	Generate checksum

Table 2-1. 16XBug System Call Routines (Continued)

Code	Name	Description
$0070	.BRD_ID	Return pointer to board ID packet
$0071	.ENVIRON	Read/write environment parameters
$0073	.PFLASH	Program FLASH memory
$0074	.DIAGFCN	Diagnostic function(s)
$0090	.SIOPEPS	Retrieve SCSI pointers
$0120	.IOINQ	Port Inquiry
$0124	.IOINFORM	Port Inform
$0128	.IOCONFIG	Port Configure
$012C	.IODELETE	Port Delete
$0130	.SYMBOLTA	Attach Symbol Table
$0131	.SYMBOLTD	Detach Symbol Table
$0140	.ACFSTAT	ACFAIL Status Inquiry

Note In most examples of commands and displays given in this manual, 167Bug is used. However, the commands, displays, and system calls apply to all 68K CISC debugging packages, unless otherwise noted.

.INCHR Function

Name

INCHR - Input character routine

Code

$0000

Description

.INCHR reads a character from the default input port. The character is returned in the stack.

Entry Conditions

SP ==>	Space for character.	*byte*
	Word fill.	*byte*

Exit Conditions Different from Entry

SP ==>	Character.	*byte*
	Word fill.	*byte*

Example

```
SUBQ.L    #2,A7       Allocate space for result.
SYSCALL   .INCHR      Call .INCHR.
MOVE.B    (A7)+,D0    Load character in D0.
```

.INSTAT Function

Name

.INSTAT - Input serial port status

Code

$0001

Description

.INSTAT is used to see if there are characters in the default input port buffer. The condition codes are set to indicate the result of the operation.

Entry Conditions

No arguments or stack allocation required.

Exit Conditions Different from Entry

Z(ero) = 1 if the receiver buffer is empty.

Example

```
LOOP    SYSCALL     .INSTAT         Any characters?
        BEQ.S       EMPTY           No, branch.
        SUBQ.L      #2,A7           Yes, then read them in buffer.
        SYSCALL     .INCHR
        MOVE.B      (A7)+,(A0)+
        BRA.S       LOOP            Check for more.
EMPTY
```

.INLN Function

Name

.INLN - Input line routine

Code

$0002

2

Description

.INLN is used to read a line from the default input port. The buffer size should be at least 256 bytes.

Entry Conditions

SP ==>	Address of string buffer.	*longword*

Exit Conditions Different from Entry

SP ==>	Address of last character in the string + 1.	*longword*

Example

If A0 contains the address where the string is to go;

```
SUBQ.L    #4,A7       Allocate space for result.
PEA       (A0)        Push pointer to destination
TRAP      #15         (May also invoke by SYSCALL
DC.W      2           macro SYSCALL .INLN.)
MOVE.L    (A7)+,A1    Retrieve address of last character
                       + 1.
```

Note A line is a string of characters terminated by <CR>. The maximum allowed size is 254 characters. The terminating <CR> is not considered part of the string, but it is returned in the buffer, that is, the returned pointer points to it. Control character processing as described in the section on *Terminal Input/Output Control* is in effect.

.READSTR Function

Name

.READSTR - Read string into variable-length buffer

Code

$0003

Description

READSTR is used to read a string of characters from the default input port into a buffer. On entry, the first byte in the buffer indicates the maximum number of characters that can be placed in the buffer. The buffer size should at least be equal to that number+2. The maximum number of characters that can be placed in a buffer is 254 characters. On exit, the count byte indicates the number of characters in the buffer. Input terminates when a **<CR>** is received. A null character appears in the buffer, although it is not included in the string count. All printable characters are echoed to the default output port. The **<CR>** is not echoed. Some control character processing is done:

^G	Bell	Echoed.
^X	Cancel line	Line is erased.
^H	Backspace	Last character is erased.
<DEL>	Same as backspace	Last character is erased.
<LF>	Line Feed	Echoed.
<CR>	Carriage Return	Terminates input.

All other control characters are ignored.

Entry Conditions

SP ==>	Address of input buffer.	*longword*

Exit Conditions Different from Entry

SP ==> Top of stack.

The count byte contains the number of bytes in the buffer.

Example

If A0 contains the string buffer address;

```
MOVE.B    #75,(A0)     Set maximum string size.
PEA       (A0)         Push buffer address.
TRAP      #15          (May also invoke by SYSCALL
DC.W      3            macro SYSCALL .READSTR.)
MOVE.B    (A0),D0      Read actual string size.
```

Note This routine allows the caller to dictate the maximum length of input to be less than 254 characters. If more characters are entered, then the buffer input is truncated. Control character processing as described in the section on *Terminal Input/Output Control* is in effect.

.READLN Function

Name

.READLN - Read line to fixed-length buffer

Code

$0004

Description

.READLN is used to read a string of characters from the default input port. Characters are echoed to the default output port. A string consists of a count byte followed by the characters read from the input. The count byte indicates the number of characters in the input string, excluding **<CR><LF>**. A string may be up to 254 characters.

Entry Conditions

SP ==>	Address of input buffer.	*longword*

Exit Conditions Different from Entry

SP ==> Top of stack.

The first byte in the buffer indicates the string length.

Example

If A0 points to a 256 byte buffer.

```
PEA       (A0)       Long buffer address and read a
SYSCALL   .READLN    line from default input port.
```

Note The caller must allocate 256 bytes for a buffer. Input may be up to 254 characters. <CR><LF> is sent to default output following echo of input. Control character processing as described in the section on *Terminal Input/Output Control* is in effect.

.CHKBRK Function

Name

.CHKBRK - Check for break

Code

$0005

Description

.CHKBRK returns "zero" status in the condition code register if break status is detected at the default input port.

Entry Conditions

No arguments or stack allocation required.

Exit Conditions Different from Entry

Z flag set in CCR if break status is detected.

Example

```
SYSCALL     .CHKBRK
BEQ         BREAK
```

.DSKRD, .DSKWR Functions

Name

.DSKRD - Disk read function
.DSKWR - Disk write function

Code

$0010
$0011

Description

These functions are used to read and write blocks of data from/to the specified disk or tape device. Information about the data transfer is passed in a command packet which has been built somewhere in memory. (Your program must first manually prepare the packet.) The address of the packet is passed as an argument to the function. The same command packet format is used for **.DSKRD** and **.DSKWR**. It is eight words in length and is arranged as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Memory Address	Most Significant Word
$06		Least Significant Word
$08	Block Number (Disk) or	Most Significant Word
$0A	File Number (Tape)	Least Significant Word
$0C	Number of Blocks	
$0E	Flag Byte	Address Modifier

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use.

Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix F for meanings of returned error codes.
Memory Address	Address of buffer in memory. On a disk read, data is written starting at this address. On a disk write, data is read starting at this address.
Block Number	For disk devices, this is the block number where the transfer starts. On a disk read, data is read starting at this block. On a disk write, data is written starting at this block.
File Number	For streaming tape devices, this is the file number where the transfer starts. This field is used if the IFN bit in the Flag Byte is cleared (refer to the Flag Byte description). On a disk read, data is read starting at this file. On a disk write, data is written starting at this file.
Number of Blocks	This field indicates the number of blocks to read from the disk (**.DSKRD**) or to write to the disk (**.DSKWR**). For streaming tape devices, the actual number of blocks transferred is returned in this field.
Flag Byte	The flag byte is used to specify variations of the same command, and to receive special status information. Bits 0 through 3 are used as command bits, and bits 4 through 7 are used as status bits. For disk devices, this field must be set to zero. For streaming tape devices, the following bits are defined: Bit 7 is the Filemark flag: 1 A filemark was detected at the end of the last operation. Bit 1 is the Ignore File Number (IFN) flag: 0 The file number field is used to position the tape before any reads or writes are done. 1 The file number field is ignored, and reads or writes start at the present tape position. Bit 0 is the End of File flag:

0 Reads or writes are done until the specified block count is exhausted.

1 Reads are done until the count is exhausted or until a filemark is found. Writes are terminated with a filemark.

Address Modifier — VMEbus address modifier to use while transferring data. If zero, a default value is selected by the bug. If nonzero, the specified value is used..

Entry Conditions

SP ==> Address of command packet. *longword*

Exit Conditions Different from Entry

SP ==> Top of stack.

Status word of command packet is updated.
Data is written into memory as a result of **.DSKRD** function.
Data is written to disk as a result of **.DSKWR** function.
Z(ero) = Set to 1 if no errors.

Example

If A0, A1 point to packets formatted as specified above.

```
        PEA         (A0)
        SYSCALL     .DSKRD      Read from disk.
        BNE         ERROR       Branch if error.
        PEA         (A1)
        SYSCALL     .DSKWR      Write to disk.
        BNE         ERROR       Branch if error.
        .
        .
        .
ERROR   xxxxx       xxx         Handle error.
        xxxxx       xxx
```

.DSKCFIG Function

Name

.DSKCFIG - Disk configure function

Code

$0012

2

Description

This function allows you to change the configuration of the specified device. It effectively performs an "**IOT** under program control". All the required parameters are passed in a command packet which has been built somewhere in memory. The address of the packet is passed as an argument to the function. This function is provided for use in special applications, because **.DSKCFIG** is invoked automatically the first time that a device is accessed by **.DSKRD**, **.DSKWR**, or **.DSKFMT**. The packet format is as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Memory Address	Most Significant Word
$06		Least Significant Word
$08	0	
$0A	0	
$0C	0	
$0E	Flag Byte	Address Modifier

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use.
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix F for meanings of returned error codes.

Memory Address	Contains a pointer to a Device Descriptor Packet that contains the configuration information to be changed.
Flag Byte	This field contains additional information. Bit 0 is used to allow reading/writing the configuration of the specified device. It is interpreted as follows: 0 You can change (write) the configuration. 1 You can view (read) the configuration.
Address Modifier	VMEbus address modifier to use while transferring data. If zero, a default value is selected by the bug. If nonzero, the specified value is used.

The Device Descriptor Packet format is as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	0	
$04	Parameters Mask	Upper (Most Significant) Word
$06		Lower (Least Significant) Word
$08	Attributes Mask	Upper (Most Significant) Word
$0A		Lower (Least Significant) Word
$0C	Attributes Flags	Upper (Most Significant) Word
$0E		Lower (Least Significant) Word
$10	Parameters	

Field descriptions:

Most of the fields in the Device Descriptor Packet are equivalent to the fields defined in the CFGA Configuration Area block, as described in Appendix D. In the field descriptions following,

reference is made to the equivalent field in the CFGA whenever possible. For additional information on these fields, refer to Appendix D.

Controller LUN	Same as in command packet.
Device LUN	Same as in command packet.
Parameters Mask	Equivalent to the IOSPRM and IOSEPRM fields, with the lower word equivalent to IOSPRM, and the upper word equivalent to IOSEPRM.
Attributes Mask	Equivalent to the IOSATM and IOSEATM fields, with the lower word equivalent to IOSATM, and the upper word equivalent to IOSEATM.
Attributes Flags	Equivalent to the IOSATW and IOSEATW fields, with the lower word equivalent to IOSATW, and the upper word equivalent to IOSEATW.
Parameters	The parameters used for device reconfiguration are specified in this area. Most parameters have an *exact* CFGA equivalent. The following list shows the field name, offset from start of packet, length, equivalent CFGA field, and short description of each field. Those parameters that do not have an exact equivalent are indicated with " * ", and are explained after the list.

Field Name	Offset (Bytes)	Length (Bytes)	CFGA Equivalent	Description
P_DDS*	$10	1	-	Device descriptor size
P_DSR	$11	1	IOSSR	Step rate
P_DSS*	$12	1	IOSPSM	Sector size (encoded)
P_DBS*	$13	1	IOSREC	Block size (encoded)
P_DST*	$14	2	IOSSPT	Sectors/track
P_DIF	$16	1	IOSILV	Interleave factor
P_DSO	$17	1	IOSSOF	Spiral offset

Field Name	Offset (Bytes)	Length (Bytes)	CFGA Equivalent	Description
P_DSH*	$18	1	IOSSHD	Starting head
P_DNH	$19	1	IOSHDS	Number of heads
P_DNCYL	$1A	2	IOSTRK	Number of cylinders
P_DPCYL	$1C	2	IOSPCOM	Precompensation cylinder
P_DRWCYL	$1E	2	IOSRWCC	Reduced write current cylinder
P_DECCB	$20	2	IOSECC	ECC data burst length
P_DGAP1	$22	1	IOSGPB1	Gap 1 size
P_DGAP2	$23	1	IOSGPB2	Gap 2 size
P_DGAP3	$24	1	IOSGPB3	Gap 3 size
P_DGAP4	$25	1	IOSGPB4	Gap 4 size
P_DSSC	$26	1	IOSSSC	Spare sectors count
P_DRUNIT	$27	1	IOSRUNIT	Reserved area units
P_DRCALT	$28	2	IOSRSVC1	Reserved count for alternates
P_DRCCTR	$2A	2	IOSRSVC2	Reserved count for controller

List notes:

P_DDS — This field is for internal use only, and does not have an equivalent CFGA field. It should be set to 0.

P_DSS — This is a one byte encoded field, whereas the IOSPSM field is a two byte unencoded field containing the actual number of bytes per sector. The P_DSS field is encoded as follows:

$00	128 bytes
$01	256 bytes
$02	512 bytes
$03	1024 bytes

P_DBS	This is a one byte encoded field, whereas the IOSREC field is a two byte unencoded field containing the actual number of bytes per record (block). The P_DBS field is encoded as follows
	$00 128 bytes
	$01 256 bytes
	$02 512 bytes
	$03 1024 bytes
	$04 - $FF Reserved encodings
P_DST	This is a two byte field, whereas the IOSSPT field is one byte.
P_DSH	This is a one byte field, whereas the IOSSHD field is two bytes. This field is equivalent to the *lower* byte of IOSSHD.

Entry Conditions

SP ==> Address of command packet. *longword*

Exit Conditions Different from Entry

SP ==> Top of stack.

Status word of command packet is updated.
The device configuration is changed.
Z(ero) = Set to 1 if no errors.

Example

If A0 points to packet formatted as specified above.:

```
        PEA.L     (A0)          Load command packet.
        SYSCALL   .DSKCFIG      Reconfigure device.
        BNE       ERROR         Branch if error.
        :
        .
ERROR   xxxxx     xxx           Handle error.
        xxxxx     xxx
```

.DSKFMT Function

Name

.DSKFMT - Disk format function

Code

$0014

Description

This function allows you to send a format command to the specified device. The parameters required for the command are passed in a command packet which has been built somewhere in memory. The address of the packet is passed as an argument to the function. The packet format is as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Half-Word	
$04	Memory Address	Most Significant Word
$06		Least Significant Word
$08	Disk Block Number	Most Significant Word
$0A		Least Significant Word
$0C	0	
$0E	Flag Byte	Address Modifier

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use.
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix F for meanings of returned error codes.

Memory Address — Address of buffer in memory. On a disk read, data is written starting at this address. On a disk write, data is read starting at this address.

Block Number — For disk devices, when doing a format track, the track that contains this block number is formatted. This field is ignored for streaming tape devices.

Flag Byte — Contains additional information.

Bit 0 is interpreted as follows for disk devices:

- 0 Indicates a "Format Track" operation. The track that contains the specified block is formatted.
- 1 Indicates a "Format Disk" operation. All the tracks on the disk are formatted.

Bit 0 is interpreted as follows for streaming tapes:

- 0 Rewinds the tape to BOT, advances the tape without interruptions to EOT, and then rewinds it back to BOT. Tape retension is recommended by cartridge tape suppliers before writing or reading data when a cartridge has been subjected to a change in environment or a physical shock, has been stored for a prolonged period of time or at extreme temperature, or has been previously used in a start/stop mode.
- 1 Selects an "Erase Tape" operation. This completely clears the tape of previous data and at the same time retensions the tape.

Bit 3 is interpreted as follows:

- 0 The grown defect list is used when formatting.

1 The grown defect list is ignored when formatting.

Note that the previous flag byte operations are still true; the operation settings are OR'd together.

Address Modifier — VMEbus address modifier to use while transferring data. If zero, a default value is selected by the bug. If nonzero, the specified value is used.

Entry Conditions

SP ==>	Address of command packet.	*longword*

Exit Conditions Different from Entry

SP ==>	Top of stack.

Status word of command packet is updated.

Example

If A0 points to packet formatted as specified above.

```
        PEA.L     (A0)        Load command packet.
        SYSCALL   .DSKFMT     Format device.
        BNE       ERROR       Branch if error.
        .
        .
        .
ERROR   xxxxx     xxx         Handle error.
        xxxxx     xxx
```

.DSKCTRL Function

Name

.DSKCTRL - Disk control function

Code

$0015

Description

This function is used to implement any special device control functions that cannot be accommodated easily with any of the other disk functions. At the present, the only defined function is SEND packet, which allows you to send a packet in the specified format of the controller. The required parameters are passed in a command packet which has been built somewhere in memory. The address of the packet is passed as an argument to the function. The packet format is as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Memory Address	Most Significant Word
$06		Least Significant Word
$08	0	
$0A	0	
$0C	0	
$0E	0	Address Modifier

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use.
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix F for meanings of returned error codes.

Memory Address — Contains a pointer to the controller packet to send. Note that the controller packet to send (as opposed to the command packet) is controller and device dependent. Information about this packet should be found in the user's manual for the controller and device being accessed.

Address Modifier — VMEbus address modifier to use while transferring data. If zero, a default value is selected by the bug. If nonzero, the specified value is used.

Entry Conditions

SP ==>	Address of command packet.	*longword*

Exit Conditions Different from Entry

SP ==> Top of stack.

Status word of command packet is updated.
Additional side effects depend on the packet sent to the controller.
Z(ero) = Set to 1 if no errors.

Example

If A1 points to a packet formatted as specified above;

```
        PEA.L     (A1)          Load command packet.
        SYSCALL   .DSKCTRL      Invoke control function.
        BNE       ERROR         Branch if error.
        .
        .
        .
ERROR   XXXXX     XXX           Handle error.
        XXXXX     XXX
```

.NETRD, .NETWR Functions

Name

.NETRD - Read/get from host
.NETWR - Write/send to host

Code

$0018/$0019

Description

These functions are used to get/send files from/to the destination host over the specified network interface. Information about the file transfer is passed in a command packet which has been built in memory. (The user program must first manually prepare the packet.) The address of the packet is passed as an argument to the function. These functions basically behave the same as the **NIOP** command, but under program control. All packets must be longword aligned. The packet structure, NIOPCALL, is listed in the "C" header file in Appendix I. Its format is shown below:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Data Transfer Address	Most Significant Word
$06		Least Significant Word
$08	Maximum Length of Transfer	Most Significant Word
$0A		Least Significant Word
$0C	Byte Offset	Most Significant Word
$0E		Least Significant Word
$10	Transfer Time in Seconds (Status)	Most Significant Word
$12		Least Significant Word
$14	Transfer Byte Count (Status)	Most Significant Word
$16		Least Significant Word
$18	Boot Filename String	$40(&64) Bytes
$56		

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use.
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Data Transfer Address	Address of buffer in memory. On a NET read, data is read to (received to) starting at this address. On a NET write, data is written (sent) starting at this address.
Length of Transfer	The length specifies the number of bytes from the "data transfer address" to transfer. A length of 0 specifies to transfer the entire file on a read. On a write the length must be set to the number of bytes to transfer.
Byte Offset	The offset field specifies the offset into the file on a read. This permits users to wind into a file.
Transfer Time	This field is status only and will be updated only on a successful data transfer. The transfer time will be in the number of seconds that elapsed for the period of the data transfer.
Transfer Byte Count	This field is status only and will be updated only on a successful data transfer. If the length field above is set to a non-zero value on a read and the desired file is smaller than the desired length, the length will be written to the actual number of bytes transferred, up to the desired length.

Boot Filename String	This field is the string of the name of the file to load/store. On a write the file must exist on the host system and also be writable (write permission). The filename string must be null terminated. The maximum length of the string is 64 bytes inclusive of the null terminator.

Example

See Appendix I.

.NETCFIG Function

Name

.NETCFIG - Configure network parameters

Code

$001A

Description

This function allows you to change the configuration parameters of the specified network interface. .NETCFIG effectively performs a NIOT command under program control. All the required parameters are passed in a command packet which has been built in memory.

The address of the packet is passed as an argument to the function. This packet contains the memory address (pointer) of the configuration parameters to/with you wish to update/change. The packet also contains a control flag field; this control flag specifies the configuration operation: read, write, or write to NVRAM. All packets must be longword aligned. The packet structure, NIOTCALL, is listed in the "C" header file in Appendix I. Its format is shown below:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Network Configuration Parameters Pointer	Most Significant Word
$06		Least Significant Word
$08	Device Configuration Parameters Pointer	Most Significant Word
$0A		Least Significant Word
$0C	Control Flag	Most Significant Word
$0E		Least Significant Word

Field descriptions:

Controller LUN	Logical Unit Number of controller to use.
Device LUN	Logical Unit Number of device to use.
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Network Configuration Parameters Pointer	This pointer (address) specifies the location in memory of the network configuration parameters.
Device Configuration Parameters Pointer	This pointer (address) specifies the location in memory of the device configuration parameters. To date no device configuration parameters are used or needed.
Control Flag	This field specifies the configuration parameters operation: read, write, or write to NVRAM. The control flag bit definitions are as follows: 0 Read configuration parameters. Pointer specifies destination. 1 Write (update) configuration parameters. Pointer specifies source. 2 Write (update) configuration parameters in NVRAM. Pointer specifies source.

