iRMX™ 86 DEBUGGER REFERENCE MANUAL

CONTENTS

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CHAPTER 1 INTRODUCTION

The development of almost every software application requires debugging. To aid in the development of iRMX 86 based systems, Intel provides various debugging tools.

OVERVIEW OF iRMX™ 86 OPERATING SYSTEM DEBUGGING TOOLS

This section will give an overview of some of the debugging tools available from Intel for iRMX 86 based systems

iRMX™ 86 DEBUGGER

The first tool available for system debugging is the iRMX 86 Debugger. The Debugger's essential power is in its ability to allow a software engineer to dynamically examine the data structures handled by the iRMX 86 operating system. For example, the Debugger can show which tasks are waiting at a particular mailbox while the application program is running. This capability permits you to easily debug a multitasking operation.

The Debugger supplies its own Terminal Handler, which includes all of the capabilities described in the iRMX 86 TERMINAL HANDLER REFERENCE MANUAL. Your application software can make use of the Debugger's Terminal Handler, or you can include a separate version (or versions) of the Terminal Handler in your system configuration for application use. Refer to the iRMX 86 CONFIGURATION GUIDE for further configuration information.

SYSTEM DEBUG MONITORS

The second tool available to the programmer is the Intel series of monitors. In this group are the iRMX 86 System Debug Monitor (SDB), the iSDM 86 monitor, and the iSBC 286 monitor. All of these system debug monitors can, among many other functions, single step instruction code, set execution and memory breakpoints, display memory in various formats (such as ASCII), perform I/O read and write operations, and move, search, and compare blocks of memory. The iRMX System Debugger Monitor (SDB) extends the use of the monitors so that you can directly examine Operating System data structures. For more information on the monitors, consult the following manuals: iSDM 86 SYSTEM DEBUG MONITOR REFERENCE MANUAL; the iSDM 286 SYSTEM DEBUG MONITOR REFERENCE MANUAL; or the iRMX 86 RELEASE 6 SYSTEM DEBUG REFERENCE MANUAL.

IN-CIRCUIT EMULATORS

The third debugging tool provided by Intel is the In-Circuit Emulator (ICE). The ICE lets you get closer to the system hardware by permitting you to examine the state of input pins and output ports, to set breakpoints, to look at the most recent 80 to 150 assembly language instructions, and to use the memory of your Intel Microprocessor Development System as if that memory were on your prototype board. For more information on the capabilities of the ICE, consult the ICE-86/ICE-88 MICROSYSTEMS IN-CIRCUIT EMULATOR OPERATION INSTRUCTIONS FOR ISIS-II USERS MANUAL.

CRASH ANALYZER

The fourth tool available for debugging iRMX 86 based systems is the Crash Analyzer. The Crash Analyzer is an utility used to dump the contents of memory into a file while formatting that information for display or printing. The file produced from the memory dump will allow you to see the state of every object at the time of the dump. For example, the programmer can see the size of memory segments when the dump occurred. For more information on the Crash Analyzer see the iRMX 86 CRASH ANALYZER REFERENCE MANUAL.

iRMX™ 86 DEBUGGER IMPLEMENTATION ON iAPX 186/286 CPUs

One of the advantages of the iRMX 86 Operating System is that it can be implemented using one of several Intel microprocessors. As a result, the use of the iRMX 86 Debugger does not change even though the microprocessor running the operating system maybe the iAPX 86, iAPX 186, iAPX 88, iAPX 188, or the iAPX 286 CPUs. This occurs because the Debugger acts on those features, such as registers, which the iAPX 86 and iAPX 186/286/88/188 microprocessors have in common. Thus, the iRMX 86 Debugger will appear to see an iAPX 86 CPU although another microprocessor may be physically running the system. (In the iAPX 286 microprocessor this is achieved by using the Real Address Mode.)

The same principle of compatability mentioned previously applies for the Numeric Processor Extension (NPX) used by the particular microprocessors. The iRMX 86 Debugger will see only those registers which the 8087 NPX has in common with the other Numeric Processor Extensions (e.g. the iAPX 286/20 processor).

OVERVIEW OF THE CAPABILITIES OF THE iRMX™ 86 DEBUGGER

The iRMX 86 Debugger enables you to do the following:

- Use the Debugger as a task, job, or system exception handler.
- View iRMX 86 object lists, including the lists of jobs, tasks, ready tasks, suspended tasks, asleep tasks, task queues at exchanges, object queues at mailboxes, exchanges, and iRMX 86 segments.
- Inspect jobs, tasks, exchanges, segments composites, and extensions.
- Examine and/or alter the contents of absolute memory locations.
- Set, change, view, and delete breakpoints.
- View the list of tasks that have incurred breakpoints and remove tasks from it.
- Declare a task to be the breakpoint task.
- Examine and/or alter the breakpoint task's register values.
- Set, change, view, and delete special variables for debugging.
- Deactivate the Debugger.

INVOKING THE DEBUGGER

You can invoke the Debugger from your iRMX 86 terminal by entering:

```
control-D
```

The Debugger responds with its sign-on message:

```
iRMX 86 DEBUGGER <version no.>
Copyright <year> Intel Corporation
*
```

The asterisk is the prompt character for the Debugger. It indicates that the Debugger is ready to accept additional input from the terminal.

In addition to the functions the Debugger can perform when it has been invoked, there are two services it can perform at any time, even when not invoked. First, if a task encounters a breakpoint, the Debugger responds as described in Chapter 4.

Second, if a task has the Debugger as its exception handler and the task causes an exceptional condition, then the Debugger displays a message to that effect at the terminal. A task can get the Debugger as its exception handler in one of the following ways:

- By using the SET$EXCEPTION$HANDLER system call.

- By acquiring the Debugger as the default exception handler. This is done at configuration time. Refer to the iRMX 86 CONFIGURATION GUIDE for a description of the this process.

- By having the Debugger declared as the exception handler when the task is created with CREATE$JOB or CREATE$TASK. An example of code setting up one of these calls is the following:

```
RQ$DEBUGGER$EX: PROCEDURE (EX$CODE, PARAM$NO, RESERVED,
                           NDP$STATUS, DUMMY$IF$COMPACT) EXTERNAL;
     DECLARE
          EX$CODE             WORD,
          PARAM$NO            BYTE,
          RESERVED            WORD,
          NDP$STATUS          WORD,
          DUMMY$IF$COMPACT    WORD;
END RQ$DEBUGGER$EX;

     DECLARE EXCEPT$BLOCK STRUCTURE (
          EXCEPT$PROC         POINTER,
          EXCEPT$MODE         BYTE);
          .
          .
          .

EXCEPT$BLOCK.EXCEPT$PROC = @RQ$DEBUGGER$EX;
EXCEPT$BLOCK.EXCEPT$MODE = ZERO$ONE$TWO$OR$THREE;
          .
          .
          .

RQ$CREATE$JOB(...,@EXCEPT$BLOCK,...);
  or
RQ$CREATE$TASK(...,@EXCEPT$BLOCK,...);
```

For this code to work, the task code must be linked to the CROOT.LIB library that is supplied with the Nucleus. The DUMMY$IF$COMPACT parameter in the RQ$DEBUGGER$EX declaration is a dummy parameter that you must include if your task is compiled using the PL/M-86 COMPACT.

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CHAPTER 2 SPECIAL CHARACTERS

In addition to the Debugger commands listed in Chapter 4, the Debugger recognizes several special characters. This chapter lists these characters and describes their functions.

END-OF-LINE CHARACTERS

The Debugger obtains input one line at a time from its Terminal Handler. The end-of-line characters separate individual input lines. The Debugger recognizes three end-of-line characters. They are:

Carriage Return
Line Feed
ESCape

Both Carriage Return and Line Feed send the current input line to the Debugger for processing. ESCape causes the Debugger to discard the current input line and display a prompt.

CONTROL-S

The Debugger generates display at the iRMX 86 terminal by sending output messages to its Terminal Handler. Application tasks can also send messages to the same terminal. To suppress output from application tasks during a debugging session, type control-S. The Debugger then stores the output from application tasks until you type control-Q. If you do not enter control-S, any output from tasks is interspersed with output from the Debugger. Control-S has no effect on output from the Debugger.

CONTROL-Q

Control-Q negates the effect of a previously entered control-S character. To resume the output from tasks, type control-Q. Control-Q also causes the Debugger to display all output that was suppressed by control-S. Control-Q has no effect on output from the Debugger.

CONTROL-O

Certain Debugger command responses are lengthy and can roll off the screen. To freeze the top part of such a display before it disappears, enter control-O. This discards all output including Debugger prompts until you enter another control-O. The discarded output cannot be retrieved.

CONTROL-D

Occasionally you will want to terminate a Debugger memory command function response before it is finished. For example, if you asked for a display of memory locations 0000H to 0FFFFH, it would be natural to change your mind. To abort the display and regain the Debugger prompt, enter control-D.

Note that control-O affects the display only, whereas control-D stops the function entirely.

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CHAPTER 3 COMMAND SYNTAX

When using the iRMX 86 Debugger, you sit at a terminal and type commands. This chapter describes the syntactical standards for commands to the Debugger, and it introduces notational conventions that are used throughout this manual.

CONVENTIONS

The first one or two characters of a command constitute a key sequence for the command:

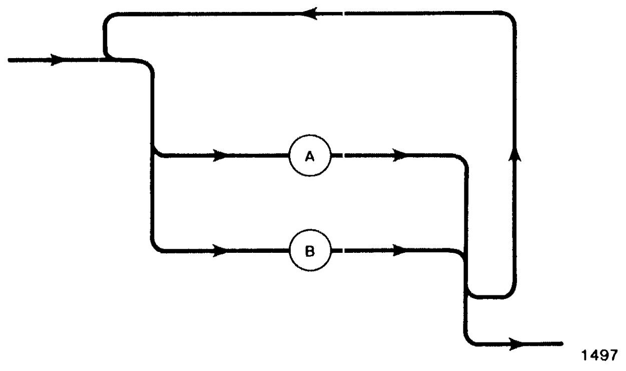
- Most Debugger commands are specified by one or two letters. The key letters or pairs of letters are BL, BT, D, DB, G, I, L, M, N, Q, R, V, and Z.
- In a few cases, a command is specified by beginning the command with a name. A name, for the Debugger, must consist of a period followed by a variable name.