The Network Configuration Parameters structure has the following format:

	F E D C B A 9 8 7 6 5 4 3 2 1 0	
$00	Packet Version/Identifier	Most Significant Word
$02		Least Significant Word
$04	Node Control Memory Address	Most Significant Word
$06		Least Significant Word
$08	Boot File Load Address	Most Significant Word
$0A		Least Significant Word
$0C	Boot File Execution Address	Most Significant Word
$0E		Least Significant Word
$10	Boot File Execution Delay	Most Significant Word
$12		Least Significant Word
$14	Boot File Length	Most Significant Word
$16		Least Significant Word
$18	Boot File Byte Offset	Most Significant Word
$1A		Least Significant Word
$1C	Trace Buffer Address (TXD/RXD)	Most Significant Word
$1E		Least Significant Word
$20	Client IP Address	Most Significant Word
$22		Least Significant Word
$24	Server IP Address	Most Significant Word
$26		Least Significant Word
$28	Subnet IP Address Mask	Most Significant Word
$2A		Least Significant Word
$2C	Broadcast IP Address Mask	Most Significant Word
$2E		Least Significant Word
$30	Gateway IP Address	Most Significant Word
$32		Least Significant Word
$34	BOOTP/RARP Retry	TFTP/ARP Retry
$36	BOOTP/RARP Control	Update Control
$38	Boot Filename String	$40(&64) Bytes
$76		
$78	Argument Filename String	$40(&64) Bytes
$B6		

Field descriptions:

Node Control Memory Address	This parameter specifies the starting address of the necessary memory needed for the transmit and receive buffers. Currently 65,536 bytes are needed for the specified Ethernet driver (transmit/receive buffers).
Client IP Address	The parameter specifies the IP address of the client. The firmware is considered to be the client.
Server IP Address	The parameter specifies the IP address of the server. The firmware is considered to be the server.
Subnet IP Address Mask	The parameter specifies the subnet IP address mask. This mask is used to determine if the server and client are resident on the same network. If they are not, the gateway IP address is used as the intermediate target (server).
Broadcast IP Address	This parameter specifies the broadcast IP address that the firmware utilizes when an IP broadcast needs to be performed.
Gateway IP Address	This parameter specifies the gateway IP address. The gateway address would be necessary if the server and the client do not reside on the same network. The gateway IP address would be used as the intermediate target (server).
Boot File Name	This parameter specifies the name of the boot file to load. Once the file is loaded, control is passed to the loaded file (program). To specify a null filename, the string 'NULL' must be used. This resets the filename buffer to a null character string.
Argument File Name	This parameter specifies the name of the argument file. This file may be used by the booted file (program) for an additional file load. To specify a null filename, the string 'NULL' must be used. This resets the filename buffer to a null character string.

Boot File Load Address	This parameter specifies the load address of the boot file.
Boot File Execution Address	This parameter specifies the execution address of the boot file.
Boot File Execution Delay	This parameter specifies a delay value in seconds before control is passed to the loaded file (program).
Boot File Length/Offset	These parameters behave the same as the "Length" and "Offset" parameters associated with the **NIOP** command.
BOOTP/RARP Request Retry	This parameter specifies the number of the number of retries that should be attempted prior to giving up. A retry value of zero specifies always to retry (not give up).
TFTP/ARP Request Retry	This parameter specifies the number of the number of retries that should be attempted prior to giving up. A retry value of zero specifies always to retry (not give up).
Trace Character Buffer Address	This parameter specifies the starting address of memory in which to place the trace characters. The receive/transmit packet tracing is disabled by default (value of 0). Any non-zero value enables tracing. Tracing would only be used in a debug environment and normally should be disabled. Care should be exercised when enabling this feature; you should ensure adequate memory exists. The following characters are defined for tracing: ? Unknown & Unsupported Ethernet type * Unsupported IP type % Unsupported UDP type $ Unsupported BOOTP type [BOOTP request] BOOTP reply + Unsupported ARP type (ARP request

	) ARP reply - Unsupported RARP type { RARP request } RARP reply ^ Unsuppported TFTPtype \ TFTP read request / TFTP write request < TFTP acknowledgment > TFTP data | TFTP error , Unsupported ICMP type : ICMP echo request ; ICMP echo reply
BOOTP/RARP Request Control	This parameter specifies the BOOT/RARP request control during the boot process. Control can be set either to always (A) or to when needed (W). When control is set to "always", the BOOTP/RARP request is always sent, and the accompanying reply always expected. When control is set to "when needed", the BOOTP/RARP request is sent if needed (i.e., IP addresses of 0, null boot file name).
BOOTP/RARP Replay Update Control	This parameter specifies the updating of the configuration parameters following a BOOTP/RARP reply. Receipt of a BOOTP/RARP reply would only be in lieu of a request being sent.

Example

See Appendix I.

.NETFOPN Function

Name

.NETFOPN - Open file for reading

Code

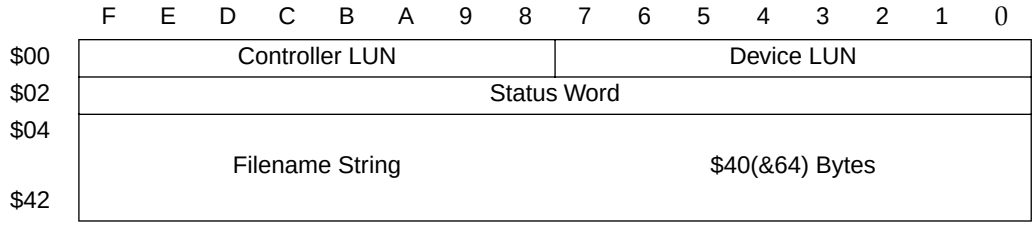
$001B

Description

These function allows the user to open a file for reading. The firmware basically transmits a TFTP Read Request for the specified file and returns to the user. It is your responsibility to retrieve the forthcoming file blocks; youwould use the .NETFRD system call to do this. You must also perform the file block retrievals in a timely fashion, else the TFTP server will time-out.

Information about the file open/request is passed in a command packet which has been built in memory. (The user program must first manually prepare the packet.) The address of the packet is passed as an argument to the function. All packets must be longword aligned.

The packet structure, NFILEOPEN, is listed in the "C" header file in Appendix I. Its format is shown below:



Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use.

Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Filename String	This field is the string of the name of the file to load. The filename string must be null terminated. The maximum length of the string is 64 bytes, inclusive of the null terminator.

Example

See Appendix I.

.NETFRD Function

Name

.NETFRD - Retrieve specified file blocks

Code

$001C

Description

This function allows you to retrieve the specified file blocks. You would use this function multiple times to retrieve the entire file. Prior to using this function a .NETFOPN system call must have been performed. For each file block retrieved the firmware will transmit a TFTP ACK packet to acknowledge the receipt of data. The end of data will be signified when the number o f bytes transferred is smaller than the block size. The block size is set at 512 bytes (TFTP convention). For each .NETFRD system call performed, you must update (increment by one) the block number field of the command packet. Initially the block number is one.

Information about the file block is passed in a command packet which has been built in memory. (The user program must first manually prepare the packet.) The address of the packet is passed as an argument to the function. All packets must be longword aligned. The packet structure, NFILEREAD, is listed in the "C" header file in Appendix I. Its format is shown below:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Data Transfer Address	Most Significant Word
$06		Least Significant Word
$08	Transfer Byte Count	
$0A	Block Number	
$0C	Data Packet (File Block) Timeout	Most Significant Word
$0E		Least Significant Word

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use.
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Data Transfer Address	Address of buffer in memory to which to transfer the file block.
Transfer Byte Count	This field is status only and will be updated only on a successful data transfer. The size of each file block is 512 bytes unless it is the last block of the file (0 to 511 bytes).
Block Count	This parameter specifies the next expected block number to be received.
Data Packet Timeout	This parameter specifies the number of seconds to wait before giving up control to the caller.

Example

See Appendix I.

.NETCTRL Function

Name

.NETCTRL - Implement special control functions

Code

$001D

Description

This function is used to implement any special control functions that cannot be accommodated easily with any of the other network functions. At the present, the only defined packet is SEND packet, which allows you to send a packet in the specified format to the specified network interface driver. The required parameters are passed in a command packet which has been built somewhere in memory.

The address of the packet is passed as an argument to the function. This function effectively performs an **NIOC** command, but under program control. All packets must be longword aligned. The packet structure, NIOCCALL, is listed in the "C" header file in Appendix I. Its format is shown below:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Command Identifier	Most Significant Word
$06		Least Significant Word
$08	Memory Address (Data Transfers)	Most Significant Word
$0A		Least Significant Word
$0C	Number of Bytes (Data Transfers)	Most Significant Word
$0E		Least Significant Word
$10	Status/Control Flags	Most Significant Word
$12		Least Significant Word

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use.
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Command Identifier	This parameter specifies the command operation type. The command types (identifiers) are as follows: 0 Initialize device/channel/node 1 Get hardware (e.g., Ethernet) address (network node) 2 Transmit (put) data packet 3 Receive (get) data packet 4 Flush receiver and receive buffers 5 Reset device/channel/node Rules on commands: The initialization (type 0) of the device/channel/node must always be performed first. If you have booted or initiated some other network I/O command, the initialization would already have been done. The flush receiver and receive buffer (type 4) would be used if, for example, the current receive data is not longer needed, or to provide a known buffer state prior to initiating data transfers.

	The reset device/channel/node (type 5) would be used if another operating system (node driver) needs to be in control of the device/channel/node. Basically, put the device/channel/node to a known state.
Memory Address	This parameter specifies the memory address in which the data transfer operation (types 1, 2, and 3) would take place from/to.
Number of Bytes	This parameter specifies the number of bytes of the data transfer.
Status/Control Flags	This parameter specifies control and status flags as needed by the operation types. Bit #16 -- Receive data transferred to user's memory.

Example

See Appendix I.

.OUTCHR Function

Name

.OUTCHR - Output character routine

Code

$0020

Description

This function outputs a character to the default output port.

Entry Conditions

SP ==>	Character.	*byte*
	Word fill (placed automatically by MPU).	*byte*

Exit Conditions Different from Entry

SP ==> Top of stack.

Character is sent to the default I/O port.

Example

```
MOVE.B   D0,-(A7)      Send character in D0
SYSCALL  .OUTCHR       to default output port.
```

.OUTSTR, .OUTLN Functions

Name

.OUTSTR - Output string to default output port
.OUTLN - Output string along with **<CR><LF>**

Codes

$0021
$0022

Description

.OUTSTR outputs a string of characters to the default output port. .OUTLN outputs a string of characters followed by a **<CR><LF>** sequence.

Entry Conditions

SP ==>	Address of first character +4.	*longword*
	Address of last character + 1.	*longword*

Exit Conditions Different from Entry

SP ==>	Top of stack.

Example

If A0 = start of string
If A1 = end of string+1

```
MOVEM.L   A0/A1,-(A7)      Load pointers to string
SYSCALL   .OUTSTR          and print it.
```

.WRITE, .WRITELN Functions

Name

.WRITE - Output string with no **<CR>** or **<LF>**
.WRITELN - Output string with **<CR>** and **<LF>**

Code

$0023
$0024

Description

These output functions are designed to output strings formatted with a count byte followed by the characters of the string. The user passes the starting address of the string. The output goes to the default output port.

Entry Conditions

Four bytes of parameter positioned in stack as follows:

SP ==> Address of string. *longword*

Exit Conditions Different from Entry

SP ==> Top of stack.

Parameter stack will have been deallocated.

Example

The following section of code ...

```
MESSAGE1  DC.B    9,'MOTOROLA'
MESSAGE2  DC.B    9,'QUALITY!'
          .
          .
          .
          PEA     MESSAGE1(PC)   Push address of string.
```

```
SYSCALL  .WRITE          Use TRAP #15 macro.
PEA      MESSAGE2(PC)    Push address of other string.
SYSCALL  .WRITE          Invoke function again.
```

... would print out the following message:

```
MOTOROLA QUALITY!
```

Using function **.WRITELN**, however, instead of function **.WRITE** would output the following message:

```
MOTOROLA
QUALITY!
```

Note The string must be formatted such that the first byte (the byte pointed to by the passed address) contains the count (in bytes) of the string. There is no special character at the end of the string as a delimiter.

.PCRLF Function

Name

.PCRLF - Print **<CR><LF>** sequence

Code

$0026

Description

.PCRLF sends a **<CR><LF>** sequence to the default output port.

Entry Conditions

No arguments or stack allocation required.

Exit Conditions Different from Entry

None.

Example

```
SYSCALL     .PCRLF   output <CR><LF>
```

.ERASLN Function

Name

.ERASLN - Erase Line

Code

$0027

Description

.ERASLN is used to erase the line at the present cursor position. If the terminal type flag is set for hardcopy mode, a **<CR><LF>** is issued instead.

Entry Conditions

No arguments required.

Exit Conditions Different from Entry

The cursor is positioned at the beginning of a blank line.

Example

```
SYSCALL     .ERASLN>
```

.WRITD, .WRITDLN Functions

Name

.WRITD - Output string with data
.WRITDLN - Output string with data and <CR><LF>

Code

$0028
$0025

Description

These trap functions take advantage of the monitor I/O routine which outputs a user string containing embedded variable fields. You pass the starting address of the string and the address of a data stack containing the data which is inserted into the string. The output goes to the default output port.

Entry Conditions

Eight bytes of parameter positioned in stack as follows:

SP ==>	Address of string.	*longword*
	Data list pointer.	*longword*

A separate data stack or data list arranged as follows:

Data list pointer =>	Data for first variable in string.	*longword*
	Data for next variable.	*longword*
	Data for next variable.	*longword*
	Etc.	

Exit Conditions Different from Entry

SP ==>	Top of stack.

Parameter stack space will have been deallocated.

Example

The following section of code ...

```
ERRMESSG  DC.B     $14,'ERROR CODE = |10,8Z|'
          :
          .
          MOVE.L   #3,-(A5)        Push error code on data stack.
          PEA      (A5)            Push data stack location.
          PEA      ERRMESSG(PC)    Push address of string.
          SYSCALL  .WRITDLN        Invoke function.
          TST.L    (A5)+           Deallocate data from data stack.
```

... would print out the following message:

```
ERROR CODE = 3
```

Notes 1. The string must be formatted such that the first byte (the byte pointed to by the passed address) contains the count (in bytes) of the string (including the data field specifiers, described in Note 2. following).

2. Any data fields within the string must be represented as follows: "|*radix*,*fieldwidth*[Z]|" where *radix* is the base that the data is to be displayed in (in hexadecimal, for example, "A" is base 10, "10" is base 16, etc.) and *fieldwidth* is the number of characters this data is to occupy in the output. The data is right justified, and left-most characters are removed to make the data fit.

The "Z" is included if you want to suppress leading zeros in output. The vertical bars "|" are required characters.

3. All data is to be placed in the stack as 32-bit longwords. Each time a data field is encountered in the user string, a longword is read from the stack to be displayed.

4. The data stack is not destroyed by this routine. If it is necessary that the space in the data stack be deallocated, then this must be done by the calling routine, as shown in the preceding example.

.SNDBRK Function

Name

.SNDBRK - Send break

Code

$0029

Description

.SNDBRK is used to send a break to the default output port(s).

Entry Conditions

No arguments or stack allocation required.

Exit Conditions Different from Entry

Each serial port specified by current default output port list has sent "break".

Example

```
SYSCALL     .SNDBRK>
```

.DELAY Function

Name

.DELAY - Timer delay function

Code

$0043

Description

This function is used to generate accurate timing delays that are independent of the processor frequency and instruction execution rate. This function uses the onboard timer for operation. You specify the desired delay count in milliseconds. .DELAY returns to the caller after the specified delay count is exhausted.

Entry Conditions

SP ==>	Delay time in milliseconds.	*longword*

Exit Conditions Different from Entry

SP ==>	Top of stack.

Example

```
PEA.L     &15000          Load a 15 second delay.
SYSCALL   .DELAY
.
.
.
PEA.L     &50             Load a 50 millisecond delay.
SYSCALL   .DELAY
```

.RTC_TM Function

Name

.RTC_TM - Time initialization for RTC

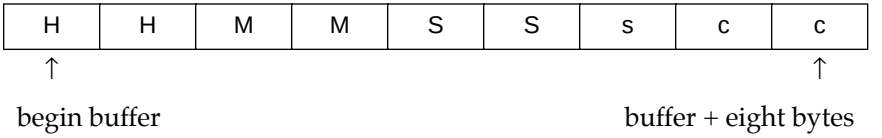
Code

$0050

Description

.RTC_TM initializes the MK48Txx Real-Time Clock with the time that is located in a user-specified buffer.

The data input format can be either ASCII or unpacked BCD. The order of the data in the buffer is:



HH	Hours
MM	Minutes
SS	Seconds
s	Sign of calibration factor (+ or -)
cc	Value of calibration factor

Entry Conditions

SP ==>	Time initialization buffer.	*address*

Exit Conditions Different from Entry

SP ==> Top of stack.

Parameter is deallocated from stack.

Example

Time is to be initialized to 2:05:32 PM with a calibration factor of -15 (s=sign, cc=value).

```
Data in BUFFER is 3134 3035 3332 2D 3135 or
         x1x4 x0x5 x3x2 2D x1x5.  (x = don't care)

PEA.L     BUFFER(PC)          Put buffer address on stack.
SYSCALL   .RTC_TM             Initialize time and start clock.
```

.RTC_DT Function

Name

.RTC_DT - Date initialization

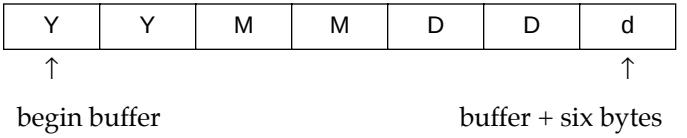
Code

$0051

Description

.RTC_DT initializes the MK48Txx Real-Time Clock with the date that is located in a user-specified buffer.

The data input format can be either ASCII or unpacked BCD. The order of the data in the buffer is:



YY	Year
MM	Month
DD	Day of month
d	Day of week (1 = Sunday)

Entry Conditions

SP ==>	Date initialization buffer.	*address*

Exit Conditions Different from Entry

SP ==> Top of stack.

Parameter is deallocated from stack.

Example

Date is to be initialized to Monday, Nov. 18, 1988 (d = day of week):

```
Data in BUFFER is 3838 3131 3138 32 or
          x8x8 x1x1 x1x8 x2. (x = don't care)

PEA.L     BUFFER(PC)        Put buffer address on stack.
SYSCALL   .RTC_DT           Initialize date and start clock.
```

.RTC_DSP Function

Name

.RTC_DSP - Display time from RTC

Code

$0052

Description

.RTC_DSP displays the date and time on the console from the current cursor position. The format is as follows:

DAY MONTH DD, YYYY hh:mm:ss.s

Entry Conditions

No arguments or stack allocation required.

Exit Conditions Different from Entry

The cursor is left at the end of the string.

Example

```
SYSCALL   .RTC_DSP        Displays the day, date, and time
                          on the screen.
```

.RTC_RD Function

Name

.RTC_RD - Read the RTC registers

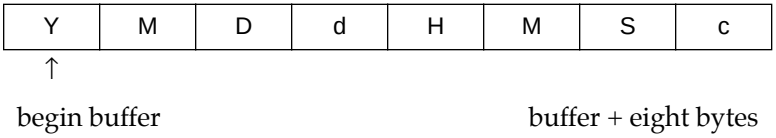
Code

$0053

Description

.RTC_RD is used to read the Real-Time Clock registers. The data returned is in packed BCD.

The order of the data in the buffer is:



Y	Year (2 nibbles packed BCD)
M	Month (2 nibbles packed BCD)
D	Day of month (2 nibbles packed BCD)
d	Day of week (2 nibbles packed BCD)
H	Hour of 24 hr clock (2 nibbles packed BCD)
M	Minute (2 nibbles packed BCD)
S	Seconds (2 nibbles packed BCD)
c	Calibration factor (MS nibble = 0 negative, 1 positive), (LS nibble = value)

Entry Conditions

SP ==>	Buffer address where RTC data is to be returned. *longword*

Exit Conditions Different from Entry

SP ==>	Top of stack.

Buffer now contains date and time in BCD format.