After the key initial sequence, a command may be followed by one or more parameters or additional specifiers. Blanks are used as delimiters between elements of a command; they are mandatory except as follows:

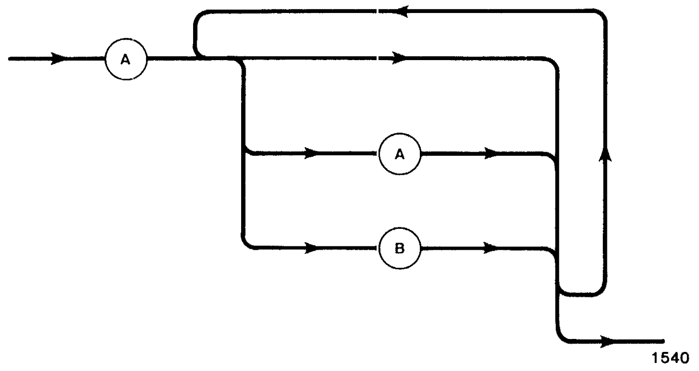
- Immediately after a command key that is not a name.
- Between a letter or digit and a non-letter, non-digit. The legal characters of the latter type are the following: ; @ = / : ( ) * + - ,

PICTORIAL REPRESENTATION OF SYNTAX

In this manual, a schematic device illustrates the syntax of commands. The schematic consists of what looks like an aerial view of a model railroad setup, with syntactic entities scattered along the track. Imagine that a train enters the system at the upper left, drives around as much as it can or wants to (sharp turns and backing up are not allowed), and finally departs at the lower right. The command it generates in so doing consists, in order, of the syntactic entities that it encounters on its journey. For example, a string of A's and B's, in any order, would be depicted as:



If such a string has to begin with an A, the schematic could be drawn as:



In the second drawing, it is necessary to represent the letter A twice because A is playing two roles. It is the first symbol (necessarily) and it is a symbol that may (optionally) be used after the first symbol. Note that a train could avoid the second A but cannot avoid the first A. The arrows are not necessary and henceforth are omitted.

SPECIAL SYMBOLS FOR THE DEBUGGER

The entities that will be used in the remainder of this manual, as A and B were used in the previous paragraph, are the following:

- CONSTANT. Constants are always hexadecimal. Unlike such constants in PL/M-86, they do not require an H as the last character. H's may be used if desired. Leading zeroes are not necessary unless they help to distinguish between constants and other things. For example, AH is a register in the iAPX 86, but 0AH is a constant.

- NAME. A name is a period followed by up to 11 characters, the first of which must be alphabetic. The other characters can be alphabetic, numeric, question marks (?), or dollar signs ($).

  Examples:

  ```
  .task

  .mailbox$7
  ```

- ITEM. An item is either an expression or one of the segment registers of the given CPU. The values of items are used variously as tokens and as offsets in Debugger commands. Graphically, an item is defined in Figure 3-2.

- EXPRESSION. As in algebra, an expression is either a term or is the result of adding and subtracting terms. Also as in algebra, a term is a product; each factor in the product is either a constant, a name, a parenthetical expression, or one of the registers AX, BX, CX, DX, DS, ES, SS, CS, IP, FL, SI, DI, BP, and SP. Graphically, term and expression are shown in Figure 3-1:

NOTE

If the computed value of an expression is too large to fit into four hexadecimal digits, then only the low order four digits are used.