Example

A date and time of Saturday, May 11, 1988 2:05:32 PM are to be returned in the buffer (d = day of week, c = calibration value)

Data in buffer is 88 05 11 07 14 05 32 xx (xx = unknown)

```
PEA.L     BUFFER(PC       Put buffer address on stack.
SYSCALL   .RTC_RD         Read timer.
```

.REDIR Function

Name

.REDIR - Redirect I/O function

Code

$0060

Description

.REDIR is used to select an I/O port and at the same time invoke a particular I/O function. The invoked I/O function reads or writes to the selected port.

Entry Conditions

SP ==>	Port.	*word*
	I/O function to call.	*word*
	Parameters of I/O function.	*size specified by function (if needed)*
	Space for results.	*size specified by function (if needed)*

Exit Conditions Different from Entry

SP ==>	Result.	*size specified by function (if needed)*

To use **.REDIR**, you should:

1. Allocate space on the stack for the I/O function results (only if required).
2. Push the parameters required for the I/O function on the stack (only if required).
3. Push code for the desired I/O function on the stack.
4. Push the desired port number on the stack.

5. Call the **.REDIR** function.
6. Pop the results off the stack (only if required).

Example

Read a character from port 1 using .REDIR

```
CLR.B     -(A7)          Allocate space for results.
MOVE.W    #$0000,-(A7)   Load code for function .INCHR.
MOVE.W    #1,-(A7)       Load port number.
SYSCALL   .REDIR         Call redirect I/O function.
MOVE.B    (A7)+,D0       Read character.
```

Example

Write a character to port 0 using .REDIR

```
MOVE.B    #`A',-(A7)     Push character to write.
MOVE.W    #$0020,-(A7)   Load code for function
                         .OUTCHR.
MOVE.W    #0,-(A7)       Load port number.
SYSCALL   .REDIR         Call redirect I/O function.
```

.REDIR_I, .REDIR_O Functions

Name

.REDIR_I - Redirect input
.REDIR_O - Redirect output

Codes

$0061
$0062

Description

The .REDIR_I and .REDIR_O functions are used to change the default port number of the input and output ports, respectively. This is a permanent change, that is, it remains in effect until a new .REDIR command is issued.

Entry Conditions

SP ==>	Port number.	*word*

Exit Conditions Different from Entry

SP ==>	Top of stack.
.SIO_IN	Loaded with a new mask if .REDIR_I called.
.SIO_OUT	Loaded with a new mask if .REFIR_O called.

Example

```
MOVE.W   #1,-(A7)      Load port number.
SYSCALL  .REDIR_I      Set it as new default (all inputs
                       will now come from this port,
                       output port remains unaffected).
```

.RETURN Function

Name

.RETURN - Return to 16XBug

Code

$0063

Description

.RETURN is used to return control to 16XBug from the target program in an orderly manner. First, any breakpoints inserted in the target code are removed. Then, the target state is saved in the register image area. Finally, the routine returns to 16XBug.

Entry Conditions

No arguments required.

Exit Conditions Different from Entry

Control is returned to 16XBug.

Example

```
SYSCALL   .RETURN          Return to 16XBug .
```

Note .RETURN must be used only by code that was started using 16XBug.

.BINDEC Function

Name

.BINDEC - Used to calculate the Binary Coded Decimal (BCD) equivalent of the binary number specified

Code

$0064

Description

.BINDEC takes a 32-bit unsigned binary number and changes it to an equivalent BCD number.

Entry Conditions

SP ==>	Argument: Hexadecimal number.	*longword*
	Space for result 2.	*longword*

Exit Conditions Different from Entry

SP ==>	Decimal number.	
	(two most significant DIGITS)	*longword*
	(eight least significant DIGITS)	*longword*

Example

```
SUBQ.L    #8,A7          Allocate space for result.
MOVE.L    D0,-(A7)       Load hex number.
SYSCALL   .BINDEC        Call .BINDEC.
MOVE.L    (A7)+,D1/D2    Load resul.
```

.CHANGEV Function

Name

.CHANGEV - Parse value, assign to variable

Code

$0067

Description

Attempt to parse value in user-specified buffer. If user's buffer is empty, prompt user for new value, otherwise update integer offset into buffer to skip "value". Display new value and assign to variable unless user's input is an empty string.

Entry Conditions

SP ==>	Address of 32-bit offset into your buffer.
	Address of your buffer (pointer/count format string).
	Address of 32-bit integer variable to "change".
	Address of string to use in prompting and displaying value.

Exit Conditions Different from Entry

SP ==>	Top of stack.

Example

```
PROMPTDC.B    14,'COUNT = |10,8|'
GETCOUNTPEA   PROMPT(PC)      Point to prompt string.
      PEA     COUNT           Point to variable to change.
      PEA     BUFFER          Point to buffer.
      PEA     POINT           Point to offset into buffer.
      SYSCALL .CHANGEV        Make the system call.
      RTS                     COUNT changed, return.
```

If the above code was called with BUFFER containing "1 3" in pointer/count format and POINT containing 2 (longword), COUNT would be assigned the value 3, and POINT would contain 4 (pointing to first character past "3"). Note that POINT is the offset from the start address of the buffer (not the address of the first character in the buffer!) to the next character to process. In this case, a value of 2 in POINT indicates that the space between "1" and "3" is the next character to be processed. After calling **.CHANGEV**, the screen displays the following line:


```
COUNT = 3
```

If the above code was called again, nothing could be parsed from BUFFER, so a prompt would be issued. For purpose of example, the string "5" is entered in response to the prompt.

```
COUNT = 3? 5 (CR)
COUNT = 5
```

If in the previous example nothing had been entered at the prompt, COUNT would retain its prior value.

```
COUNT = 3? (CR)
COUNT = 3
```

.STRCMP Function

Name

.STRCMP - Compare two strings (pointer/count)

Code

$0068

Description

Comparison for equality is made and a Boolean flag is returned to caller. The flag is $00 if the strings are not identical; otherwise it is $FF.

Entry Conditions

SP ==>	Address of string 1.
	Address of string 2.
	Three bytes (unused).
	Byte to receive string comparison result.

Exit Conditions Different from Entry

SP ==>	Three bytes (unused).
	Byte to receive string comparison result.

Example

If A1 and A2 contain addresses of the two strings;

```
SUBQ.L    #4,A7       Allocate longword to receive result.
PEA       (A1)        Push address of one string.
PEA       (A2)        Push address of the other string.
SYSCALL   .STRCMP     Compare the strings.
MOVE.L    (A7)+,D0    Pop boolean flag into data register.
TST.B     D0          Check boolean flag.
BNE       ARE_SAME    Branch if strings are identical.
```

.MULU32 Function

Name

.MULU32 - Unsigned 32-bit x 32-bit multiply

Code

$0069

Description

Two 32-bit unsigned integers are multiplied and the product is returned as a 32-bit unsigned integer. No overflow checking is performed.

Entry Conditions

SP ==>	32-bit multiplier.
	32-bit multiplicand.
	32-bit space for result.

Exit Conditions Different from Entry

SP ==>	32-bit product (result from multiplication).

Example

Multiply D0 by D1; load result into D2.

```
SUBQ.L   #4,A7          Allocate space for result.
MOVE.L   D0,-(A7)       Push multiplicand.
MOVE.L   D1,-(A7)       Push multiplier.
SYSCALL  .MULU32        Multiply D0 by D1.
MOVE.L   (A7)+,D2       Get product.
```

.DIVU32 Function

Name

.DIVU32 - Unsigned 32-bit x 32-bit divide

Code

$006A

Description

Unsigned division is performed on two 32-bit integers and the quotient is returned as a 32-bit unsigned integer. The case of division by zero is handled by returning the maximum unsigned value $FFFFFFFF.

Entry Conditions

SP ==>	32-bit divisor (value to divide by).
	32-bit dividend (value to divide).
	32-bit space for result.

Exit Conditions Different from Entry

SP ==>	32-bit quotient (result from division).

Example

Divide D0 by D1; load result into D2.

```
SUBQ.L   #4,A7          Allocate space for result.
MOVE.L   D0,-(A7)       Push dividend.
MOVE.L   D1,-(A7)       Push divisor.
SYSCALL  .DIVU32        Divide D0 by D1.
MOVE.L   (A7)+,D2       Get quotient.
```

.CHK_SUM Function

Name

.CHK_SUM - Generate checksum for address range

Code

$006B

Description

This function generates a checksum for an address range that is passed in as arguments.

Entry Conditions

SP ==>	Beginning address.	*longword*
+4	Ending address + 1.	*longword*
+8	Scale of checksum. 0 = Default setting (longword) 1 = byte 2 = word 4 = longword	*longword*
+C	Space for checksum.	*longword*

Exit Conditions Different from Entry

SP ==>	Checksum.	*longword*

Example #1

Byte checksum:

```
CLR.L     -(A7)        Allocate space for "checksum".
MOVE.L    #1,-(A7)     Push scale of checksum.
PEA.L     (A1)         Push pointer to "ending address + 1".
PEA.L     (A0)         Push pointer to "starting address".
SYSCALL   .CHK_SUM     Invoke TRAP #15 system call.
```

```
MOVE.L    (A7)+,D0      Load checksum and deallocate
                        space, bits 7 to 0 contain the byte
                        checksum.
```

Example #2

Word hecksum:

```
CLR.L     -(A7)         Allocate space for "checksum".
MOVE.L    #2,-(A7)      Push scale of checksum.
PEA.L     (A1)          Push pointer to "ending address + 1".
PEA.L     (A0)          Push pointer to "starting address".
SYSCALL   .CHK_SUM      Invoke TRAP #15 system call.
MOVE.L    (A7)+,D0      Load checksum and deallocate space,
                        bits 15 to 0 contain the word
                        checksum.
```

Example #3

Longword checksum:

```
CLR.L     -(A7)         Allocate space for "checksum".
MOVE.L    #4,-(A7)      Push scale of checksum.
PEA.L     (A1)          Push pointer to "ending address + 1".
PEA.L     (A0)          Push pointer to "starting address".
SYSCALL   .CHK_SUM      Invoke TRAP #15 system call.
MOVE.L    (A7)+,D0      Load checksum and deallocate
                        space,bits 31 to 0 contain the
                        longword checksum.
```

Notes 1. If a Bus Error results from this routine, then the bug bus error exception handler is invoked and the calling routine is also aborted.

2. The calling routine must insure that the beginning and ending addresses are on word boundaries or the integrity of the checksum cannot be guaranteed.

.BRD_ID Function

Name

.BRD_ID - Return pointer to board ID packet

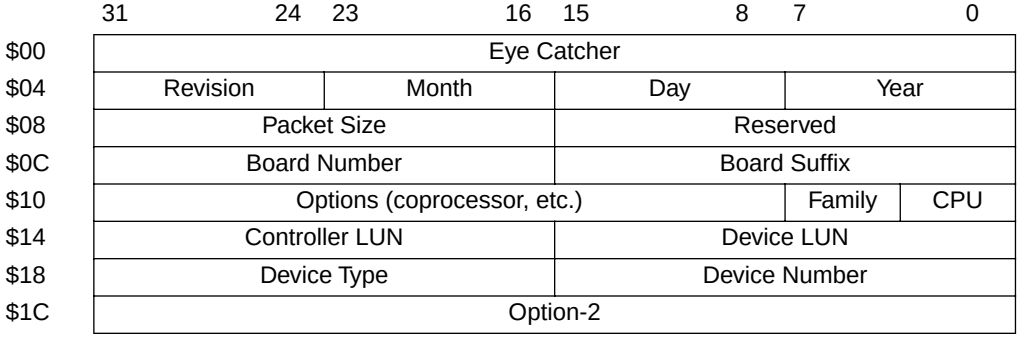
Code

$0070

Description

This routine returns a pointer on the stack to the "board identification" packet. The packet is built at initialization time and contains information about the board and peripherals it supports.

The format of the board identification packet is shown below:



Field descriptions:

Eye Catcher	Longword containing ASCII string "BDID".
Revision	Byte containing bug revision (in BCD).
Month, Day, Year	Three Bytes contain date (in BCD) bug was frozen.
Packet Size	Word contains the size of the packet.
Reserved	Reserved for future use.
Board Number	Word contains the board number (in BCD).
Board Suffix	Word contains the ASCII board suffix (e.g. XT, A, 20).

Options:

	Bits 0-3 Four bits contain CPU type: CPU = 1 ; MC68010 present CPU = 2 ; MC68020 present CPU = 3 ; MC68030 present CPU = 4 ; MC68040 present CPU = 5 ; MC68060 present CPU = 8 ; MC88100 present CPU = 9 ; MC88110 present
	Bits 4-6 Three bits contain the Family type: Fam = 0 ; 68xxx family Fam = 1 ; 88xxx family
	Bits 7-31 The remaining bits define various board specific options: Bit 7 set = FPC present Bit 8 set = MMU present Bit 9 set = MMB present
Controller LUN	The Logical Unit Number for the boot device controller (refer to Appendices E and G).
Device LUN	The Logical Unit Number for the boot device (refer to Appendices E and G).
Device Type	The device type of the boot device (refer to the following table).
Device Number	The number of the boot device on the controller (refer to the following table).
Option-2	Reserved for future use (zero in this implementation).

Device Type	Controller	Device Number
0 or 1	MVME320 ST506 Disk Controller	0 = Winchester hard drive 1 = Winchester hard drive 2 = Floppy disk drive 3 = Floppy disk drive
2 or 3	MVME327A SCSI Controller	00 = SCSI Common Command Set (CCS) 10 = SCSI Common Command Set (CCS) 20 = SCSI Common Command Set (CCS) 30 = SCSI Common Command Set (CCS) 40 = Archive Viper streaming tape 50 = Archive Viper streaming tape 60 = Exabyte Mini-disk 80 = Local floppy drive 81 = Local floppy drive
4 or 5	MVME350 Streaming Tape Controller	0 = Streaming tape drive
6 or 7	MVME328 SCSI Controller	00 = SCSI Common Command Set (CCS), direct access 08 = SCSI Common Command Set (CCS), direct access 10 = SCSI Common Command Set (CCS), direct access 18 = SCSI Common Command Set (CCS), direct access 20 = SCSI Common Command Set (CCS), sequential access 28 = SCSI Common Command Set (CCS), sequential access 30 = Floppy disk drive 40 = SCSI Common Command Set (CCS), direct access 48 = SCSI Common Command Set (CCS), direct access 50 = SCSI Common Command Set (CCS), direct access 58 = SCSI Common Command Set (CCS), direct access 60 = SCSI Common Command Set (CCS), sequential access 68 = SCSI Common Command Set (CCS), sequential access 70 = Floppy disk drive
8 or 9	MVME323 ESDI Disk Controller	0 = First drive 1 = Second drive 2 = Third drive 3 = Fourth drive

Refer to Appendix G for data on supported network controllers.

Entry Conditions

SP ==>	Result.
	Allocate space for ID packet address.*longword*

Exit Conditions Different from Entry

SP ==>	Address.
	Starting address of ID packet. *longword*

Example

```
PEA.L     (A0)        Reserve space on stack for return value.
SYSCALL   .BRD_ID     Board ID trap call.
MOVE.L    (A7)+,A0    Get pointer off stack.
```

.ENVIRON Function

Name

.ENVIRON - Read/write environment parameters

Code

$0071

Description

The purpose of the TRAP is to allow a user program access to certain Debugger environmental parameters. These parameters include default boot devices and startup configurations.

Entry Conditions

SP ==> Parameter storage buffer.
+4 ==> Size of the storage buffer
+8 ==> Operation type:

0 Size in bytes of the information the debugger will pass.
1 Update the Debugger's NVRAM with environmental parameters passed.
2 The Debugger will update your parameter storage buffer with environmental information from the Debugger's NVRAM.

Exit Conditions Different from Entry

For operations 1 & 2,

Z(ero) = Set to 1 if no errors.

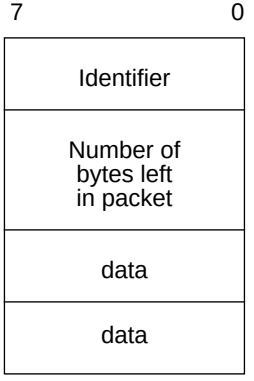
Z(ero) = Cleared if debugger has more data than the passed buffer could hold.
Partial data transferred, or Checksum error occurred during the write update (write only).

For operation 0,

The number of bytes required to store the debugger information will be contained in register D0.

Description of Parameter Packets

The data contained in the parameter storage area is organized as a set of data packets. Each data packet has the following structure:



Currently Supported Packets and Formats

0 End of the list. (End Record)

0

0

1 Debugger Start-Up Parameters

1

$6

System or Bug mode flag.

Field service menu flag.

Remote start method flag.

Probe system for controllers flag.

Negate SYSFAIL always flag.

Reset local SCSI on board reset flag.

2 Disk Auto Boot Information

2

$15

Disk Auto Boot Enable

Disk Auto Boot at power up only

Disk Auto Boot Controller Logical Unit Number

Disk Auto Boot Device Logical Unit Number

Disk Auto Boot Abort Delay

Disk Auto Boot String to be passed to load program ($10 bytes in length)

3 ROM Boot Information

3

0C

ROM Boot Enable.

ROM Boot at power up only

ROM Boot from VME bus

ROM Boot Abort Delay

ROM Boot Starting Address (4 bytes in length)

ROM Boot Ending Address (4 bytes in length)

4 NETBoot Information

4

$9

NETBoot Enable

NETBoot at power up only

NETBoot Controller Logical Unit Number

NETBoot Device Logical Unit Number

NETBoot Abort Delay

NETBoot parameter pointer (4 bytes in length)

5 Memory Size Information

5

$9

Memory Size Enable ($4E or $59)

Memory Size Starting Address (4 bytes)

Memory Size ending Address

For an explanation of each entry and definition of options, refer to the **ENV** command in the Debugger manual.

The Debugger will return all parameter packets on a read. During a write you may return only the packets that need to be updated; however, the packet may not be returned out of order.

During an update, entries that have specific values will be verified. If an entry is in error, that parameter will be unchanged.

.PFLASH Function

Name

.PFLASH - Program FLASH memory

Code

$0073

Description

The purpose of this TRAP is to program FLASH memory under program control. The address of the packet is passed as an argument to the function. The address of the packet is passed in the longword memory location pointed to by the current stack pointer. The packet contains the necessary arguments/data to program the FLASH memory.

Entry Conditions

SP ==> Address: Starting address of control *longword* packet.

Exit Conditions Different from Entry

None.

Format of flash memory control packet:

The FLASH Memory Control Packet must be longword/word (32 bit) aligned.

	31 24	23 16	15 8	7 0
$00	Status Word		Control Word	
$04	Source Starting Address			
$08	Number of Bytes to Program			
$0C	Destination Starting Address			
$10	Instruction Execution Address			

Field descriptions:

Control/Status Word	Specifies control and status of the various phases of the FLASH memory programming. This parameter has two 16-bit parts: bits #31 to #16 specify status and bits #15 to #0 specify control.
Source Starting Address	Specifies the source starting address of the data with which to program the FLASH memory. Table 3-2 describes the address and range alignment requirements for this parameter.
Number of Bytes to Program	Specifies the number of bytes of the source data (or the number bytes to program the FLASH memory with). Table 3-2 describes the address and range alignment requirements for this parameter.
Destination Starting Starting Address	Specifies the starting address of the FLASH memory to program the source data with. Table 3-2 describes the address and range alignment requirements for this parameter.
Instruction Execution Address	Specifies the instruction execution address to be executed upon completion of the FLASH memory programming. This parameter must meet the syntax of the reset vector of the applicable MPU architecture of the host product. This parameter is qualified with a control bit in the control/status word; execution will only occur when the control bit is set and no errors occur during programming/verification. This non-execution on error can be invalidated by yet another control bit in the control/status word.

The next table describes the definitions of the control and status bits in the Control/Status Word field.

Type	Bit Position	Definition
Control	0	Execution address valid.
Control	1	Execute address on error as well.
Control	2	Execute local reset.
Control	3	Execute local reset on error as well.
Control	4	Non-verbose, no display messages. (NOTE)
Control	5-15	Unused, Reserved
Status	16	Error of some type, see remaining status bits.
Status	17	Address/Range alignment error.
Status	18	FLASH Memory address range error.
Status	19	FLASH Memory erase error.
Status	20	FLASH Memory write error.
Status	21	Verification (read after write) error.
Status	22	Time-Out during erase operation.
Status	23	Time-Out during byte write operation.
Status	24	Unexpected manufacturer identifier read from the device.
Status	25	Unexpected device identifier read from the device.
Status	26	Unable to initialize the FLASH device to zero.
Status	27-29	Unused, Reserved
Status	30	FLASH Memory program control driver downloaded.
Status	31	No return possible to caller.

Note When programming the FLASH device in which the FLASH memory is executing, bit 4 will have no effect. All programming operations that involve the FLASH device in which the FLASH memory is executing will be NON-VERBOSE.

.DIAGFCN Function

Name

.DIAGFCN - Diagnostic function(s)

Code

$0074

Description

.DIAGFCN is a system-call-like function, for the diagnostics. This .DIAGFCN system call provides the debugger and external software (operating systems) with a single-point-of-entry to information maintained by the firmware diagnostics.