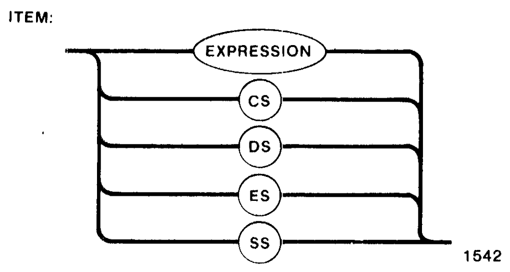


Figure 3-1. Syntax Diagram For Item

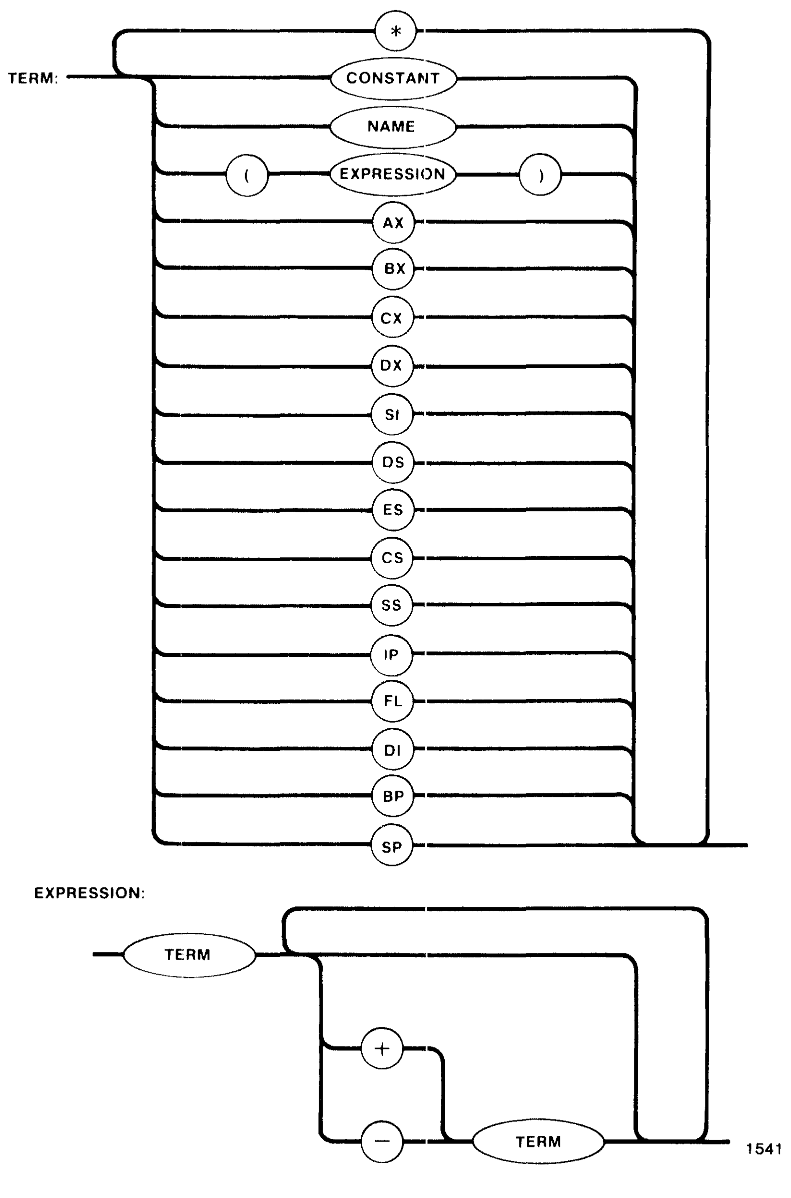


Figure 3-2. Syntax Diagrams For Term And Expression

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CHAPTER 4
DEBUGGER COMMANDS

This chapter presents the details of the Debugger commands. It is divided into several sections, each of which describes a related group of commands. The command groupings are as follows:

Symbolic Name Commands
Breakpoint Commands
Memory Commands
Commands to Inspect iRMX 86 Objects
Commands to View Object Lists
Commands to Exit the Debugger

Each section contains a general information portion followed by detailed command descriptions.

Between this introduction and the discussions of the individual commands is a command dictionary. This dictionary, which lists the commands in alphabetical order, includes short descriptions and page numbers of the complete descriptions in this chapter. Those commands which are not associated with specific command letters are listed at the end of the dictionary.

Because the iRMX 86 operating system can run under several microprocessors, the generic term "CPU" will be used in place of the names iAPX 86, iAPX 186, iAPX 88, iAPX 188, and iAPX 286.

COMMAND DICTIONARY

SYMBOLIC NAME COMMANDS

For your convenience during debugging, the Debugger supports the use of alphanumeric variable names that stand for numerical quantities. The names and their associated values can be accessed by the Debugger from any of the following sources:

- A Debugger-maintained symbol table. The table contains name/value pairs that have been cataloged by the Debugger as numeric variables. This section describes commands for defining, changing, listing, and deleting numeric variables.

- The object directory of the current job. The current job is defined to be the job that contains the breakpoint task. (The command used to establish the breakpoint task is contained in the "Breakpoint Commands" section of this chapter.) If there is no breakpoint task, the current job is the root job.

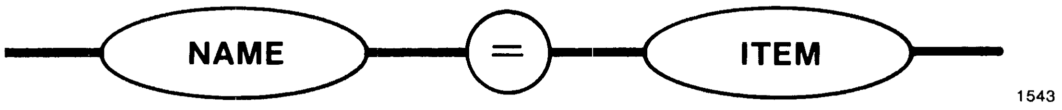
- The object directory of the root job.

When you use a symbolic name that is not the name of a breakpoint variable, the Debugger searches these sources in the order just listed.

Suppose that you want to refer to a particular task by means of the name .TASK001. If the task is cataloged in the object directory of either the root job or the current job, then the Debugger will go to the appropriate directory and fetch a token for the task whenever the name .TASK001 is used in a Debugger command. If the task is not so cataloged, you can use VJ (view job), IJ (inspect job), VT (view task), and IT (inspect task) commands to deduce a token for the task. Then you can define .TASK001 to be a numeric variable whose value is that token.

CHANGING NUMERIC VARIABLES

This command changes the value of an existing numeric variable. The syntax for this command is as follows:



PARAMETERS

NAME	Name of an existing numeric variable.
ITEM	An expression or the name of an CPU segment register. The value of ITEM is associated with the variable name NAME.

DESCRIPTION

This command removes from the Debugger symbol table the value originally associated with NAME, and replaces it with the value of ITEM.

EXAMPLES

```
.TASKA = 2F00
*
```

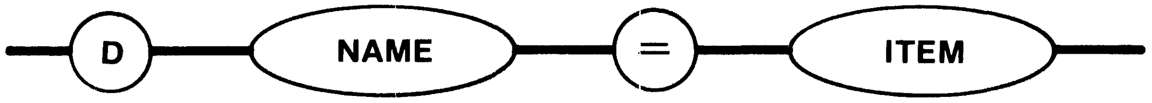
This command changes the value of .TASKA to 2F00h.

```
.TASKA = .TASKB
*
```

This command changes the value of .TASKA to that of .TASKB. In a previous example, .TASKB had a value of 2B8Ch. Therefore, this command changes the value of .TASKA to 2B8Ch.

DEFINING NUMERIC VARIABLES -- D

This command associates a variable name with a numeric value. The syntax for the D command is as follows:



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PARAMETERS

NAME	Name of the variable. This must be a period followed by up to 11 characters, the first of which must be alphabetic. The other characters can be alphabetic, numeric, question marks (?), or dollar signs ($).
ITEM	An expression or the name of an CPU segment register. The value of ITEM is associated with the variable name NAME.

DESCRIPTION

This command places NAME and the value of ITEM into the Debugger symbol table. You can use this command to create symbolic names for tokens, registers, or any other values. Then, you can use the symbolic names in other Debugger commands instead of entering the actual hexadecimal values.

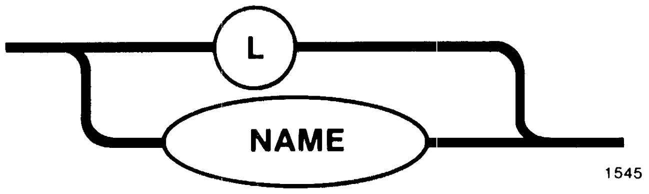
EXAMPLES

```
D .TASKA = 2DC3
*
```

This command creates a symbol called .TASKA in the Debugger's local symbol table and assigns this symbol the hexadecimal value 2DC3.

LISTING NUMERIC AND BREAKPOINT VARIABLES -- L

This command lists numeric and breakpoint variable names and their associated values. The syntax for the L command is as follows:



PARAMETER

NAME	Name of an existing numeric or breakpoint variable. If entered, the Debugger lists the name and value of the indicated name only.

DESCRIPTION

The L command lists all numeric and breakpoint variable names and their associated values. (Breakpoint variables are described in the "Breakpoint Commands" section of this chapter.) Specifying NAME instead of L causes only one pair to be listed. In either case, one pair is listed per line in the format:

```
NAME=xxxx
```

where xxxx is the associated value.

EXAMPLES

```
L
BP=2DC3:00FF
MBOX          2F34
TASKA         2DC3
TASKB         2B8C
TASKC         2D8A
TASKD         2CEF
*
```

This command lists the names and values of all the numeric and breakpoint variables in the Debugger's local symbol table. It lists one breakpoint variable (.BP) and four numeric variables (.TASKA, .TASKB, .TASKC, and .TASKD).

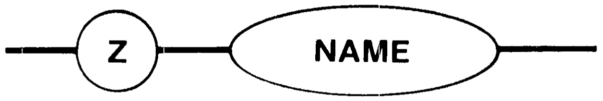
EXAMPLES (continued)

```
.TASKA
TASKA=2DC3
*
```

This command lists the value associated with the variable .TASKA.

DELETING NUMERIC VARIABLES -- Z

This command deletes a numeric variable. The syntax for the Z command is as follows:



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PARAMETER

NAME	Name of an existing numeric variable to be deleted.

DESCRIPTION

This command removes the NAME and associated value from the Debugger's symbol table.

EXAMPLE

```
Z .TASKA
*
```

This command deletes the numeric variable .TASKA.

BREAKPOINT COMMANDS

The Debugger provides you with the ability to set, change, view, or delete breakpoints. You set a breakpoint by defining an act which a task can perform. When a task performs the act, it incurs the breakpoint, causing its execution to cease. The Debugger supports three kinds of breakpoints:

- Execution breakpoint. A task incurs an execution breakpoint when it executes an instruction that is at a designated location in memory.
- Exchange breakpoint. A task incurs an exchange breakpoint when it performs a designated type of operation (send or receive) at a designated exchange.
- Exception breakpoint. A task incurs an exception breakpoint if its exception handler has been declared to be the Debugger and the task causes an exceptional condition of the type that invokes its exception handler.

When a task incurs a breakpoint (of any type), three things occur automatically:

- The task is placed in a pseudostate called "broken". Depending on the breakpoint options selected, the broken task and the tasks in the containing job might be suspended.
- If suspended, the broken task (and suspended tasks, if any) is (are) placed on a Debugger-maintained list called the breakpoint list. You can resume a task on the breakpoint list or you can remove it from the list.
- At the terminal, a display informs you that a breakpoint has been incurred. It also provides information about the event.

Each task on the breakpoint list is assigned a breakpoint state, which reflects the kind of breakpoint last incurred by the task. The states are as follows:

X	---	The task incurred an execution breakpoint.
E	---	The task incurred an exchange breakpoint.
Z	---	The task incurred an exception breakpoint.
N	---	The task was placed on the breakpoint list when another task in the same job incurred a breakpoint which had been set with the DB command (described later) using the J option.

You set an execution or exchange breakpoint with the DB command by defining a breakpoint variable and assigning it a breakpoint request. The request specifies to the Debugger the nature of the breakpoint, and the variable provides you with a convenient means of talking to the Debugger about the breakpoint. Using the breakpoint variable, you can cancel the breakpoint or replace it with a new one.