The .DIAGFCN system call requires a single argument, which is a pointer to a **diagfcn struct**. This **struct** contains an 'unsigned int' which is the number of the diagnostic function being requested, and a pointer to arguments for the function to be executed:

`unsigned int`	DIAGFCN number to execute.
`char *`	Pointer to function arguments.

This system call implements the following diagnostic functions:

01: .CHKFCN (check function)

The purpose of this function is to determine whether a given **diagfcn** is present in this revision of firmware. The argument pointer in the **diagfcn struct** simply points to an unsigned int variable, containing the **diagfcn** number to test for. If it exists, the syscall will return zero.

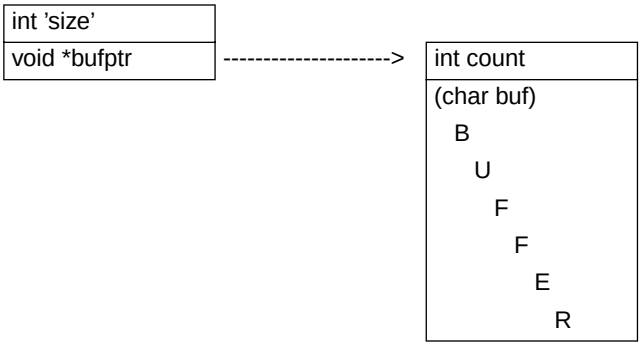
02: .TESTSTAT (output test status report)

This **diagcfn** call allows access to selftest diagnostic results. The calling function must supply the **diagcfn** call with a pointer to two arguments (a structure containing two members):

```
struct ts_bufps
{
          unsigned int size;
          void *bufptr;
}
```

'bufptr' points to a buffer in memory, where the first 'sizeof(int)' bytes are reserved for an integer 'count' variable, and the rest of the buffer is reserved as a 'char' array for ASCII string data:

```
struct ts_bufs
{
          unsigned int count;
          unsigned char buf[1];
}
```



The calling function typically first makes a call with the 'size' set to 'sizeof(int)', and 'bufptr' pointing to a section of R/W memory, 'size' bytes long. This causes the TESTSTAT function to calculate how large a buffer will be required to contain the test status report. The calculated value, plus 'sizeof(int)', will be returned in the location pointed to by 'bufptr'.

The caller will then typically allocate the number of bytes of memory requested for the report, and call the TESTSTAT function again. This time, the 'size' passed in should be at least as large as the count returned by the previous call to TESTSTAT. This function will then recalculate the memory required, compare that to the

amount of memory supplied, and either return an error if insufficient buffer space has been allocated, or generate the report and append it to the count at the location pointed to by 'bufptr'.

The test result strings placed in the buffer will have the format:

<DEL><Dir_Name><DEL><Test_Name><DEL><Description><DEL><F|P|B|M|N|E><0>

Where <DEL> is a unique delimiter char and <0> is a zero. The <F|P|B|M|N|E> is a single character:

F if the test has ever failed since the last reset.
P if the test has executed to completion without failure.
B if the test has been bypassed since the last reset.
M if the test has been masked by the operator.
N if the test has not been executed since the last reset.
E if the test is an 'eval' type, and is normally not executed.

If somehow, an invalid test index is generated internal to the debugger, a status of ? will result. This should *never* occur.

The N and E status is stored for each test at diag init time (on reset), depending on whether the test is of type 'T_TEST" (a 'regular' test) or "T_EVAL" (a test that is only run manually). This is the only time these values will be stored for a test. All other status types destructively overwrite this initial value.

The M status will be saved for a test, whenever the test is executed, if masking has been enabled for this test. It will only overwrite an N status (and not an E).

The B status indicates a test has decided not to run, due to some configuration limitation (an example would be when the MCECC tests report bypassed on a CPU that only contains parity-type RAM). The B status will overwrite the M, N, and E status.

The P status will only ever be saved, if the previous status for the test was B, M, N, or E. A P status will never overwrite an F status. If a test is aborted before completion, the previous status will remain, even if the test was passing up to the point of the abort.

The F (fail) status will overwrite all other values, and will never be changed without a reset.

These status strings are appended together in the buffer supplied by the caller. The initial delimiter character of each test result string should be read by the calling function, and used as the character to search for, when looking for separation between 'words' of the result. Each single test result string could have a different delimiter. The <0> following each result string indicates the start of the next result.

A hex dump of report data might look like:

```
100  00000204  ('count')
104  5F 72 61 6D 5F 71 75 69  6B 5F 51 75 69 63 6B 20  _ram_quik_Quick
114  57 72 69 74 65 2F 52 65  61 64 5F 4E 00 5F 72 61  Write/Read_N._ra
124  6D 5F 61 6C 74 73 5F 41  6C 74 65 72 6E 61 74 69  m_alts_Alternati
134  6E 67 20 4F 6E 65 73 2F  5A 65 72 6F 65 73 5F 4E  ng Ones/Zeroes_N
144  00 5F 72 61 6D 5F 70 61  74 73 5F 50 61 74 74 65  ._ram_pats_Patte
154  72 6E 73 5F 4E 00 5F 72  61 6D 5F 61 64 72 5F 41  rns_N._ram_adr_A
164  64 64 72 65 73 73 61 62  69 6C 69 74 79 5F 4E 00  ddressability_N.
174  5F 72 61 6D 5F 63 6F 64  65 5F 43 6F 64 65 20 45  _ram_code_Code E
. . .
```

This function will return an integer status. Zero is returned upon success. A result of `-1` is returned if an error in the system call function occurred:

```
        if ( 0 <= size < 4 )
                        return -1;

        if ( size == 4 )
                        write 'count' to 'bufptr' location in RAM
                        return 0;

        if ( 4 < size < count )
                        write 'count' to 'bufptr' location in RAM
                        return -1;

        if ( count <= size )
                        write 'count' to 'bufptr' location in RAM
                        write status report to 'bufptr +
sizeof(int)' in RAM
                        return 0;
```

The return result is handled according to the processor family that the code is being run on.

68K: returned on the stack in place of the supplied pointer.

03: .MEMSTAT (memory status)

This function implements a report mechanism for main memory diagnostics. This report is always of a fixed size, and can therefore be called by higher level software that can not dynamically allocate buffer space.

This function reports "combined" status for each of certain test directories. This list includes "RAM", "MCECC", "MEMC1", "MEMC2", "ECC", and possibly others as new hardware/software is developed.

In the case of "RAM" tests, they cover a range of memory, and typically contain nothing that is board-specific.

The "MCECC" and "ECC" tests do contain board-specific code, and will cover segments of memory, rather than a single range. In this case, these tests will likely appear in the report multiple times, once for each segment of memory.

Since the test is only ever run once, over all segments, the status result will be identical for all reported instances. If one of the segments covered does not contain an ECC type of memory board, the results will contain a zero address range (beginning address = ending address).

The "MEMC?" tests are on a per-board basis. These tests are intended for the parity memory board, but contain one or more tests that are also appropriate for the MCECC memory board. Each test covers one segment of memory on the board under test. This report may return "N" (for "not executed"), "B" (for "bypassed"), "P" (for "passed"), or "F" (for "failed").

1. Walk down through the diag directory, looking for test groups that match our list.
2. When a match is found, walk down through the tests, ignore any functions that are not of the type "T_TEST", check the status for each test (using the "test index" to look in the diagctl "teststat" array).

3. Create an overall status for the test group. The status should be a single char in the set: {P,F,N,B}, where:

   P - PASSED
   Only returned when all of the "T_TEST" type functions in the test group have posted a 'passed' status. Any test in the group posting other than 'passed' will cause a different result than P to be returned.

   F - FAILED
   If any test of type "T_TEST" in the test group has posted a 'failed' status, the result returned will be F.

   N - NOT EXECUTED
   If any test in the group, of type "T_TEST" was not executed, this status should be returned, unless any of the tests posted a 'failed' status, in which case an F should be returned.

   B - BYPASSED
   Returned if all of the "T_TYPE" functions in the test group have posted a "bypassed" status.

The upper address bound and lower address bound passed back to the caller, should be initialized to the values of "Memory Size Ending Address" and "Memory Size Starting Address" from NVRAM. These values to be returned should be overridden by any test config parameters (CF params) that might exist for the applicable test. A function will be inserted in each of the memory test groups that can be called and will return the upper and lower bounds.

The argument pointer in the diagfcn struct points to the report buffer. This buffer is 452 bytes long, and has the structure:

	unsigned int	# valid entries
Entry 1	/unsigned int	upper addr bound
	|unsigned int	lower addr bound
	|unsigned int	combined test stat (P|F|N|B)
	\char[16]	test group name (NULL terminated)
Entry 2	/unsigned int	upper addr bound
	|unsigned int	lower addr bound
	|unsigned int	combined test stat (P|F|N|B)
	\char[16]	test group name (NULL terminated)
	:	
	.	
Entry 16	/unsigned int	upper addr bound
	|unsigned int	lower addr bound
	|unsigned int	combined test stat (P|F|N|B)
	\char[16]	test group name (NULL terminated)

MEMSTAT will return a zero from the system call if there were no errors.

04: .ST_NMLIST (selftest name list)

This function will walk through the selftest directory structure, and generate a report consisting of test and group names that are present.

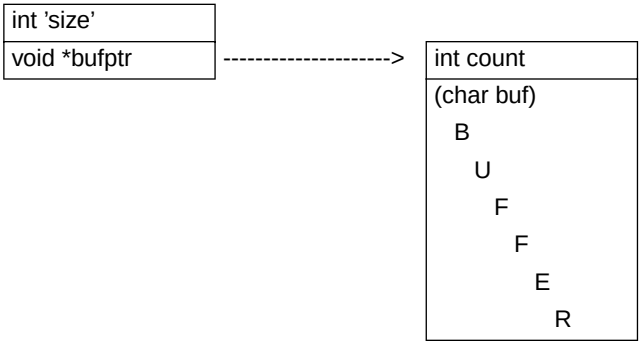
The report contains test group name, as well as the specific test name. Format of the list is the same as that for the ".TESTSTAT" diag syscall.

Each string in the list begins with the separator (unique delimiter character) that is to be used in the current line. The "test group name" comes next, followed by a separator. Next is the "test name", followed by a NULL ('\0'). For example: `#ram#pats<0>`

The caller must provide a pointer to a structure when calling this function. The structure first contains an 'int' (4 bytes) giving the size of an available buffer to be used for output from this function. This 'int' is immediately followed by the address (4 bytes) of the start of the buffer.

If this function is called with the 'size' set to 'sizeof(int)' (4), then this function will return a single integer (4 bytes) in the buffer, containing the size of buffer needed to contain the list and the size. To get the list, the function needs to be called with a buffer 'size' at least as large as is reported in the first call. Anything smaller will result in a non-zero return status, and the list will not be generated.

For 68K debuggers, the caller should place the structure pointer on the stack. An integer result will be returned, in place of the pointer passed in to this routine. A zero (0) result indicates success, non-zero indicates failure.



Entry Conditions

SP ==> Points to location containing the diagcfn struct address.

Exit Conditions Different from Entry

An integer status to the higher level is returned on the stack in place of the supplied pointer.

.SIOPEPS Function

Name

.SIOPEPS - Retrieve SCSI pointers (167/187 only)

Code

$0090

Description

The purpose of this TRAP is to allow a user program toaccess the SCSI I/O Processor package contained in the Debugger ROMs. This TRAP returns a list of pointers and table sizes that the user program uses to move the SCSI I/O Processor package from ROM to RAM. The SIOP package cannot be executed by a user program without being moved and edited. For instructions on how to move and edit the SIOP package, refer to the SIOP user's manual.

Entry Conditions

None

Exit Conditions Different from Entry

SP ==> Pointer to the SIOP pointer and size table.

Description of siop pointer and size table packet:

Format for packet containing SIOP pointers and table sizes. All entries are 4 bytes in length.

siop_init	Initialization routine entry.
siop_cmd	Command entry point entry.
siop_int	Interrupt handler entry.
sdt_tinit	SIOP debug trace initialization entry.
sdt_alloc	SIOP debug trace memory allocation entry.
relocation	Pointer to the relocation table for NCR scripts.

script_ptr	Pointer to the NCR scripts index pointer array.
script_ptr_sz	Size of the NCR scripts index pointer array.
script_array_sz	Size of the scripts array.

.IOINQ Function

Name

.IOINQ - Port Inquire

Code

$0120

Description

Writes the Port Control Structure at the user-specified address. The Port Control Structure contains I/O Port Concurrent Mode and Port Control information about the named port.

Entry Conditions

SP ==> Pointer to Port Control Structure as defined below.

The Port Number, Board Name Pointer, and I/O Control Structure Pointer members of the Port Control Structure must be USER initialized before calling **.IOINQ**.

Exit Conditions Different from Entry

SP ==> Pointer to Port Control Structure as defined below, or

SP ==> NULL (Port not recognized error).

The Port Control Structure will be modified as described above.

Port Control Structure

The Port Control Structure is of the form:

	31 24	23 16	15 8	7 0
$00	Port Number			
$04	Board Name Pointer			
$08	Channel			
$0C	Device Address			
$10	Concurrent Mode			
$14	Modem ID			
$18	I/O Control Structure Pointer			
$1C	Error Code			
$20	Reserved			
$24	Reserved			
$28	Reserved			

Field descriptions:

Port Number — The Port Number as used here is analogous to the port number as required by the 16XBug Port Format (**PF**) command. Port Numbers are assigned as follows:

$FFFFFFFE	Concurrent Port
$FFFFFFFF	System Console
$0 - $1F	Other currently assigned port

Board Name Pointer — A pointer to a null ($00) terminated ASCII string which is the name of the board (module) that is host to the target Device. The maximum length of this string is 20 bytes. The Board Name as used here is analogous to the board name as required by the 16XBug Port Format (**PF**) command. The following boards are currently supported:

MVME050	System Controller Module

MVME162	Embedded Controller Module
MVME172	Embedded Controller Module
MVME166	Single Board Computer
MVME167	Single Board Computer
MVME176	Single Board Computer
MVME177	Single Board Computer
MVME335	Serial and Parallel I/O Module

2

Channel On multi-port devices, this value specifies which port of the device is being referenced. Zero inclusive port numbering is assumed, i.e., Port A is Channel Number 0.

Device Address Base address of the I/O Device.

Concurrent Mode Nonzero Value flags concurrent mode operation of this port. Zero flags normal operation for this port.

Modem ID Modem identification code for the modem associated with this port. The Modem ID code is ONLY valid if Concurrent Mode Operation is true for this port. The following modems are currently supported:

Modem ID	Modem Type
1	Non-intelligent modem
2	Terminal Mode - Refer to Appendix A, *System Mode Operation*, the section on *Initiate Service Call*.
3	UDS 2662
4	UDS 2980
5	UDS 3382

I/O Control Structure Pointer	A pointer to the port parameter/configuration table. The I/O Control Structure is defined below.
Error Code	Contains error code if any. The following error codes are currently defined:

1. PF Error - Couldn't format the Port with the user's parameters.
2. Port Number not recognized, that is, the 16XBug does not have a definition for the given Port Number.
3. Synchronization Error - can't turn on Concurrent Mode (CM) (CM already on).
4. 16XBug has no definition for the Port Number specified.
5. Port Number not in range of -2 to $1F.
6. No info available on CM port because CM not active.
7. All legal Port Numbers are currently in use.
8. All device driver Control Structures are currently in use. Can't define any more Port Numbers.
9. Synchronization Error - can't turn off CM. CM is already off.
10. Contradictory Request. CM port number specified but user's CM flag is clear and no 16XBug port is currently operating in CM.
11. Illegal Port number for .IODELETE trap call.
12. Alias for Error #11.
13. IODELETE is not allowed to delete this port (16XBug default port(s)).
14. Alias for Error #8.

15. Alias for Error #7.

16. Unknown modem type. Returned Port Number is valid, but CM is NOT set.

Reserved — These locations are set to zero on return to the caller.

I/O Control Structure

The I/O Control Structure is of the form:

	31 24	23 16	15 8	7 0
$00	ctrlbits			
$04	baud			
$08	00	00	00	protocol
$0C	00	00	00	sync1
$10	00	00	00	sync2
$14	00	00	00	xonchar
$18	00	00	00	xoffchar

Field descriptions:

ctrlbits — The bits of this 32-bit wide integer are defined as high true flags with the following meanings:

Bit 00	Odd parity
Bit 01	Even parity
Bit 02	8 bit character word
Bit 03	7 bit character word
Bit 04	6 bit character word
Bit 05	5 bit character word
Bit 06	2 stop bits
Bit 07	1 stop bit
Bit 08	Data terminal equipment
Bit 09	Data computer equipment

	Bit 10	cts control
	Bit 11	rts control
	Bit 12	xon/xoff control
	Bit 13	hard copy flag
baud	Baud rate value for this port.	
protocol	A single ASCII character representing the desired communications protocol. The following characters are defined by the 16XBug.	
	A	Async
	M	Mono
	B	Bisync
	G	Gen
	S	SDLC
	H	HDLC

Note Only the asynchronous protocol is supported by the 16XBug at this time.

sync1	8 bit value to be used as the sync1 character in the synchronous communication protocols.
sync2	8 bit value to be used as the sync2 character in the synchronous communication protocols.
xonchar	Software flow (on) control character.
xoffchar	Software flow (off) control character.

.IOINFORM Function

Name

.IOINFORM - Port Inform

Code

$0124

2

Description

This trap will inform the 16XBug about change in I/O Port operation. The 16XBug updates its internal I/O control structures and writes ERROR CODE and (possibly) PORT NUMBER in your Port Control Structure.

If you wish to inform the 16XBug that you are "turning on" Concurrent Mode (CM), you must set the Concurrent Mode field of the Port Control Structure. It is permissible to use a Port number of -2 when "turning on" CM. The 16XBug will return a valid Port Number for your future reference. If you wish to inform the 16XBug that you are "turning off" CM operation, you must use a PORT NUMBER that has been returned by the .IOINQ or .IOINFORM system calls.

Entry Conditions

SP ==> Pointer to the Port Control Structure.

All members of the Port Control Structure, except ERROR CODE and RESERVED, as well as the BOARD NAME STRING and I/O CONTROL STRUCTURE must be USER initialized before calling .IOINFORM.

Exit Conditions Different from Entry

SP ==> Pointer to the Port Control Structure, or

SP ==> NULL (Port not recognized error).

The Port Control Structure will be modified as described above.

.IOCONFIG Function

Name

.IOCONFIG - Port Configure

Code

$0128

Description

This trap will instruct the 16XBug to access the I/O device to change port operation and to update its internal I/O Control structures. The 16XBug writes ERROR CODE and (possibly) PORT NUMBER in your Port Control Structure.

If you wish to inform the 16XBug that you are "turning on" Concurrent Mode (CM), you must set the Concurrent Mode field of the Port Control Structure. It is permissible to use a Port number of -2 when "turning on" CM. The 16XBug will return a valid Port Number for your future reference.

If you wish to inform the 16XBug that you are "turning off" CM operation, you must use a PORT NUMBER that has been returned by the .IOINQ or .IOINFORM system calls.

Entry Conditions

SP ==> Pointer to Port Control Structure as defined above.

All members of the Port Control Structure, except ERROR CODE and RESERVED, as well as the BOARD NAME STRING and I/O CONTROL STRUCTURE must be USER initialized before calling .IOCONFIG.

Exit Conditions Different from Entry

SP ==> Pointer to Port Control Structure as defined above, or

SP ==> NULL (Port not recognized error).

The Port Control Structure will be modified as described above.

.IODELETE Function

Name

.IODELETE - Port Delete

Code

$012C

Description

Causes the 16XBug to delete the named I/O port from its internal port list. The function of this call is analogous to the 16XBug NOPF command. Note that .IODELETE cannot delete the Concurrent port. You must first use the .IOINFORM trap and then you may delete the port.

Entry Conditions

SP ==> Pointer to Port Control Structure as defined above.

The Port Number member of the Port Control Structure must be USER initialized before calling .IODELETE. The Board Name Pointer, Channel, Device Address, Concurrent Flag, Modem ID, and, I/O Control Pointer members of the Port Control Structure are not used by this trap.

Exit Conditions Different from Entry

SP ==> Pointer to Port Control Structure as defined above, or

SP ==> NULL (Port not recognized error).

The Port Control Structure Error Code field will be written with an error code if any errors occurred.

.SYMBOLTA Function

Name

.SYMBOLTA - Attach Symbol Table

Code

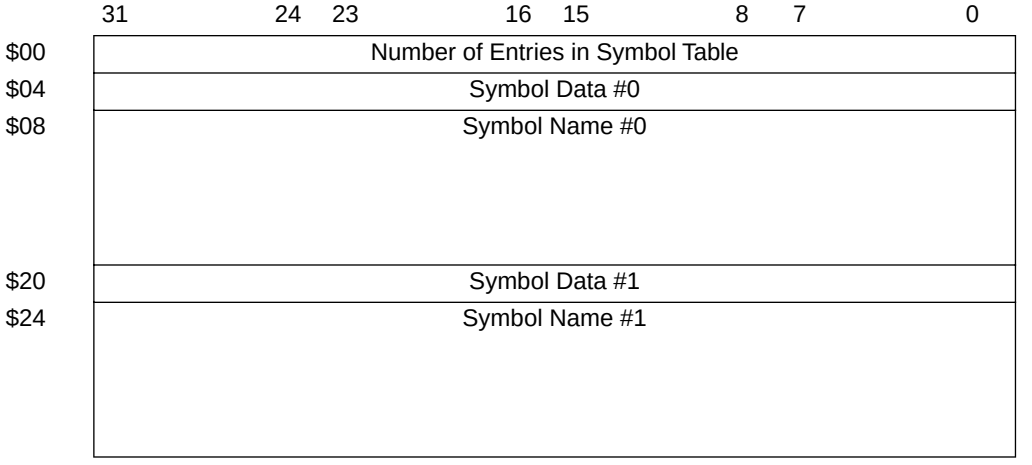
$0130

2

Description

This routine attaches a symbol table to the BUG. Once a symbol table has been attached, all displays of physical addresses are first looked up in the symbol table to see if the address is in range of any of the symbols (symbol data). If the address is in range, it is displayed with the corresponding symbol name and offset (if any) from the symbol base address (symbol data). In addition to the display, any command line input that supports an address as an argument can now take a symbol name for the address argument. The address argument is first looked up in the symbol table to see if it matches any of the addresses (symbol data) before conversion takes place. This command is analogous to the BUG command SYM. Refer to Chapter 3 for the command description.

The format of the symbol table is shown below:



Field descriptions:

Number of Entries in Symbol Table	The number of entries in table.
Symbol Data	32-bit hexadecimal value.
Symbol Name	A string of printable characters; may be null ($00) terminated.

The symbol data fields must be ascending in value (sorted numerically). Upon execution of the system call, the BUG performs a sanity check on the symbol table with the above rules. The symbol table is not attached if the check fails.

Entry Conditions

SP ==>	Address -- Starting address of symbol table.	*word*

Exit Conditions Different from Entry

SP ==>	Address -- Starting address of symbol table	*word*
Z =	0 if errors (sanity check failed).	
Z =	1 if not errors.	

.SYMBOLTD Function

Name

.SYMBOLTD - Detach Symbol Table

Code

$0131

Description

This routine detaches a symbol table from the BUG. This command is analogous to the BUG command NOSYM. Refer to Chapter 3 for the command description.

Entry Conditions

None.

Exit Conditions Different from Entry

None.

.ACFSTAT Function

Name

.ACFSTAT - ACFAIL status inquiry

Code

$0140

Description

This routine will return status indicating whether or not this powerup followed an ACFAIL shutdown. A pointer is returned that points to the ACFAIL status packet.

The format of the ACFAIL status packet is shown below:

	31 24	23 16	15 8	7 0
$00	STATUS	MONTH	DAY	YEAR
$04	HOUR	MINUTE	SECOND	RESERVED

Field descriptions:

STATUS	0 = ACFAIL condition false, 1 = true.
MONTH	Month of ACFAIL condition (BCD format).
DAY	Day of the Month of ACFAIL condition (BCD format).
YEAR	Year of ACFAIL condition (BCD format).
HOUR	Hour of ACFAIL condition (BCD format).
MINUTE	Minute of ACFAIL condition (BCD format).
SECOND	Seconds of ACFAIL condition (BCD format).
RESERVED	Reserved (alignment purposes).

Entry Conditions

None.

Exit Conditions Different from Entry

SP ==>	Address -- Starting address of ACFAIL status packet.	*word*

16XBug System Mode A

Operation

General Description

To provide compatibility with the Motorola Delta Series systems, the 16XBug has a special mode of operation that allows the following features to be enabled:

- Extended confidence tests that are run automatically on power-up or reset of the MVME16X.
- A menu that allows several system start up features to be selected, such as:
  - Continue System Start Up
  - Select Alternate Boot Device
  - Go to System Debugger
  - Initiate Service Call
  - Display System Test Errors
  - Dump Memory to Tape
- Return to the menu upon system start up errors instead of return to the debugger.
- Enabling of the Bug autoboot sequence.

The flow of system mode operation is shown in Figure A-1. Upon either power up or system reset, the MVME16X first executes a limited confidence test suite. This is the same test suite that the Bug normally executes on power up when not in the system mode.

Upon successful completion of the limited confidence tests, a five second period is allowed to interrupt the autoboot sequence. By typing any character you can cause the module to display the Service Menu permitting the selection of an alternate boot device, entry to the debugger, etc., as described above.

Upon selection of "continue start up" the module conducts a more extensive confidence test. Successful completion of the extended confidence test initiates the autoboot sequence, with boot taking place either from the default device (refer to Chapter 3 for information on entering/changing the default boot device) or from the selected boot device if an alternate device has been selected.

If the limited confidence test fails to complete correctly, it may display an error message. Explanations of these error messages can be found in Appendix B. Some error message explanations for the extended confidence test are given in the 16XBug board-specific debugger manual under the heading for the failed test.

Service Menu Details

The Service Menu lists these function choices:

```
1) Continue System Start Up
2) Select Alternate Boot Device
3) Go to System Debugger
4) Initiate Service Call
5) Display System Test Errors
6) Dump Memory to Tape
```

To select one of the functions, enter the number and press the Return or Enter key. The following paragraphs give more detailed descriptions of the menu selections.

Continue System Start Up

Enter **1 <CR>** to select "`Continue System Start Up`".

No other action is required from you. The system then continues the start up process by initializing extended confidence testing followed by a system boot.

Figure A-1. Flow Diagram of 16XBug System Operational Mode

Select Alternate Boot Device

Enter **2 <CR>** to select "`Select Alternate Boot Device`".

You are prompted with:

```
"Enter Alternate Boot Device:
 Controller:
 Drive     :
 File      :".
```

The selection of devices supported by the 16XBug is listed in Appendix E. Entering a selected device followed by a <CR> redisplays the menu for another selection, normally "`Continue System Start Up`" at this point.

Go to System Debugger

Enter **3 <CR>** to select "`Go to System Debugger`".

This places you in 16XBug's diagnostic mode, indicated by the prompt `16X-Diag>`. When you are in 16X-Diag mode, operation is defined by sections of this manual dealing with the Bug and FAT diagnostics.

If you wish to return to the Service Menu, type **menu <CR>**when the Bug prompt appears.

Initiate Service Call

Enter **4 <CR>** to select the "`Initiate Service Call`" function.

This function is described in the following paragraphs.

General Flow

The "Initiate Service Call" function is normally used to complete a connection to a customer service organization (CSO) which can then use the "dual console" mode of operation to assist a customer with a problem. Interaction with the service call function proceeds as follows:

First, the system asks

```
"Modem Type:
0) Terminal
1) Manual
2) UDS-2122662
3) UDS-2122980 (Hayes)
4) UDS-2123382 (Hayes)
Your Selection ( )?".
```

Explanation:

Terminal mode is used to connect any ASCII terminal in place of a modem, via a null modem, or equivalent cable. It is useful in certain trouble- shooting applications for providing a slave terminal without the necessity of dialing through a modem.

Manual mode connects directly to the modem in an ASCII terminal mode, allowing any nonstandard protocol modem to be used.

UDS means that the modem is compatible with the UDS modem protocol as used in internal Delta Series modems. The model number of this modem is UDS 2122662.

Hayes means that the modem is compatible with a minimal subset of the Hayes modem protocol. This minimum subset is chosen to address the broadest spectrum of Hayes compatible modem products. Note that the modem itself is not tested when Hayes protocol is chosen, while the modem is tested with the UDS protocol choice.

When a selection of one of the above options is made (option 0 in this example), the system asks:

```
Do you want to change the baud rate from 1200 (Y/N)?
```

Note that any question requiring a **Y** or **N** answer defaults to the response listed furthest to the right in the line (i.e., a question with Y/N defaults to NO if only a carriage return is entered). If you answer **Y** to the baud rate question, the system prompts:

```
Baud rate [300, 1200, 2400, 4800, 9600] 1200?
```

You should enter a selected baud rate, such as 300, and type a return. A return only leaves the baud rate as previously set. The system then asks:

```
Is the modem already connected to customer service (Y/N)?
```

When a connection has been made to Customer Service (or any other remote device), hang up does not automatically occur; it is an operation that you must initiate. If a system reset has occurred, for instance, a hang up does not take place, and connection to CSO is still in effect. In this case, it is not necessary or desirable to attempt to reconnect on a connection that is already in effect.

When an answer is entered to the question, the system responds:

```
Enter System ID Number:
```

This number is one assigned to the user system by its affiliated Customer Service Organization. The system itself does not care what is entered here, but the Customer Service computer may do a check to assure the validity of this number for login purposes. The system responds with:

```
Wait for an incoming Call or Dial Out (W/D)?
```

You have the option of either waiting for the other computer to dial in to complete the connection, or dialing out itself. If you selected **W**, then skip the next two steps. If you selected **D**, the system asks:

```
Hayes Modem:

(T) = Tone Dialing (Default), (P) = Pulse Dialing
(,) = Pause and Search for a Dial Tone

UDS Modem:

(T) = Tone Dialing (Default), (P) = Pulse Dialing
(=) = Pause and Search for a Dial Tone
(,) = Wait 2 Seconds

Enter CSO phone number:
```

You must enter the number, including area code if required, without any separators except for a comma (**,**) or equal sign (=) if required to search for a dial tone (depending on which modem

protocol was selected), such as when dialing out of a location having an internal switchboard. Additionally, the number must be prefaced by one of the above dialing mode selections. The dialing selection can also be changed within the number being dialed if necessary if an internal dialing system takes a different dialing mode than the external world switched network. When connection has been made, the system reports:

```
Service Call in progress - Connected
```

The remote system can now send one of two unique commands to the local system to request specific actions via the local firmware.

Message command. The command to send a message from the CSO center to the console of the calling system is **MESS**, 4 bytes, followed by a string of data no more than 80 bytes in length terminated with a carriage return. The ROM code moves the string to the console followed by a carriage return and a line feed. This command can be used to send canned messages to the operator, giving some indication of activity while various processes are taking place at CSO. For example, "Please Stand By". Many of these message commands may be sent while in the command mode.

Request for Concurrent Console command. The Request for Concurrent Console, or concurrent mode, command is **RCC**, 3 bytes only. You are prompted about the request. If you enter **"y"**, a single character "y" is sent to CSO followed by the console menu as displayed on the operators console. If you enter **"n"**, then the single character "f" is sent to CSO and the call is terminated.

When concurrent mode is entered, all input from either port, console or remote, is taken simultaneously. All output is sent to both ports concurrently. Either the console or the remote console may terminate the concurrent mode at any time by typing CTRL-A. The phone line is hung up by the 16X ROM code and a message is displayed indicating the end of the concurrent mode.

The most likely command sequence at this point is a message command to indicate connection to the remote system, followed by a request for concurrent mode operation. When these are received, the user system asks:

```
Concurrent mode (Y/N)?
```

If you wish to enter concurrent mode you must select **Y**. The system then presents the information:

```
Select Menu Item #8 to exit Concurrent Mode
```

The menu is redisplayed and concurrent mode is in effect. Any normal system operation can now be initiated at either the local or remote connected terminal, including system reboot.

```
1) Continue System Start Up
2) Select Alternate Boot Device
3) Go to System Debugger
4) Initiate Service Call
5) Display System Test Errors
6) Dump Memory to Tape
7) Start Conversation Mode
8) Exit Concurrent Mode
```

Note that seventh and eighth choices have been added to the menu. These prompt lines are only displayed when the system is in concurrent mode; although conversation mode actually can be selected and used at any time, and there are other ways to terminate the concurrent mode connection.

Selecting “Start Conversation Mode” allows either party to initiate a direct conversation mode between the two terminals, the remote system terminal and the local terminal. There are two ways to exit conversation mode:

<CR>.<CR>	Terminates conversation mode but remains in concurrent mode The system then redisplays the selection menu for further operator action.
CTRL-A	Terminates conversation mode AND concurrent mode, and hangs up the modem.

Choose 8) in the menu above (Exit concurrent mode), terminates concurrent mode.

You can also terminate concurrent mode from the Service Menu, while concurrent mode is in effect, by selecting menu entry 4 (Initiate Service Call) while a call is underway. The system asks:

```
Do you wish to disconnect the remote link (Y/N)?
```

If you answer **N**, the system gives the option of returning to (or entering) the conversation mode:

```
Do you wish the conversation mode (Y/N)?
```

A **Y** response results in return to conversation mode, while an **N** redisplays the menu.

If you answer Y to the disconnect remote link prompt, the system responds with the following series of messages:

```
Wait for concurrent mode to terminate

Hanging up the Modem

Concurrent Mode Terminated
```

The last message is followed by the display of the Service Menu *without* the seventh and eighth selections available. Normal system operation is now possible.

Manual Mode Connection

As described briefly earlier, a manual modem connect mode is available to allow use of modems that do not adhere to either of the standard protocols supported, but have a defined ASCII command set. If the manual mode is selected, a few differences must be taken into account.

A new mode called "transparent mode" is entered when manual modem control is attempted. This means that the user terminal is in effect connected directly to the modem for control purposes. When in transparent mode, you must take responsibility for modem control, and informing the system of when connection has taken

place, etc. If "manual mode" selection is made from the "`Is the modem already connected to customer service --`" prompt, the following dialog takes place.

All prompts and expected responses through the "`Enter System ID Number:`" takes place as above. However, in manual mode, after the ID number has been entered, the system prompts:

```
Manually call CSO and when you are connected,
exit the transparent mode
Escape character: $01=^A
```

You should type **CTRL-A** when the connection is made, or if for any reason a connection cannot be made. Because the system has no knowledge of the status of the system when transparent mode is exited, it asks:

```
Did you make the connection (Y/N)?
```

If you answer **Y** to the question, the system then continues with a normal dialog with the remote system, which would be for the remote system to send the "banner" message followed by a request for concurrent mode operation. If you enter **N**, the system asks:

```
Terminate CSO conversation (Y/N)?
```

A positive response to this question causes the system to reenter transparent mode and prompt:

```
Manually hang up the modem and when you are done,
exit the transparent mode
Escape character: $01 = ^A
```

The system is now in normal operation, and the menu is redisplayed.

Note that in manual mode of operation, transparent mode refers to the connection between the user terminal and the modem for manual modem control, and concurrent mode refers to the concurrent operation of a modem connected terminal and the system console.

Terminal Mode Operation

Operation with the terminal mode selected from the prompt string "`Is the modem already connected to customer service --`" is in most ways identical to other connection modes, except that after the prompt to allow change of baud rate, the system automatically enters concurrent mode. Additionally, exiting concurrent mode does not give prompts and messages referring to the hang up sequence. All other system operation is the same as other modes of connection.

Display System Test Errors

Enter **5 <CR>** to select "`Display System Test Errors`".

This selection displays any errors accumulated by the extended confidence test suite when last run. This can be a useful field service tool.

Dump Memory to Tape

Enter **6 <CR>** to select "`Dump Memory to Tape`".

The purpose of tape dump is to save an image of memory on tape for later analysis. The output of tape dump is two or more files on the user-specified controller and device. The first file (File 0) contains information about the Tape Dump Utility that created the tape, certain hardware specific information, and, an array of Tape Dump File Map Entries.

Other files (File 1 through *n*) written by the Tape Dump Utility are simply image(s) of memory at the time the Tape Dump Utility was invoked.

This implementation of the Tape Dump Utility allows you to define multiple blocks of memory, each block written as a separate file on the tape. The Tape Dump File Map Entries in File 0 describe the address ranges of system memory that each tape file contains.

The File Zero Structure is of the form:

```
struct fil0 {
    char magic[4];/* magic number */
    char who_do[4];/* who made dump (Bug or Unix) */
    int file0sz;/* File zero size */
    int complete;/* tape dump completed flag */
    int Trev;/* Revision of this structure */
    struct brdid bd_info;/* Board Identification Packet */
    struct tddir tdir[MAXFILES]/* Tape Dump File Map Entries */
};
```

The Board Identification/Information structure (**brdid**) is identical to the Board ID packet returned by the System Call **.BRD_ID**.

The constant FZS_REV is the File Zero Structure revision in Binary Coded Decimal (BCD) representation. FZS_REV is currently defined as $110 (that is, rev. 1.10). Member Trev is set to FZS_REV.

The constant MAXFILES determines the maximum number of Tape Dump File Map Entries in the File 0 Structure Template and, congruently, the maximum number of memory blocks that you could define and dump. MAXFILES is currently defined as 20.

The Tape Dump File Map Entry structure is of the form:

```
struct tddir {
    unsigned int fileno;/* file number */
    unsigned int saddr;/* memory starting address */
    unsigned int eaddr;/* memory ending address */
};
```

The first member of the Tape Dump File Map Entry structure is File Number (**fileno**). The normal range of values for **fileno** is from 1 to MAXFILES. The value $FFFFFFFF in **fileno** flags an invalid and unused File Map Entry.

Tape dump example:

```
1) Continue System Start Up
2) Select Alternate Boot Device
3) Go to System Debugger
4) Initiate Service Call
5) Display System Test Errors
6) Dump Memory to Tape

Enter Menu #: 6<CR>

Do you wish to dump memory (N/Y)? <CR>
Controller LUN = 04, Device LUN = 00.
Change DLUN and/or CLUN (Y/N)? <CR>
Define memory blocks to be dumped.
File Number:1
Starting Address   = 00000000? <CR>
Ending Address + 1 = 01000000? 10000<CR>
Define another memory block  (Y/N)? y<CR>
File Number:2
Starting Address   = 80000 <CR>
Ending Address + 1 = 100000 <CR>
Define another memory block  (Y/N)? <CR>

The following memory blocks have been defined:
File: 1  Start: 00000000  End: 00010000
File: 2  Start: 00080000  End: 00100000

Insert tape..Do you want to continue (N/Y)? <CR>
Rewind command executing

Erase Tape (Y/N)? <CR>

Retension Tape (Y/N)? <CR>
Writing file # 0
Writing file # 1
Writing file # 2

Dump finished.  You may remove tape.

1) Continue System Start Up
2) Select Alternate Boot Device
3) Go to System Debugger
```

```
4) Initiate Service Call
5) Display System Test Errors
6) Dump Memory to Tape

Enter Menu #:
```

This completes the description of system mode operation of the 16XBug.

Debugging Package Messages B

Debugger Messages

Table B-1. Debugger Error Messages

Debugger Error Messages	Meaning
`Bad VID Block`	String `"MOTOROLA"` is not found during **BO** command, and boot sequence aborts.
`Concurrent Mode Already Active`	Error message when trying to activate an active system in **CM** command.
`Concurrent Mode Not Active`	Error message when trying to deactivate an inactive system in **NOCM** command.
`Concurrent Mode Setup Failure`	Error in establishing communications with port/device in **CM** command.
`Concurrent Mode Terminated With Failure`	Error, closing communications link in **NOCM** command.
`Error Status: XXXX`	Disk communication error status word when **IOP** command, or .DSKRD or .DSKWR TRAP #15 functions, are unsuccessful. Refer to Appendix F for details.
`*** Illegal argument ***`	Improper argument in known command.
`*** Illegal Option ***`	Improper option in **MM** command.
`Invalid command`	Unknown command.
`*** Invalid LUN ***`	Controller and device selected during **IOP** or **IOT** command do not correspond to a valid controller and device.
`*** Invalid Range ***`	Range entered wrong in **BC**, **BF**, **BI**, **BM**, **BS**, or **DU** commands.

Table B-1. Debugger Error Messages (Continued)

Debugger Error Messages	Meaning
`*** Missing Argument ***`	Necessary field of command was not entered.
`NON-EXISTENT MNEMONIC`	Entry error in **MM** command with ;DI option.
`NON-EXISTENT OPERAND`	Entry error in **MM** command with ;DI option.
`part of S-record data`	Printed out if non-hex character is encountered in data field in **LO** or **VE** commands.
`RAM FAIL AT $`*`XXXXXXXX`*	Parity is not correct at address $*XXXXXXXX* during a **BI** command.
`STRING POOL FULL, LAST LINE DISCARDED`	String pool size (511 characters) is exceeded during **MA** command.
`The following record(s) did not verify .....` *`SNXXYYYYAAAA......ZZ........CS`*	Failure during the **LO** or **VE** commands. *ZZ* is the non-matching byte and *CS* is the non-matching checksum.
`Verify passes`	Successful **VE** command.

Diagnostic Messages

Table B-2. Diagnostic Error Messages

Diagnostic Error Messages	Meaning
`(various error messages)`	Refer to the MVME16XBUG board-specific debugging manual for error messages displayed during various diagnostic and/or FAT test commands.