If you want to monitor a particular task that has not necessarily incurred a breakpoint, you can designate it to be the breakpoint task. If the task is not on the breakpoint list when you do this, the task is suspended. However, it is not placed on the breakpoint list. After designating a breakpoint task, you can examine and alter some of its registers. You can also ascertain the breakpoint state of the task. When ready, you can easily resume the task.

The Debugger displays information when a task incurs a breakpoint. The format of the display depends on the kind of breakpoint incurred.

When the task is accessing a region, the Debugger cannot process breakpoints normally. When this situation occurs, the Debugger displays the following message:

```
     TASK IN REGION INCURRED BREAKPOINT:  bp-var, TASK=jjjjJ/ttttT
       FULL BREAKPOINT INFORMATION NOT AVAILABLE
       TASK NOT PLACED ON BREAKPOINT LIST
```

where:

bp-var	The name of the breakpoint variable.
jjjj	A token for the task's job.
tttt	A token for the task.

EXECUTION BREAKPOINT DISPLAY

The Debugger displays the following information when a task incurs an execution breakpoint.

```
     bp-var:  E, TASK=jjjjJ/ttttq, CS=cccc, IP=iiii
```

where:

bp-var	The name of the breakpoint variable.
jjjj	A token for the task's job.

tttt	A token for the task.
q	Either T (for task) or * (indicating that the task has overflowed its stack).
cccc	The base of the code segment in which the breakpoint was set.
iiii	The offset of the breakpoint within its code segment.

EXCHANGE BREAKPOINT DISPLAY

The Debugger displays the following information when a task incurs an exchange breakpoint:

```
    bp-var:  a, EXCH=jjjjJ/xxxxe, TASK=jjjjJ/ttttq, ITEM=item
```

where:

bp-var	The name of the breakpoint variable.
a	Indicates which kind of operation (S for send or R for receive) caused the breakpoint to be incurred.
jjjj	A token for the job containing the exchange whose token follows.
xxxx	A token for the exchange.
e	Indicates the type of the exchange (M for mailbox, S for semaphore, R for region).
tttt	A token for the task.
q	Either T (for task) or * (indicating that the task has overflowed its stack).
item	One of the following:

If the exchange is a mailbox, this field lists a pair of tokens, of the form:

jjjjJ/oooot,

where:

jjjj A token for the mailbox's containing job.

oooo	A token for the object being sent or received.
t	The type of the object being sent or received (J for job, T for task, M for mailbox, S for semaphore, G for segment, R for region, X for extension, and C for composite).

If the kind of operation was receive, but no object was there to be received, item is 0000.

If the exchange is a semaphore, this field lists the number of units held by the exchange.

EXCEPTION BREAKPOINT DISPLAY

The Debugger displays the following information when a task incurs an exception breakpoint:

```
EXCEPTION:  jjjjJ/ttttT, CS=cccc, IP=iiii, TYPE=wwww, PARAM=vvvv
```

where:

jjjj	A token for the job which contains the task that caused the exception condition.
tttt	A token for the task that caused the exceptional condition.
cccc and iiii	Respectively, the contents of the iAPX 86 CS and IP registers when the exceptional condition occurred.
wwww	The numerical value of the exception code; reflects the nature of the exceptional condition. Refer to the iRMX reference manuals for the mnemonic condition codes and their numerical equivalents.
vvvv	The number (0001 for first, 0002 for second, etc.) of the parameter that caused the exceptional condition. If no parameter was at fault, vvvv is 0000.

EXCEPTION BREAKPOINT DIFFERENCES

Exception breakpoints differ from execution and exchange breakpoints in several respects:

- It is not possible to set, change, view, or delete exception breakpoints by using the commands of the Debugger. Instead, each task can set an exception breakpoint by declaring the Debugger to be its exception handler. The task can subsequently delete the breakpoint by declaring a different exception handler. However, like the other kinds of breakpoints, once a task incurs an exception breakpoint and is placed on the breakpoint list, you can cause it to resume execution with the same command (the G command) that is used to resume other tasks on the breakpoint list.

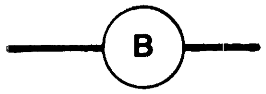
- An exception breakpoint is set for a particular task. Execution and exchange breakpoints are set for no particular task; any task can incur such a breakpoint.

- An exception breakpoint is not known to the Debugger by a breakpoint variable name.

The handling of exception breakpoints is significantly different from that of execution and exchange breakpoints. For example, exception breakpoints cannot be viewed, but the other breakpoints can be. Wherever this distinction applies, this chapter points it out.

VIEWING BREAKPOINT PARAMETERS -- B

This command displays the breakpoint parameters. The syntax for the B command is as follows:



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DESCRIPTION

The B command performs the following three functions:

- Displays the breakpoint list
- Displays the breakpoint task
- Displays the breakpoint variables

Breakpoint List Display

The B command first displays the breakpoint list in the following format:

```
BL=jjjjJ/ttttT(s) jjjjJ/ttttT(s) ... jjjjJ/ttttT(s)
```

where:

jjjj	A token for the job containing the task whose token follows.
tttt	A token for a task on the breakpoint list.
s	The breakpoint state of a task. Possible values are X (for execution), E (for exchange), Z (for exception), and N (for null).

Breakpoint Task Display

The second effect of the B command is to display the breakpoint task originally selected with the BT command. The format of this display is as follows:

```
    BT=jjjjJ/ttttT(s)
```

where:

jjjj	A token for the job containing the breakpoint task.
tttt	A token for the breakpoint task.
s	The breakpoint state of the breakpoint task. Possible values are X (for execute), E (for exchange), Z (for exception), and N (for null).

If there is no breakpoint task, the display is:

```
    BT=0
```

Breakpoint Variables Display

The third and final effect of the B command is to display the breakpoint variables. The format of the display depends on whether the variables are execution or exchange variables.

Execution breakpoints are displayed as:

```
    bp-var = xxxx:yyyy z ops
```

where:

bp-var	The name of the breakpoint variable.

xxxx	The base portion of the address at which the breakpoint is set.
yyyy	The offset portion of the address at which the breakpoint is set.
z	Indicates whether a task (T) or all the tasks in a job (J) are to be suspended and placed on the breakpoint list when the breakpoint is incurred.
ops	Indicates the breakpoint options. If any are present, they can be a C (for Continue task) and/or D (for Delete breakpoint).

Exchange breakpoints are displayed as:

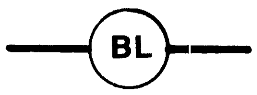
```
     bp-var = xxxx a z ops
```

where:

bp-var	The name of the breakpoint variable.
xxxx	A token for the exchange at which the breakpoint is set.
a	Indicates the kind of breakpoint activity at the exchange, either S (for Send), R (for Receive), or SR (for both).
z	Indicates whether a task (T) or all the tasks in a job (J) are to be suspended and placed on the breakpoint list when the breakpoint is incurred.
ops	Indicates the breakpoint options. If any are present, they can be C (for Continue task) and/or D (for Delete breakpoint).

VIEWING THE BREAKPOINT LIST -- BL

This command displays the breakpoint list. The syntax for the BL command is as follows:



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DESCRIPTION

The BL command displays the entire breakpoint list at the user terminal. This list appears as follows:

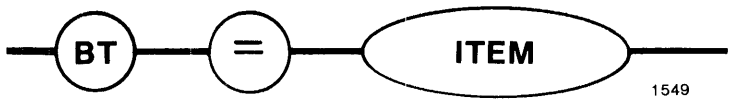
```
BL=jjjjJ/ttttT(s) jjjjJ/ttttT(s) ... jjjjJ/ttttT(s)
```

where:

jjjj	A token for the job containing the task whose token follows.
tttt	A token for a task.
s	The breakpoint state of a task. Possible values are X (for execution), E (for exchange), Z (for exception), and N (for null).

ESTABLISHING THE BREAKPOINT TASK -- BT

This command designates a task to be the breakpoint task. The syntax for the BT command is as follows:



PARAMETER

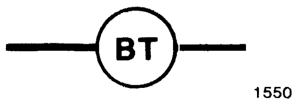
ITEM	A token for an existing task.

DESCRIPTION

The task designated by ITEM becomes the breakpoint task. The Debugger suspends the task but does not place it on the breakpoint list.

LISTING THE BREAKPOINT TASK -- BT

This command lists the job and task tokens associated with the breakpoint task. The syntax for the BT command is as follows:



DESCRIPTION

This command displays the following information about the breakpoint task:

```
BT=jjjjJ/ttttT(s)
```

where:

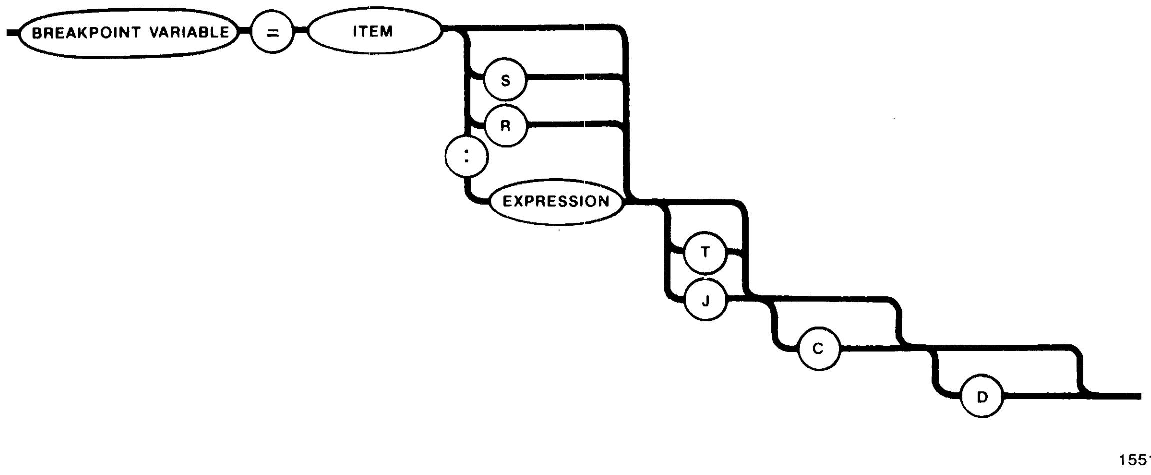
jjjj	A token for the job containing the breakpoint task.
tttt	A token for the breakpoint task.
s	The breakpoint state of the breakpoint task. Possible values are X (for execute), E (for exchange), Z (for exception), and N (for null).