Other Messages

Table B-3. Other Messages

Other Messages	Meaning
`16X-Bug>`	Debugger prompt.
`16X-Diag>`	Diagnostic prompt.
`At Breakpoint`	Indicates program has stopped at breakpoint.
`Autoboot in progress... To Abort hit <BREAK>"`	This message is displayed at Power-Up informing user that Autoboot has begun.
`--Break Detected--`	BREAK key on console has stopped operation.
`COLD Start`	Vectors have been initialized.
`Concurrent Mode Active`	The specified port echoes the system console terminal after **CM** command.
`Data = $`*XX*	*XX* is truncated data cut to fit data field size during **BF** or **BV** commands.
`Effective address:` *XXXXXXXX*	Exact location of data during **BC**, **BF**, **BI**, **BM**, **BS**, **BV**, and **DU** commands; or where program was executed during **GD**, **GN**, **GO**, and **GT** commands.
`Effective count : &`*XXX*	Actual number of data patterns acted on during **BC**, **BF**, **BI**, **BS**, or **BV** commands; or the number of bytes moved during **DU** command.
`Enter Menu #:`	**MENU** command prompt.
`Escape character: $`*HH=AA*	Exit code from transparent mode, in hex (*HH*) and ASCII (*AA*) during **TM** command.
`Initial data = $`*XX*`, increment = $YY`	*XX* is starting data and *YY* is truncated increment cut to fit data field size during **BF** or **BV** commands.

Table B-3. Other Messages (Continued)

Other Messages	Meaning
`-last match extends over range boundary-`	String found in **BS** command ends outside specified range.
`Logical unit $`*`XX`* `unassigned`	Message that may be output during **PA** or **PF** commands. $*XX* is a hex number indicating the port involved.
`M=`	Prompt for macro definitions during **MA** command.
`NO MACROS DEFINED`	Trying to list macros by **MA** command when there are none.
`No printer attached`	Message that may be output during **NOPA** command.
`-not found-`	String not found in **BS** command.
`OK to proceed (y/n)?`	"Interlock" prompt before writing macros in the **MAW** command or before configuring port in **PF** command.
`Press "RETURN" to continue`	Message output during **BS** or **HE** command when more than 24 lines of output are available.
`WARM Start`	Vectors have not been initialized.
`WARNING: Error correction on ECC memory board #`*`n`* ` has been disabled due to fatal errors during memory initialization`	The ECC memory board initialization function was unable to get a proper response from the indicated ECC board's scrubber hardware, within an acceptable time frame. It is likely that the specified memory board is broken in some way. The error-correcting feature has been disabled, and diagnostics should now be run to determine the extent of the disability.

S-Record Output Format C

Introduction

The S-record format for output modules was devised for the purpose of encoding programs or data files in a printable format for transportation between computer systems. The transportation process can thus be visually monitored and the S-records can be more easily edited.

S-Record Content

When viewed by the user, S-records are essentially character strings made of several fields which identify the record type, record length, memory address, code/data, and checksum. Each byte of binary data is encoded as a 2-character hexadecimal number: the first character representing the high-order 4 bits, and the second the low-order 4 bits of the byte.

The five fields which comprise an S-record are shown below:

type	record length	address	code / data	checksum

where the fields are composed as follows:

Field	Printable Characters	Contents
type	2	S-record type -- S0, S1, etc.
record length	2	The count of the character pairs in the record, excluding the type and record length.
address	4, 6, or 8	The 2-, 3-, or 4-byte address at which the data field is to be loaded into memory.
code / data	0-2*n*	From 0 to *n* bytes of executable code, memory-loadable data, or descriptive information. For compatibility with teletypewriters, some programs may limit the number of bytes to as few as 28 (56 printable characters in the S-record).
checksum	2	The least significant byte of the one's complement of the sum of the values represented by the pairs of characters making up the record length, address, and the code/data fields.

Each record may be terminated with a CR/LF/NULL. Additionally, an S-record may have an initial field to accommodate other data such as line numbers generated by some time-sharing system.

Accuracy of transmission is ensured by the record length (byte count) and checksum fields.

S-Record Types

Eight types of S-records have been defined to accommodate the several needs of the encoding, transportation, and decoding functions. Various upload, download, and other record transportation control programs, as well as cross assemblers, linkers, and other file-creating or debugging programs, may utilize only those S-records which serve the purpose of the program. For specific information on which S-records are supported by a particular program, the user's manual for that program must be consulted.

An S-record-format module may contain S-records of the following types:

S0	The header record for each block of S-records. The address field is normally zeroes. The code/data field may contain any descriptive information identifying the following 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. This count appears in the address field. There is no code/data field.
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. Under the operating system, a resident linker command can be used to specify this address. If not specified, the first entry point specification encountered in the object module input will be used. There is no code/data field.

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.

Creation of S-Records

S-record-format programs may be produced by dump utilities, debuggers, linkage editors, cross assemblers, or cross linkers. Refer to Chapter 3 for S-record handling utilities.

Example

Shown below is a typical S-record-format module, as printed or displayed:

```
S00A00006765745F6373720E
S325FF801BDC4E56FFB4202E00084A8067047000600270014 86EFFB42F004EB9
FF839EE6202E4C
S30DFF801BFCFFB4508F4E5E4E755B
S705FF801BDC84
```

The module consists of one S0 record, two S3 records, and an S7 record.

The S0 record is comprised of the following character pairs:

`S0`	S-record type S0, indicating that it is a header record.
`0A`	Hexadecimal 0A (decimal 10), indicating that 10 character pairs (or ASCII bytes) follow.
`0000`	Four-character 2-byte address field (zeros in this header record).
`6765745F 637372`	ASCII "get_csr" (module name).

The first S3 record is explained as follows:

`S3`	S-record type S3, indicating that it is a code/data record to be loaded/verified at an 8-byte address.
`25`	Hexadecimal 25 (decimal 37), indicating that 37 character pairs, representing 37 bytes of binary data, follow.
`FF801BDC`	Eight-character 4-byte address field; hexadecimal address FF801BDC, where the data which follows is to be loaded.

The next 32 character pairs of the first S3 record are the ASCII bytes of the actual program code/data. In this assembly language example, the hexadecimal opcodes of the program are written in sequence in the code/data fields of the S3 records:

Address	**Opcode**		**Instruction**
FF801BDC	4E56FFB4		LINK.W A6,#$FFB4
FF801BE0	202E0008		MOVE.L $8(A6),D0
FF801BE4	4A80		TST.L D0
FF801BE6	6704		BEQ.B $FF801BEC

Address	Opcode		Instruction
FF801BE8	7000		MOVEQ.L #$0,D0
FF801BEA	6002		BRA.B $FF801BEE
FF801BEC	7001		MOVEQ.L #$1,D0
FF801BEE	486EFFB4		PEA.L -$4C(A6)
FF801BF2	2F00		MOVE.L D0,-(A7)
FF801BF4	4EB9FF83	9EE6	JSR get_bscb
FF801BFA	202EFFB4		MOVE.L -$4C(A6),D0
: .	(The balance of this code is continued in the code/data fields of the remaining S3 record, and stored in memory location FF801BFE, etc.)		
4C	The checksum of the first S3 record.		

The second S3 record contains $0D (13) character pairs and is ended with checksum 5B.

The S7 record is explained as follows:

`S7`	S-record type S7, indicating that it is a termination record.
`05`	Hexadecimal 05, indicating that five character pairs (5 bytes) follow.
`FF801BDC`	The address field, indicating the address of the instruction to which control may be passed (program entry point).
`84`	The checksum of the S7 record.

Each printable character in an S-record is encoded in a hexadecimal (ASCII in this example) representation of the binary bits which are actually transmitted. For example, the first S3 record above is sent as:

Type		Length		Address								Code / Data						Check-sum	
S 3		2 5		F	F	8	0	1	B	D	C	4	E	5	6	F	...	4 C	
53	33	32	35	46	46	38	30	31	42	44	43	34	45	35	36	46	...	34	43

Information Used by BO and BH Commands

D

VID

Table D-1. Volume ID Block #0 (VID)

Label	Offsets(&)	Length (Bytes)	Contents
VIDOSS	$14 (20)	4	Starting block number of operating system.
VIDOSL	$18 (24)	2	Operating system length in blocks.
VIDOSA	$1E (30)	4	Starting memory location to load operating system.
VIDCAS	$90 (144)	4	Media configuration area starting block.
VIDCAL	$94 (148)	1	Media configuration area length in blocks.
VIDMOT	$F8 (248)	8	Contains the string "MOTOROLA".

CFGA

Table D-2. Configuration Area Block #1 (CFGA)

Label	Offsets(&)	Length (Bytes)	Contents
IOSATM	$04 (4)	2	Attributes mask.
IOSPRM	$06 (6)	2	Parameters mask.
IOSATW	$08 (8)	2	Attributes word.
IOSREC	$0A (10)	2	Record (block) size in bytes.
IOSSPT	$18 (24)	1	Sectors/track.
IOSHDS	$19 (25)	1	Number of heads on drive.

Table D-2. Configuration Area Block #1 (CFGA) (Continued)

Label	Offsets(&)	Length (Bytes)	Contents
IOSTRK	$1A (26)	2	Number of cylinders.
IOSILV	$1C (28)	1	Interleave factor on media.
IOSSOF	$1D (29)	1	Spiral offset.
IOSPSM	$1E (30)	2	Physical sector size of media in bytes.
IOSSHD	$20 (32)	2	Starting head number.
IOSPCOM	$24 (36)	2	Precompensation cylinder.
IOSSR	$27 (39)	1	Stepping rate code.
IOSRWCC	$28 (40)	2	Reduced write current cylinder number.
IOSECC	$2A (42)	2	ECC data burst length.
IOSEATM	$2C (44)	2	Extended attributes mask.
IOSEPRM	$2E (46)	2	Extended parameters mask.
IOSEATW	$30 (48)	2	Extended attributes word.
IOSGPB1	$32 (50)	1	Gap byte 1.
IOSGPB2	$33 (51)	1	Gap byte 2.
IOSGPB3	$34 (52)	1	Gap byte 3.
IOSGPB4	$35 (53)	1	Gap byte 4.
IOSSSC	$36 (54)	1	Spare sectors count.
IOSRUNIT	$37 (55)	1	Reserved area units.
IOSRSVC1	$38 (56)	2	Reserved count 1.
IOSRSVC2	$3A (58)	2	Reserved count 2.

IOSATM and IOSEATM

A “1” in a particular bit position indicates that the corresponding attribute from the attributes (or extended attributes) word should be used to update the configuration. A “0” in a bit position indicates that the current attribute should be retained.

Table D-3. IOSATM Attribute Mask Bit Definitions

Label	Bit Position	Description
IOADDEN	0	Data density.
IOATDEN	1	Track density.
IOADSIDE	2	Single/double sided.
IOAFRMT	3	Floppy disk format.
IOARDISC	4	Disk type.
IOADDEND	5	Drive data density.
IOATDEND	6	Drive track density.
IOARIBS	7	Embedded servo drive seek.
IOADPCOM	8	Post-read/pre-write precompensation.
IOASIZE	9	Floppy disk size.
IOATKZD	13	Track zero data density.

At the present, all IOSEATM bits are undefined and should be set to 0.

IOSPRM and IOSEPRM

A “1” in a particular bit position indicates that the corresponding parameter from the configuration area (CFGA) should be used to update the device configuration. A “0” in a bit position indicates that the parameter value in the current configuration will be retained.

Table D-4. IOSPRM Parameter Mask Bit Definitions

Label	Bit Position	Description
IOSRECB	0	Operating system block size.
IOSSPTB	4	Sectors per track.
IOSHDSB	5	Number of heads.
IOSTRKB	6	Number of cylinders.
IOSILVB	7	Interleave factor.
IOSSOFB	8	Spiral offset.
IOSPSMB	9	Physical sector size.
IOSSHDB	10	Starting head number.
IOSPCOMB	12	Precompensation cylinder number.
IOSSRB	14	Step rate code.
IOSRWCCB	15	Reduced write current cylinder number and ECC data burst length.

IOSATW and IOSEATW

Contains various flags that specify characteristics of the media and drive.

Table D-5. IOSEPRM Parameter Mask Bit Definitions

Label	Bit Position	Description
IOAGPB1	0	Gap byte 1.
IOAGPB2	1	Gap byte 2.
IOAGPB3	2	Gap byte 3.
IOAGPB4	3	Gap byte 4.
IOASSC	4	Spare sector count.
IOARUNIT	5	Reserved area units.
IOARVC1	6	Reserved count 1.
IOARVC2	7	Reserved count 2.

Table D-6. IOSATW Bit Definitions

Bit Number	Description	
Bit 0	Data density	0 = Single density (FM encoding)
		1 = Double density (MFM encoding)
Bit 1	Track density	0 = Single density (48 TPI)
		1 = Double density (96 TPI)
Bit 2	Number of sides	0 = Single sided floppy
		1 = Double sided floppy
Bit 3	Floppy disk format (sector numbering)	0 = Motorola format 1 to N on side 0 N+1 to 2N on side 1
		1 = Standard IBM format 1 to N on both sides
Bit 4	Disk type	0 = Floppy disk
		1 = Hard disk

Table D-6. IOSATW Bit Definitions (Continued)

Bit Number	Description	
Bit 5	Drive data density	0 = Single density (FM encoding)
		1 = Double density (MFM encoding)
Bit 6	Drive track density	0 = Single density
		1 = Double density
Bit 7	Embedded servo drive	0 = Do not seek on head switch
		1 = Seek on head switch
Bit 8	Post-read/pre-write precompensation:	0 = Pre-write
		1 = Post-read
Bit 9	Floppy disk size:	0 = 5-1/4 inch floppy
		1 = 8-inch floppy
Bit 13	Track zero density:	0 = Single density (FM encoding)
		1 = Same as remaining tracks

At the present, all IOSEATW bits are undefined and should be set to 0.

Parameter Fields

Table D-7. Parameter Field Definitions

Parameter	Description
Record (Block) size	Number of bytes per record (block). Must be an integer multiple of the physical sector size.
Sectors/track	Number of sectors per track.
Number of heads	Number of recording surfaces for the specified device.
Number of cylinders	Number of cylinders on the media.
Interleave factor	This field specifies how the sectors are formatted on a track. Normally, consecutive sectors in a track are numbered sequentially in increments of 1 (interleave factor of 1). The interleave factor controls the physical separation of logically sequential sectors. This physical separation gives the host time to prepare to read the next logical sector without requiring the loss of an entire disk revolution.
Physical sector size	Actual number of bytes per sector on media.
Spiral offset	Used to displace the logical start of a track from the physical start of a track. The displacement is equal to the spiral offset times the head number, assuming that the first head is 0. This displacement is used to give the controller time for a head switch when crossing tracks.
Starting head number	Defines the first head number for the device.
Precompensation cylinder	Defines the cylinder on which precompensation begins.

Table D-7. Parameter Field Definitions (Continued)

Parameter	Description
Stepping rate code	The step rate is an encoded field used to specify the rate at which the read/write heads can be moved when seeking a track on the disk. The encoding is as follows: Step Rate Code / Winchester Hard Disks / 5-1/4 Inch Floppy / 8-Inch Floppy 000 / 0 msec / 12 msec / 6 msec 001 / 6 msec / 6 msec / 3 msec 010 / 10 msec / 12 msec / 6 msec 011 / 15 msec / 20 msec / 10 msec 100 / 20 msec / 30 msec / 15 msec
Reduced write current cycle	This field specifies the cylinder number at which the write current should be reduced when writing to the drive. This parameter is normally specified by the drive manufacturer.
ECC data burst length	This field defines the number of bits to correct for an ECC error when supported by the disk controller.
Gap byte 1	This field contains the number of words of zeros that are written before the header field in each sector during format.
Gap byte 2	This field contains the number of words of zeros that are written between the header and data fields during format and write commands.
Gap byte 3	This field contains the number of words of zeros that are written after the data fields during format commands.
Gap byte 4	This field contains the number of words of zeros that are written after the last sector of a track and before the index pulse.

Table D-7. Parameter Field Definitions (Continued)

Parameter	Description
Spare sectors count	This field contains the number of sectors per track allocated as spare sectors. These sectors are only used as replacements for bad sectors on the disk.
Reserved area units	This field specifies the units used for the next two fields (IOSRSVC1 and IOSRSVC2). If zero, the units are in tracks; if 1, the units are in cylinders.
Reserved count 1	This field specifies the number of tracks (IOSRUNIT = 0), or the number of cylinders (IOSRUNIT = 1) reserved for the alternate mapping area on the disk.
Reserved count 2	This field specifies the number of tracks (IOSRUNIT = 0), or the number of cylinders (IOSRUNIT = 1) reserved for use by the controller.

Disk/Tape Controller Data E

Disk/Tape Controller Modules Supported

The following VMEbus disk/tape controller modules are supported by the 16XBug. However, not all modules listed in the table are supported by every microprocessor VMEmodule.

The default address for each controller type is First Address and the controller can be addressed by First CLUN during commands **BH**, **BO**, or **IOP**, or during TRAP #15 calls .DSKRD or .DSKWR.

Note that if another controller of the same type is used, the second one must have its address changed by its onboard jumpers and/or switches, so that it matches Second Address and can be called up by Second CLUN.

Table E-1. Disk/Tape Controller Data

Controller Type	First CLUN	First Address	Second CLUN	Second Address
CISC Single Board Computer (SBC)	$00 (Note 1)	--	--	--
MVME320 - Winchester/Floppy Controller	$11 (Note 2)	$FFFFB000	$12 (Note 2)	$FFFFAC00
MVME323 - ESDI Winchester Controller	$08	$FFFFA000	$09	$FFFFA200
MVME327A - SCSI Controller	$02	$FFFFA600	$03	$FFFFA700
MVME328 - SCSI Controller	$06	$FFFF9000	$07	$FFFF9800
MVME328 - SCSI Controller	$16	$FFFF4800	$17	$FFFF5800
MVME328 - SCSI Controller	$18	$FFFF7000	$19	$FFFF7800
MVME350 - Streaming Tape Controller	$04	$FFFF5000	$05	$FFFF5100

Notes: 1. If the SBC (e.g., an MVME167) SCSI port is used, then the SBC module has CLUN 0.

2. For SBCs, the first MVME320 has CLUN $11, and the second MVME320 has CLUN $12.

Disk/Tape Controller Default Configurations

Note: SCSI Common Command Set (CCS) devices are only the ones tested by Motorola Computer Group.

Table E-2. CISC Single Board Computers -- 7 Device

Controller		Device	
CLUN	**Address**	**DLUN**	**Type**
0	$*XXXXXXXX*	00 10 20 30 40 50 60	SCSI Common Command Set (CCS), which may be any of these: - Fixed direct access - Removable flexible direct access (TEAC style) - CD-ROM - Sequential access
		80 81	Local floppy drive

Table E-3. MVME320 -- 4 Devices

Controller		Device	
CLUN	**Address**	**DLUN**	**Type**
11	$FFFFB000	0 1	Winchester hard drive
12	$FFFFAC00	2 3	5-1/4" DS/DD 96 TPI floppy drive

Table E-4. MVME323 -- 4 Devices

Controller		Device	
CLUN	**Address**	**DLUN**	**Type**
8	$FFFFA000	0 2	ESDI Winchester hard drive
9	$FFFFA200	3 4	

Table E-5. MVME327A -- 9 Devices

Controller		Device	
CLUN	**Address**	**DLUN**	**Type**
2	$FFFFA600	00	SCSI Common Command Set (CCS), which may be any of these: - Fixed direct access - Removable flexible direct access (TEAC style) - CD-ROM - Sequential access
		10	
3	$FFFFA700	20	
		30	
		40	
		50	
		60	
		80	Local floppy drive
		81	

Table E-6. MVME328 -- 14 Devices

Controller		Device	
CLUN	**Address**	**DLUN**	**Type**
6	$FFFF9000	00	SCSI Common Command Set (CCS), which may be any of these: - Removable flexible direct access (TEAC style) - CD-ROM - Sequential access
		08	
7	$FFFF9800	10	
		18	
16	$FFFF4800	20	
		28	
17	$FFFF5800	30	
		40	Same as above, but these will only be available if the daughter card for the second SCSI channel is present
18	$FFFF7000	48	
		50	
19	$FFFF7800	58	
		60	
		68	
		70	

Table E-7. MVME350 -- 1 Device

Controller		Device	
CLUN	**Address**	**DLUN**	**Type**
4	$FFFF5000	0	QIC-02 streaming tape drive
5	$FFFF5100		

IOT Command Parameters for Supported Floppy Types

The following table lists the proper **IOT** command parameters for floppies used with boards such as the MVME328, MVME167, and MVME187.

Table E-8. IOT Command Parameters

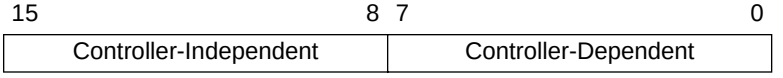
IOT Parameter	Floppy Types and Formats						
	DSDD5	**PCXT8**	**PCXT9**	**PCXT9_3**	**PCAT**	**PS2**	**SHD**
Sector Size 0- 128 1- 256 2- 512 3-1024 4-2048 5-4096 =	1	2	2	2	2	2	2
Block Size: 0- 128 1- 256 2- 512 3-1024 4-2048 5-4096 =	1	1	1	1	1	1	1
Sectors/Track	10	8	9	9	F	12	24
Number of Heads =	2	2	2	2	2	2	2
Number of Cylinders =	50	28	28	50	50	50	50
Precomp. Cylinder =	50	28	28	50	50	50	50
Reduced Write Current Cylinder =	50	28	28	50	50	50	50
Step Rate Code =	0	0	0	0	0	0	0
Single/Double DATA Density =	D	D	D	D	D	D	D
Single/Double TRACK Density =	D	D	D	D	D	D	D
Single/Equal_in_all Track Zero Density =	S	E	E	E	E	E	E
Slow/Fast Data Rate =	S	S	S	S	F	F	F
Other Characteristics							
Number of Physical Sectors	0A00	0280	02D0	05A0	0960	0B40	1680
Number of Logical Blocks (100 in size)	09F8	0500	05A0	0B40	12C0	1680	2D00
Number of Bytes in Decimal	653312	327680	368460	737280	1228800	1474560	2949120
Media Size/Density	5.25/DD	5.25/DD	5.25/DD	3.5/DD	5.25/HD	3.5/HD	3.5/ED

Notes:
1. All numerical parameters are in hexadecimal unless otherwise noted.
2. The DSDD5 type floppy is the default setting for the debugger.

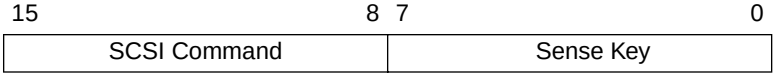
Disk Communication Status Codes

F

The status word returned by the disk TRAP #15 routines flags an error condition if it is nonzero. The most significant byte of the status word reflects controller-independent errors, and they are generated by the disk trap routines. The least significant byte reflects controller-dependent errors, and they are generated by the controller. The status word is shown below:



Because of the nature of the MVME328 Dual SCSI Host Adapter, additional status may be returned. The format of the additional error status is as follows:



The SCSI Command is a byte that identifies the command that was issued in which the Sense Key was returned. The Sense Key is a byte that is returned in Request Sense Data buffer (byte number two). Refer to the ANSI X3T9.2 SCSI Specification.

Table F-1. Controller-Independent Status Codes

Code	Description
$00	No error detected.
$01	Invalid controller type.
$02	Controller descriptor not found.
$03	Device descriptor not found.
$04	Controller already attached.
$05	Descriptor table not found.
$06	Invalid command packet.

Table F-1. Controller-Independent Status Codes (Continued)

Code	Description
$07	Invalid address for transfer.
$08	Block conversion error.
$09	Invalid parameter in configuration.
$0A	Transfer data count mismatch error.
$0B	Invalid status received in command packet.
$0C	Command aborted via break.

MVME167/MVME177 SCSI Firmware Status Codes

The following is a list of error codes returned by the MVME167/177 SCSI firmware that cause the error codes returned by the bug.

The bug returns a single word (16 bits) for an error code. The upper byte is Controller-Independent, and is assigned by the bug, while the lower byte is Controller-Dependent, and is formed from selecting one of two bytes (SIOP Status or SCSI Bus Status) of error information returned by the firmware. The precedence by which one of the two bytes is selected by the bug is: if the SCSI Bus Status byte returned by the firmware is non-zero, return this byte as the Controller-Dependent code and throw away the SIOP Status byte; else if the SCSI Bus Status is zero, return the SIOP Status byte.

Therefore, there is dual use of the Controller-Dependent error code byte, for error code bytes $02, $04, $08, $10, $14, and $18. For example, if the Controller-Dependent value returned by the bug is a $02, then this code could have two possible meanings:

```
$02    SCSI Bus Status:   Check condition.
$02    SIOP Status:       Command aborted - SCSI bus reset.
```

Below is a list of the error codes and a short description of each for the SCSI Bus Status and the SIOP Status.

Table F-2. MVME167/MVME177 SCSI Firmware Status Codes

Code	Description
SCSI Bus Status	
$00	Good completion.
$02	Check condition.
$04	Condition met good.
$08	Busy.
$10	Intermediate good.
$14	Intermediate condition met good.
$18	Reservation conflict.
$22	Command terminated.
$28	Queue full.
SIOP Status	
$00	Good status.
$01	No operation bits were set.
$02	Command aborted - SCSI bus reset.
$03	Command aborted - bus device reset message.
$04	Command aborted - abort message.
$05	Command aborted - abort tag message.
$06	Command aborted - clear queue message.
$07	Data overflow - too much data.
$08	Data underrun - not enough data.
$09	Clock faster than 75 MHz.
$0A	Bad clock parameter - ASCII clock value Zero or non-ASCII.

Table F-2. MVME167/MVME177 SCSI Firmware Status Codes (Continued)

Code	Description
$0B	Queue depth too large (> 255).
$0C	Selection time-out.
$0D	Reselection time-out.
$0E	Bus error during a data phase.
$0F	Bus error during a non-data phase.
$10	Illegal NCR script instruction.
$11	Command aborted - unexpected disconnect.
$12	Command aborted - unexpected phase change.
$13	SCSI bus hung during command.
$14	Data phase not expected by user.
$15	Data phase was in wrong direction.
$16	Incorrect phase following select.
$17	Incorrect phase following message-out.
$18	Incorrect phase following data.
$19	Incorrect phase following command.
$1A	Incorrect phase following status.
$1B	Incorrect phase following rptr message.
$1C	Incorrect phase following sdptr message.
$1D	No identify message after re-selection.
$1E	Siop failed during script patching.
$1F	SIOP not attached to SCSI bus.

Table F-3. MVME320 Controller-Dependent Status Codes

Code	Description
$00	Correct execution without error.
$01	Nonrecoverable error which cannot be completed (auto retries were attempted).
$02	Drive not ready.
$03	Reserved.
$04	Sector address out of range.
$05	Throughput error (floppy data overrun).
$06	Command rejected (illegal command).
$07	Busy (controller busy).
$08	Drive not available (head out of range).
$09	DMA operation cannot be completed (VMEbus error).
$0A	Command abort (reset busy).
$0B-$FF	Not used.

Table F-4. MVME323 Controller-Dependent Status Codes

Code	Description
$00	Correct execution without error.
$10	Disk not ready.
$11	Not used.
$12	Seek error.
$13	ECC code error-data field.

Table F-4. MVME323 Controller-Dependent Status Codes (Continued)

Code	Description
$14	Invalid command code.
$15	Illegal fetch and execute command.
$16	Invalid sector in command.
$17	Illegal memory type.
$18	Bus time-out.
$19	Header checksum error.
$1A	Disk write-protected.
$1B	Unit not selected.
$1C	Seek error time-out.
$1D	Fault time-out.
$1E	Drive faulted.
$1F	Ready time-out.
$20	End of Medium.
$21	Translation Fault.
$22	Invalid Header Pad.
$23	Uncorrectable error.
$24	Translation error - cylinder.
$25	Translation error - head.
$26	Translation error - sector.
$27	Data overrun.
$28	No index pulse on format.
$29	Sector not found.
$2A	ID field error - wrong head.
$2B	Invalid sync in data field.
$2C	No valid header found.

Table F-4. MVME323 Controller-Dependent Status Codes (Continued)

Code	Description
$2D	Seek time-out error.
$2E	Busy time-out.
$2F	Not on cylinder.
$30	RTZ time-out.
$31	Invalid sync in header.
$32-3F	Not used.
$40	Unit not initialized.
$41	Not used.
$42	Gap specification error.
$43-4A	Not used.
$4B	Seek error.
$4C-4F	Not used.
$50	Sectors-per-track error.
$51	Bytes-per-sector specification error.
$52	Interleave specification error.
$53	Invalid head address.
$54	Invalid cylinder address.
$55-5C	Not used.
$5D	Invalid DMA transfer count.
$5E-5F	Not used.
$60	IOPB failed.
$61	DMA failed.

Table F-4. MVME323 Controller-Dependent Status Codes (Continued)

Code	Description
$62	Illegal VME address.
$63-69	Not used.
$6A	Unrecognized header field.
$6B	Mapped header error.
$6C-6E	Not used.
$6F	No spare sector enabled.
$70-76	Not used.
$77	Command aborted.
$78	ACFAIL detected.
$79-EF	Not used.
$F0-FE	Unforeseen error - call your field service representative and tell them the IOPB and UIB information that was available at the time the error occurred.
$FF	Command not implemented.

Table F-5. MVME327A Controller-Dependent Status Codes

Code	Description
$00	Good.
$01-0F Command Parameter Errors	
$01	Bad descriptor.
$02	Bad command.

Table F-5. MVME327A Controller-Dependent Status Codes (Continued)

Code	Description
$03	Unimplemented command.
$04	Bad drive.
$05	Bad logical address.
$06	Bad scatter/gather table.
$07	Unimplemented device.
$08	Unit not initialized.
$10-1F Media Errors	
$10	No ID found on track.
$11	Seek error.
$12	Relocated track error.
$13	Record not found, bad ID.
$14	Data sync fault.
$15	ECC error.
$16	Record not found.
$17	Media error.
$20-2F Drive Errors	
$20	Drive fault.
$21	Write protected media.
$22	Motor not on.
$23	Door open.
$24	Drive not ready.
$25	Drive busy.
$30-3F VME DMA Errors	
$30	VMEbus error.
$31	Bad address assignment.

Table F-5. MVME327A Controller-Dependent Status Codes (Continued)

Code	Description
$32	Bus time-out.
$33	Invalid DMA transfer count.
$40-4F Disk Format Errors	
$40	Not enough alternates.
$41	Format failed.
$42	Verify error.
$43	Bad format parameters.
$44	Cannot fix bad spot.
$45	Too many defects.
$80-FF MVME327A Specific Errors	
$80	SCSI error, additional status available.
$81	Indeterminate media error, no additional information.
$82	Indeterminate hardware error.
$83	Blank check (EOD or corrupted WORM).
$84	Incomplete extended message from target.
$85	Invalid reselection by an unthreaded target.
$86	No status returned from target.
$87	Message out not transferred to target.
$88	Message in not received from target.
$89	Incomplete data read to private buffer.
$8A	Incomplete data write from private buffer.
$8B	Incorrect CDB size was given.
$8C	Undefined SCSI phase was requested.
$8D	Time-out occurred during a select phase.
$8E	Command terminated due to SCSI bus request.

Table F-5. MVME327A Controller-Dependent Status Codes (Continued)

Code	Description
$8F	Invalid message received.
$90	Command not received.
$91	Unexpected status phase.
$92	SCSI script mismatch.
$93	Unexpected disconnect caused command failure.
$94	Request sense command was not successful.
$95	No write descriptor for controller drive.
$96	Incomplete data transfer.
$97	Out of local resources for command processing.
$98	Local memory resources lost.
$99	Channel reserved for another VME host.
$9A	Device reserved for another SCSI device.
$9B	Already enabled, expecting target response.
$9C	Target not enabled.
$9D	Unsupported controller type.
$9E	Unsupported peripheral device type.
$9F	Block size mismatch.
$A0	Invalid cylinder number in format defect list.
$A1	Invalid head number in format defect list.
$A2	Block size mismatch--nonfatal.
$A3	Our SCSI ID was not changed by command.
$A4	Our SCSI ID has changed.
$A5	No target enable has been completed.
$A6	Cannot do longword transfers (Note).
$A7	Cannot do DMA transfers.

Table F-5. MVME327A Controller-Dependent Status Codes (Continued)

Code	Description
$A8	Invalid logical block size.
$A9	Sectors per track mismatch.
$AA	Number of heads mismatch.
$AB	Number of cylinders mismatch.
$AC	Invalid floppy parameter(s).
$AD	Already reserved.
$AE	Was not reserved.
$AF	Invalid sector number.
$CC	Self test failed.
Note:	A “longword” in M68000 systems is the same size as a “word” in M88000 systems: four bytes.

Table F-6. MVME328 Controller-Dependent Status Codes

Code	Description
MACSI/Controller Error Codes	
$00	Good status.
$01	Queue full.
$02	Work queue initialization error.
$03	First command error.
$04	Command code error.
$05	Queue number error.
$06	Queue already initialized.
$07	Queue uninitialized.

Table F-6. MVME328 Controller-Dependent Status Codes (Continued)

Code	Description
$08	Queue mode not ready.
$09	Command unavailable.
$0B	Invalid burst count.
General Error Code Information	
$10	Reserved field error.
$11	Reset bus status.
$12	Secondary port unavailable.
$13	SCSI ID error.
$14	SCSI bus reset status.
$15	Command aborted by reset.
$16	Page size error.
$17	Invalid command tag.
$18	Busy command tag.
VMEbus Errors	
$20	VMEbus bus error.
$21	VMEbus time-out.
$23	VMEbus illegal address.
$24	VMEbus illegal memory type.
$25	Illegal count specified.
$26	VMEbus fetch error.
$27	VMEbus fetch time-out.
$28	VMEbus post error.
$29	VMEbus post time-out.
$2A	VMEbus illegal fetch address.
$2B	VMEbus illegal post address.

Table F-6. MVME328 Controller-Dependent Status Codes (Continued)

Code	Description
$2C	VMEbus scatter/gather fetch.
$2D	VMEbus scatter/gather time-out.
$2E	Invalid scatter/gather count.
SCSI Errors	
$30	SCSI selection time-out error.
$31	SCSI disconnect time-out error.
$32	Abnormal SCSI sequence.
$33	SCSI disconnect error.
$34	SCSI transfer count exception.
$35	SCSI parity error.
Scatter/Gather Errors	
$40	Illegal scatter/gather count.
$41	Illegal scatter/gather memory type.
$42	Illegal scatter/gather address.
Error Handling Codes	
$50	Read/write buffer count error.
$51	Illegal read/write.
$80	Flush on error in progress.
$81	Flush work queue status.
$82	Missing command.
$83	Counter exhausted.
$84	Data direction error.
Printer Port Errors	
$90	Printer status change.
$91	Printer count too short.

Table F-6. MVME328 Controller-Dependent Status Codes (Continued)

Code	Description
$92	Bad data length field.
$93	Printer unavailable.
$99	Scatter/gather selected for printer port.
Other Errors	
$C0	Bad IOPB type.
$C1	IOPB time-out error.

Table F-7. MVME350 Controller-Dependent Status Codes

Code	Description
$00	Correct execution without error.
$01	Block in error not located.
$02	Unrecoverable data error.
$03	End of media.
$04	Write protected.
$05	Drive offline.
$06	Cartridge not in place.
$0D	No data detected.
$0E	Illegal command.
$12	Tape reset did not occur.
$17	Time-out.
$18	Bad drive.
$1A	Bad command.
$1E	Fatal error.

Network Controller Data G

Network Controller Modules Supported

The following VMEbus network controller modules are supported by the debugger. The default address for each type and position is showed to indicate where the controller must reside to be supported by the debugger.

The controllers are accessed via the specified CLUN and DLUNs listed here. The CLUN and DLUNs are used in conjunction with the debugger commands **NBH**, **NBO**, **NIOP**, **NIOC**, **NIOT**, **NPING**, and **NAB**, and also with the debugger system calls .NETRD, .NETWR, .NETFOPN, .NETFRD, .NETCFIG, and .NETCTRL.

Table G-1. Network Controller Data

Controller Type	CLUN	DLUN	Address	Interface Type
MVME162	$00	$00	$FFF46000	Ethernet
MVME167	$00	$00	$FFF46000	Ethernet
MVME177	$00	$00	$FFF46000	Ethernet
MVME376	$02	$00	$FFFF1200	Ethernet
MVME376	$03	$00	$FFFF1400	Ethernet
MVME376	$04	$00	$FFFF1600	Ethernet
MVME376	$05	$00	$FFFF5400	Ethernet
MVME376	$06	$00	$FFFF5600	Ethernet
MVME376	$07	$00	$FFFFA400	Ethernet
MVME374	$10	$00	$FF000000	Ethernet
MVME374	$11	$00	$FF100000	Ethernet

Table G-1. Network Controller Data (Continued)

Controller Type	CLUN	DLUN	Address	Interface Type
MVME374	$12	$00	$FF200000	Ethernet
MVME374	$13	$00	$FF300000	Ethernet
MVME374	$14	$00	$FF400000	Ethernet
MVME374	$15	$00	$FF500000	Ethernet

Network Communication Status Codes

H

The network communication error codes are classified in two types; controller independent and controller dependent. The controller-independent error codes are independent of the specified network interface; these errors are normally some type of operator error. The controller-dependent error codes relate directly to the specified network interface; these errors occur at the driver level out to and including the network.

The status word returned by the network TRAP #15 routines flags an error condition if it is nonzero. The most significant byte of the status word reflects controller-independent errors, and they are generated by the network trap routines. The least significant byte reflects controller dependent errors, and they are generated by the controller. The status word is shown below:

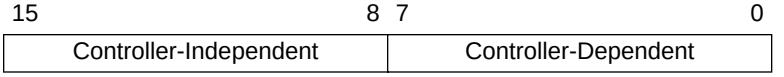


Table H-1. Controller-Independent Status Codes

Code	Description
$01	Invalid controller logical unit number.
$02	Invalid device logical unit number.
$03	Invalid command identifier.
$04	Clock (RTC) is not running.
$05	TFTP retry count exceeded.
$06	BOOTP retry count exceeded.
$07	NVRAM write failure.
$08	Illegal IPL load address.

Table H-1. Controller-Independent Status Codes

Code	Description
$09	User abort, break key depressed.
$0A	Time-out expired.
$81	TFTP, File not found.
$82	TFTP, Access violation.
$83	TFTP, Disk full or allocation exceeded.
$84	TFTP, Illegal TFTP operation.
$85	TFTP, Unknown transfer ID.
$86	TFTP, File already exists.
$87	TFTP, No such user.

Table H-2. Controller-Dependent Status Codes

Code	Description
Intel 82596 - LAN Coprocessor	
$01	64Kbyte buffer not 16 byte aligned.
$02	SCP block not 16 byte aligned.
$03	SCB read address failure.
$04	Configure command completed with error.
$05	Command unit not idle.
$06	Command unit pending interrupt status.
$07	Individual address setup (IAS) command completed with error.
$08	Transmit command completed with error.
$09	64Kbyte buffer limit exceeded (software).
$0A	Receive unit not idle.
$0B	Invalid data length, larger than Ethernet packet maximum.

Table H-2. Controller-Dependent Status Codes (Continued)

Code	Description
MVME374 (AMD AM7990 - LANCE)	
$01	256Kbyte buffer not 16 byte aligned.
$02	Shared memory buffer limit exceeded (software).
$03	Invalid data length, larger than Ethernet packet maximum.
$10	LANCE memory error.
$11	LANCE transmitter babble error.
$12	LANCE transmitter collision error.
$13	LANCE transmitter buffer error.
$14	LANCE transmitter underflow error.
$15	LANCE transmitter late collision error.
$16	LANCE transmitter loss of carrier error.
$17	LANCE transmitter retry error.
$18	LANCE receiver buffer error.
$19	LANCE receiver CRC error.
$1A	LANCE receiver overflow error.
$1B	LANCE receiver framing error.
$20	Board failure error.
$21	No response from server error.
MVME376 (AMD AM7990 - LANCE)	
$01	256Kbyte buffer not 16 byte aligned.
$02	Shared memory buffer limit exceeded (software).
$03	Invalid data length, larger than Ethernet packet maximum.
$10	LANCE memory error.
$11	LANCE transmitter babble error.
$12	LANCE transmitter collision error.

Table H-2. Controller-Dependent Status Codes (Continued)

Code	Description
$13	LANCE transmitter buffer error.
$14	LANCE transmitter underflow error.
$15	LANCE transmitter late collision error.
$16	LANCE transmitter loss of carrier error.
$17	LANCE transmitter retry error.
$18	LANCE receiver buffer error.
$19	LANCE receiver CRC error.
$1A	LANCE receiver overflow error.
$1B	LANCE receiver framing error.

Network Header File and Assembly Interface

I

"C" Header File

```
/**/
/*     Source Code Control System ID header  */
/**/
/*     @(#)net.h 1.1 3/6/92 */
/**/
/*
 * Module name: net.h
 * Description:
 *      Network I/O Definitions Header File
 * SCCS identification: 1.1
 * Branch: 0
 * Sequence: 0
 * Date newest applied delta was created (MM/DD/YY): 3/6/92
 * Time newest applied delta was created (HH:MM:SS): 12:46:22
 * SCCS file name /riscy/fwdb/BUGDB/src/src/include/s.net.h
 * Fully qualified SCCS file name:
 *     /riscy/fwdb/BUGDB/src/src/include/s.net.h
 * Copyright:
 *     (C) BRAND X, INC. 1992
 *     ALL RIGHTS RESERVED
 * Notes:
 *     1. This file was created for the benefit of users.  It
 *        does not really exist in the debugger source data base;
 *        however, various pieces were extracted from source files.
 * History:
 * Date          Revision     Who               Comments
 * 01/29/92      1.00         John Doe          Initial release.
 *
 */
/*
 * internet protocol (IP) address structure template
 */
#define IPA_LENGTH  4
typedef struct ip_address {
 UCHAR address[IPA_LENGTH];
} IP_ADDRESS;
```

```
/*
 * network configuration parameters structure template
 *
 * note:
 * when any changes are made to this structure template
 * the NET_MAGIC definition needs modification
 */
#define BFNAMESIZE  64          /* boot filename size */
#define NET_MAGIC  0x12301983   /* structure template magic number */
typedef struct netcnfgp {
 UINT magic;                    /* magic number of this template */
 UINT nodememory;               /* node control memory address */
 UINT bfla;                     /* boot file load address */
 UINT bfea;                     /* boot file execution address */
 UINT bfed;                     /* boot file execution delay */
 UINT bfl;                      /* boot file length */
 UINT bfbo;                     /* boot file byte offset */
 UINT tbuffera;                 /* trace buffer address (txd/rxd packets) */
 IP_ADDRESS cipa;               /* client IP address */
 IP_ADDRESS sipa;               /* server IP address */
 IP_ADDRESS subnetmask;         /* subnet IP address mask */
 IP_ADDRESS broadcast;          /* broadcast IP address */
 IP_ADDRESS gipa;               /* gateway IP address */
 UCHAR bootp_retrys;            /* maximum number of retrys, BOOTP/RARP request */
 UCHAR tftp_retrys;             /* maximum number of retrys, TFTP/ARP request */
 UCHAR bootp_ctl;               /* BOOTP/RARP request control */
 UCHAR cnfgp_ctl;               /* configuration parameters update control */
 UCHAR filename[BFNAMESIZE];    /* boot filename buffer string */
 UCHAR argfname[BFNAMESIZE];    /* argument filename buffer string */
} NETCNFGP;
/*
 * device configuration parameters structure template
 * (currently not used)
 */
typedef struct devicecp {
 UINT fill;
} DEVICECP;
/*
 * error status word structure template
 */

struct estatusw {
 UCHAR ci;                      /* controller independent */
 UCHAR cd;                      /* controller dependent */
};
/*
 * controller independent error codes
 */
```

```
#define NIO_ERR_ICLUN        0x01     /* invalid controller logical unit number */
#define NIO_ERR_IDLUN        0x02     /* invalid device logical unit number */
#define NIO_ERR_ICID         0x03     /* invalid command identifier */
#define NIO_ERR_NOCLOCK      0x04     /* clock is not running */
#define NIO_ERR_TFTPRE       0x05     /* TFTP retry count exceeded */
#define NIO_ERR_BOOTPRE      0x06     /* BOOTP retry count exceeded */
#define NIO_ERR_NVRAMWF      0x07     /* NVRAM write failure */
#define NIO_ERR_IIPLLA       0x08     /* illegal IPL load address */
#define NIO_ERR_USRABRT      0x09     /* user abort, break key depressed */
#define NIO_ERR_TOEXPRD      0x0A     /* timeout expired */
/*
 * MVME167/187 Error Codes
 *
 * error codes returned by driver, these codes will be placed in
 * the controller dependent field of the command packet status
 * word
 *
 * note: all error codes must be non-zero, an error code of 0x00
 *       signifies no error
 */
#define V187_ERR_BNA         0x01     /* 64Kbyte buffer not 16 byte aligned */
#define V187_ERR_SCPNA       0x02     /* SCP block not 16 byte aligned */
#define V187_ERR_SCBRAF      0x03     /* SCB read address failure */
#define V187_ERR_CNFGCE      0x04     /* configure command completed with error */
#define V187_ERR_CUNIDLE     0x05     /* command unit not idle */
#define V187_ERR_CUPIS       0x06     /* command unit pending interrupt status */
#define V187_ERR_IASCE       0x07    /* individual address setup (IAS) command
completed with error */
#define V187_ERR_TXDCE       0x08     /* transmit command completed with error */
#define V187_ERR_BSIZ       0x09    /* 64Kbyte buffer limit exceeded (software)
*/
#define V187_ERR_RUNIDLE     0x0A     /* receive unit not idle */
#define V187_ERR_IDLNGTH     0x0B     /* invalid data length (MIN <= LNGTH <=
MAX) */
/*
 * MVME374 Error Codes
 *
 * error codes returned by driver, these codes will be placed in
 * the controller dependent field of the command packet status
 * word
 *
 * note: all error codes must be non-zero, an error code of 0x00
 *       signifies no error
 */
#define V374_ERR_BNA         0x01     /* 256Kbyte buffer not 16 byte aligned */
#define V374_ERR_BSIZ        0x02     /* shared memory buffer limit exceeded
(software) */
#define V374_ERR_IDLNGTH     0x03     /* invalid data length (MIN <= LNGTH <=
MAX) */
#define V374_ERR_MERR        0x10     /* memory error */
#define V374_ERR_BABL        0x11     /* transmitter babble error */
#define V374_ERR_CERR        0x12     /* transmitter collision error */
```

```
#define V374_ERR_TBUFF       0x13     /* transmitter buffer error */
#define V374_ERR_UFLO        0x14     /* transmitter underflow error */
#define V374_ERR_LCOL        0x15     /* transmitter late collision error */
#define V374_ERR_LCAR        0x16     /* transmitter loss of carrier error */
#define V374_ERR_RTRY        0x17     /* transmitter retry error */
#define V374_ERR_RBUFF       0x18     /* receiver buffer error */
#define V374_ERR_CRC         0x19     /* receiver CRC error */
#define V374_ERR_OFLO        0x1A     /* receiver overflow error */
#define V374_ERR_FRAM        0x1B     /* receiver framing error */
#define V374_ERR_BFAIL       0x20     /* board failure error */
#define V374_ERR_SRVR        0x21     /* no response from server error */
/*
 * MVME376 Error Codes
 *
 * error codes returned by driver, these codes will be placed in
 * the controller dependent field of the command packet status
 * word
 *
 * note: all error codes must be non-zero, an error code of 0x00
 *      signifies no error
 */
#define V376_ERR_BNA         0x01     /* 256Kbyte buffer not 16 byte aligned */
#define V376_ERR_BSIZ        0x02     /* shared memory buffer limit exceeded
(software) */
#define V376_ERR_IDLNGTH     0x03     /* invalid data length (MIN <= LNGTH <=
MAX) */
#define V376_ERR_MERR        0x10     /* memory error */
#define V376_ERR_BABL        0x11     /* transmitter babble error */
#define V376_ERR_CERR        0x12     /* transmitter collision error */
#define V376_ERR_TBUFF       0x13     /* transmitter buffer error */
#define V376_ERR_UFLO        0x14     /* transmitter underflow error */
#define V376_ERR_LCOL        0x15     /* transmitter late collision error */
#define V376_ERR_LCAR        0x16     /* transmitter loss of carrier error */
#define V376_ERR_RTRY        0x17     /* transmitter retry error */
#define V376_ERR_RBUFF       0x18     /* receiver buffer error */
#define V376_ERR_CRC         0x19     /* receiver CRC error */
#define V376_ERR_OFLO        0x1A     /* receiver overflow error */
#define V376_ERR_FRAM        0x1B     /* receiver framing error */
/*
 * status/control word definitions
 */

#define S_RXDATA             (1<<16)     /* status: receive data present */
/*
 * network drivers entry points (command identifiers)
 *
 * note:
 *     these command identifiers are documented in user's manuals
 */
```

```
#define NIO_CMD_INIT        0     /* initialize device/channel/node */
#define NIO_CMD_GHA         1     /* get hardware address (network node) */
#define NIO_CMD_TXD         2     /* transmit (put) data packet */
#define NIO_CMD_RXD         3     /* receive (get) data packet */
#define NIO_CMD_RFLSH       4     /* flush receiver and receive buffers */
#define NIO_CMD_RESET       5     /* reset device/channel/node */
/*
 * system call .NETRD/.NETWR packet template
 */
typedef struct niopcall {
 UCHAR clun;                    /* controller logical unit number */
 UCHAR dlun;                    /* device logical unit number */
 struct estatusw swrd;          /* error status word */
 UINT x_address;                /* data transfer address */
 UINT x_length;                 /* maximum length of transfer */
 UINT x_offset;                 /* byte offset */
 UINT x_time;                   /* transfer time in seconds (status) */
 UINT x_bytes;                  /* transfer byte count (status) */
 UCHAR filename[BFNAMESIZE];    /* boot filename buffer string */
} NIOPCALL;
/*
 * system call .NETCTRL packet template
 */
typedef struct nioccall {
 UCHAR clun;                    /* controller logical unit number */
 UCHAR dlun;                    /* device logical unit number */
 struct estatusw swrd;          /* error status word */
 UINT cid;                      /* command identifier */
 UINT memaddr;                  /* memory address (data transfers) */
 UINT nbytes;                   /* number of bytes (data transfers) */
 UINT csword;                   /* status/control word */
} NIOCCALL;
/*
 * system call .NETCFIG packet template
 */
typedef struct niotcall {
 UCHAR clun;                 /* controller logical unit number */
 UCHAR dlun;                 /* device logical unit number */
 struct estatusw swrd;       /* error status word */
 NETCNFGP *netcnfgp_p;       /* network configuration parameters pointer */
 DEVICECP *devicecp_p;       /* device configuration parameters pointer */
 UINT cntrlflg;              /* control flag */
} NIOTCALL;
/*
 * system call .NETCFIG packet "cntrlflg" definitions
 */
#define NIOT_CTRL_READ       (1<<0)     /* read configuration parameters */
#define NIOT_CTRL_WRITE      (1<<1)     /* write configuration parameters */
#define NIOT_CTRL_NVRAM      (1<<2)     /* write configuration parameters to
NVRAM */
```

```
/*
 * system call .NETFOPN packet template
 */
typedef struct nfileopen {
 UCHAR clun;                    /* controller logical unit number */
 UCHAR dlun;                    /* device logical unit number */
 struct estatusw swrd;          /* error status word */
 UCHAR filename[BFNAMESIZE];    /* filename buffer string */
} NFILEOPEN;
/*
 * system call .NETFRD packet template
 *
 * note:
 * maximum block size returned (x_bytes) is fixed at 512 bytes
 */
typedef struct nfileread {
 UCHAR clun;                  /* controller logical unit number */
 UCHAR dlun;                  /* device logical unit number */
 struct estatusw swrd;        /* error status word */
 UINT x_address;              /* data transfer address */
 USHORT x_bytes;              /* transfer byte count (status) */
 USHORT x_blockno;            /* block number */
 UINT x_timeout;              /* number of seconds to wait for data packet */
} NFILEREAD;
/*
 * network boot information block structure template
 */
typedef struct netbootinfo {
 IP_ADDRESS cipa;               /* client IP address */
 IP_ADDRESS sipa;               /* server IP address */
 IP_ADDRESS gipa;               /* gateway IP address */
 IP_ADDRESS subnetmask;         /* subnet IP address mask */
 IP_ADDRESS broadcast;          /* broadcast IP address */
} NETBOOTINFO;
/*
 * trace buffer character definitions
 */
#define TC_UNKNOWN            `?'     /* unknown */
#define TC_E_US               `&'     /* unsupported ETHERNET type */
#define TC_IP_US              `*'     /* unsupported IP type */
#define TC_UDP_US             `%'     /* unsupported UDP type */
#define TC_BOOTP_US           `$'     /* unsupported BOOTP type */
#define TC_BOOTP_REQUEST      `[`     /* BOOTP request */
#define TC_BOOTP_REPLY        `]'     /* BOOTP reply */
#define TC_ARP_US             `+'     /* unsupported ARP type */
#define TC_ARP_REQUEST        `(`     /* ARP request */
#define TC_ARP_REPLY          `)'     /* ARP reply */
#define TC_RARP_US            `-'     /* unsupported RARP type */
#define TC_RARP_REQUEST       `{`     /* RARP request */
#define TC_RARP_REPLY         `}'     /* RARP reply */
```

```
#define TC_TFTP_US              `^'     /* unsupported TFTP type */
#define TC_TFTP_RRQ             `\xab    /* TFTP read request */
#define TC_TFTP_WRQ             `/'     /* TFTP write request */
#define TC_TFTP_ACK             `<`     /* TFTP acknowledgment */
#define TC_TFTP_DATA            `>'     /* TFTP data */
#define TC_TFTP_ERROR           `|'     /* TFTP error */
#define TC_ICMP_US              `,'     /* unsupported ICMP type */
#define TC_ICMP_ERQST           `:'     /* ICMP echo request */
#define TC_ICMP_ERPLY           `;'     /* ICMP echo reply */
```

Assembly Interface Routines

```
        file          "io.s"
        text
#
#     abstract:
#          this module contains low levels routines to
#          perform the various needed debugger system calls
#     copyright:
#          (c) brand x inc., 1992
#          all rights reserved
#     history:
#          03/07/92      john doe          initial release
#
        set     SC_VECTOR,15            # system call vector number
# system call identifiers
#
        set     INCHR,0x0000            # input character
        set     INSTAT,0x0001           # input serial port status
        set     NETRD,0x0018            # network read, tftp read request
        set     NETWR,0x0019            # network write, tftp write request
        set     NETCFIG,0x001a          # network configure
        set     NETFOPN,0x001b          # network file open (request)
        set     NETFRD,0x001c           # network file rea
        set     NETCTRL,0x001d          # network control, raw packets
        set     OUTCHR,0x0020           # output character
        set     RETURN,0x0063           # return to the bug
#
#     name:      getstat
#     description:
#          perform the bug system call .INSTAT, .INSTAT retrieves
#          the status from current console port
#          this subroutine will execute a trap instruction
#          (vector number 15) which the bug will interpret as
#          a system call
#     call:
#          getstat()
#          no arguments
#     return:
#          %d0 = zero: no character, non-zero: character
#
```

```
        global      getstat
getstat:
        trap        &SC_VECTOR          # launch system call, trap to bug
        short       INSTAT              # load system call identifier
        beq         getstat_nc          # if equal, no character, branch
        mov.l       &1,%d0              # setup non-zero status
        rts                             # return to caller
getstat_nc:
        clr.l       %d0                 # setup zero status
        rts                             # return to caller
#
#       name:       getchar
#       description:
#            perform the bug system call .INCHR, .INCHR retrieves
#            a character from current console port
#            this subroutine will execute a trap instruction
#            (vector number 15) which the bug will interpret as
#            a system call
#       call:
#            getchar()
#            no arguments
#       return:
#            %d0 = character read (get)
#
        global      getchar
getchar:
        sub.l      &2,%a7               # allocate space for character
        trap       &SC_VECTOR           # launch system call, trap to bug
        short      INCHR                # load system call identifier
        mov.b      (%a7)+,%d0           # load character and deallocate
        rts                             # return to caller
#
#       name:       putchar
#       description:
#            perform the bug system call .OUTCHR, .OUTCHR outputs
#            the specified character to current console port
#            this subroutine will execute a trap instruction
#            (vector number 15) which the bug will interpret as
#            a system call
#       call:
#            putchar(character-to-send)
#            7(%a7) = character to output (send)
#       return:
#            none
#
        global      putchar
putchar:
        mov.b       7(%a7),-(%a7)          # load character for call
        trap        &SC_VECTOR             # launch system call, trap to bug
        short       OUTCHR                 # load system call identifier
        rts                                # return to caller
#
#       name:       gobug
```

```
#     description:
#          perform the bug system call .RETURN, .RETURN returns
#          instruction control back to the bug
#          this subroutine will execute a trap instruction
#          (vector number 15) which the bug will interpret as
#          a system call
#     call:
#          no arguments
#     return:
#          does not return to the caller
#
     global     gobug
gobug:
     trap       &SC_VECTOR          # launch system call, trap to bug
     short      RETURN              # load system call identifier
     rts                            # return to caller
#
#     name:      netrd
#     description:
#          perform the bug system call .NETRD, .NETRD is a TFTP
#          read request for a specified file, this subroutine
#          will execute a trap instruction (vector number 15)
#          which the bug will interpret as a system call
#          the command packet specifies the name of the file
#          and where to load it
#          this system call functions as the bug command "NIOP"
#     call:
#          netrd(pointer-to-command-packet)
#          4(%a7) = pointer to command packet
#     return:
#          %d0 = zero: okay, non-zero: error
#
      global     netrd
netrd:
      mov.l      4(%a7),-(%a7)          # load pointer to packet
      trap       &SC_VECTOR             # launch system call, trap to bug
      short      NETRD                  # load system call identifier
      bne        netrderr               # if not equal, error, branch
      clr.l      %d0                    # setup zero status
      rts                               # return to caller
netrderr:
      mov.l      &1,%d0         # setup non-zero status
      rts                       # return to caller
#
#     name:      netwr
#     description:
#          perform the bug system call .NETWR, .NETWR is a TFTP
#          write request to a specified file, this subroutine
#          will execute a trap instruction (vector number 15)
#          which the bug will interpret as a system call
#          the command packet specifies the name of the file
#          and where to retrieve it
#          this system call functions as the bug command "NIOP"
```

```
#     call:
#          netwr(pointer-to-command-packet)
#          4(%a7) = pointer to command packet
#     return:
#          %d0 = zero: okay, non-zero: error
#
      global     netwr
netwr:
      mov.l      4(%a7),-(%a7)          # load pointer to packet
      trap       &SC_VECTOR             # launch system call, trap to bug
      short      NETWR                  # load system call identifier
      bne        netwrerr               # if not equal, error, branch
      clr.l      %d0                    # setup zero status
      rts                               # return to caller
netwrerr:
      mov.l      &1,%d0                 # setup non-zero status
      rts                               # return to caller
#
#     name:      netctrl
#     description:
#          perform the bug system call .NETCTRL, .NETCTRL
#          allows the user to control the specified network
#          interface directly, the control is specified in the
#          command packet, this subroutine will execute a trap
#          instruction (vector number 15) which the bug will
#          interpret as a system call
#          this system call functions as the bug command "NIOC"
#     call:
#          netctrl(pointer-to-command-packet)
#          4(%a7) = pointer to command packet
#     return:
#          %d0 = zero: okay, non-zero: error
#
      global     netctrl
netctrl:
      mov.l      4(%a7),-(%a7)          # load pointer to packet
      trap       &SC_VECTOR             # launch system call, trap to bug
      short      NETCTRL                # load system call identifier
      bne        netctrlerr             # if not equal, error, branch
      clr.l      %d0                    # setup zero status
      rts                               # return to caller
netctrlerr:
      mov.l      &1,%d0                 # setup non-zero status
      rts                               # return to caller
#
#     name:      netcfig
#     description:
#          perform the bug system call .NETCFIG, .NETCFIG
#          allows the user to configure (read or write) the
#          parameters associated with the specified network
#          interface, this subroutine will execute a trap
#          instruction (vector number 15) which the bug will
#          interpret as a system call
```

```
#          this system call functions as the bug command "NIOT"
#     call:
#          netcfig(pointer-to-command-packet)
#          4(%a7) = pointer to command packet
#     return:
#          %d0 = zero: okay, non-zero: error
#
      global     netcfig
netcfig:
      mov.l      4(%a7),-(%a7)          # load pointer to packet
      trap       &SC_VECTOR             # launch system call, trap to bug
      short      NETCFIG                # load system call identifier
      bne        netcfigerr             # if not equal, error, branch
      clr.l      %d0                    # setup zero status
      rts                               # return to caller
netcfigerr:
      mov.l      &1,%d0                 # setup non-zero status
      rts                               # return to caller
#
#     name:      netfopn
#     description:
#          perform the bug system call .NETFOPN, .NETFOPN
#          allows the user to request the transfer of a file,
#          this subroutine will execute a trap instruction
#          (vector number 15) which the bug will interpret
#          as a system call
#     call:
#          netfopn(pointer-to-command-packet)
#          4(%a7) = pointer to command packet
#     return:
#          %d0 = zero: okay, non-zero: error
#
      global     netfopn
netfopn:
      mov.l      4(%a7),-(%a7)          # load pointer to packet
      trap       &SC_VECTOR             # launch system call, trap to bug
      short      NETFOPN                # load system call identifier
      bne        netfopnerr             # if not equal, error, branch
      clr.l      %d0                    # setup zero status
      rts                               # return to caller
netfopnerr:
      mov.l      &1,%d0                 # setup non-zero status
      rts                               # return to caller
#
#     name:      netfrd
#     description:
#          perform the bug system call .NETFRD, .NETFRD
#          allows the user to retrieve the file data blocks,
#          this subroutine will execute a trap instruction
#          (vector number 15) which the bug will interpret
#          as a system call
#     call:
#          netfrd(pointer-to-command-packet)
```

```
#          4(%a7) = pointer to command packet
#     return:
#          %d0 = zero: okay, non-zero: error
#
      global     netfrd
netfrd:
      mov.l      4(%a7),-(%a7)          # load pointer to packet
      trap       &SC_VECTOR             # launch system call, trap to bug
      short      NETFRD                 # load system call identifier
      bne        netfrderr              # if not equal, error, branch
      clr.l      %d0                    # setup zero status
      rts                               # return to caller
netfrderr:
      mov.l      &1,%d0                 # setup non-zero status
      rts                               # return to caller
#
      data
```

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