If there is no breakpoint task, the Debugger displays the following:

```
BT=
```

CHANGING A BREAKPOINT

This command changes an existing breakpoint. The syntax for this command is as follows:



PARAMETERS

BREAKPOINT VARIABLE	An existing Debugger breakpoint name. If the Debugger's symbol table does not already contain this name, an error message will appear on the terminal's display.
ITEM	If you are changing an execution breakpoint, ITEM is used in combination with EXPRESSION to specify the address of the breakpoint. ITEM must contain the base portion of the address. It must be followed by ":" and an EXPRESSION, which must contain the offset portion. If you are changing an exchange breakpoint, ITEM must contain a token for an exchange.
S and R	To be used only when changing an exchange breakpoint. S means that the exchange breakpoint is for senders only, while R means that it is for receivers only. If you want to set an exchange breakpoint for both senders and receivers, omit both S and R, as well as both ":" and EXPRESSION.

T and J	Indicate which tasks are to be put on the breakpoint list when a breakpoint is incurred. T indicates only the task that incurred the breakpoint, while J indicates all of the tasks in that task's job. If neither T nor J is present, T is assumed.
C	Continue task execution option. This option directs the Debugger not to "break" tasks that incur the breakpoint, and not to put them on the breakpoint list. When a task incurs such a breakpoint, the Debugger generates a breakpoint display, but the task continues to run.
D	Delete breakpoint option. This option directs the Debugger to delete the breakpoint after it is first incurred by a task. The Debugger generates a breakpoint display and, unless the C option is also specified, places the task that incurred the breakpoint on the breakpoint list.

DESCRIPTION

This command deletes the breakpoint that was associated with the breakpoint variable name and replaces it with a new breakpoint, as specified in the command. The breakpoint variable name can be used when deleting or changing the breakpoint.

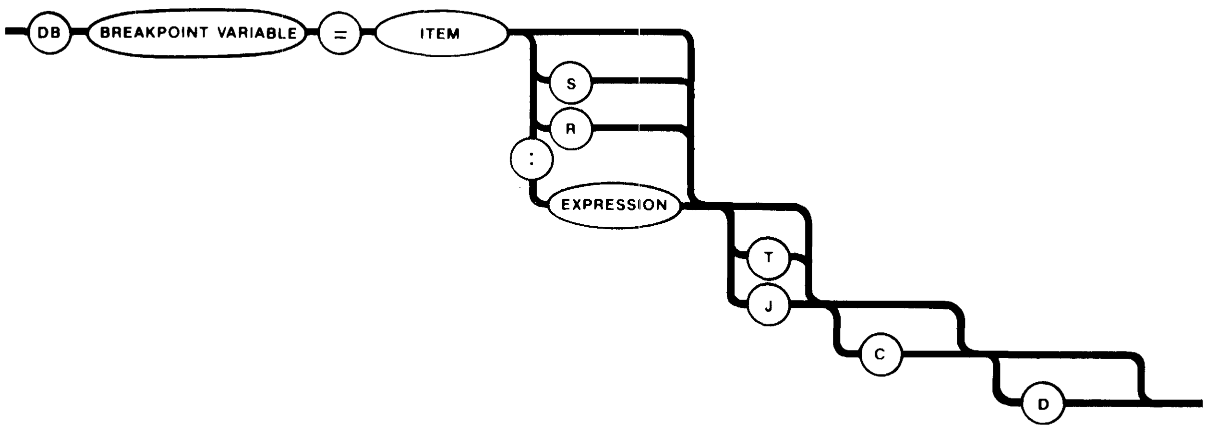
EXAMPLE

```
.BPOINT
BPOINT=2F34 S T C
*
.BPOINT = 2D2A S C
*
.BPOINT
BPOINT=2D2A S C
*
```

In this example, the user lists a breakpoint variable, changes it, and lists it again.

DEFINING A BREAKPOINT -- DB

This command defines an execution or exchange breakpoint. The syntax for the DB command is as follows:



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PARAMETERS

BREAKPOINT VARIABLE	A Debugger name by which to identify the breakpoint. This name must consist of a period followed by up to 11 characters, the first of which must be alphabetic. The other characters can be alphabetic, numeric, question marks (?), or dollar signs ($). If the Debugger's symbol table already contains this name, an error message will appear on the terminal's display.
ITEM	If you are setting an execution breakpoint, ITEM is used in combination with EXPRESSION to specify the address of the breakpoint. ITEM must contain the base portion of the address. It must be followed by ":" and an EXPRESSION, which must contain the offset portion. If you are setting an exchange breakpoint, ITEM must contain a token for an exchange.
S and R	To be used only when setting an exchange breakpoint. S means that the exchange breakpoint is for senders only, while R means that it is for receivers only. If you want to set an exchange breakpoint for both senders and receivers, omit both S and R, as well as both ":" and EXPRESSION.

EXPRESSION	To be used only when setting an execution breakpoint. EXPRESSION must contain the offset portion of the address of the execution breakpoint.
T and J	Indicate which tasks are to be put on the breakpoint list when a breakpoint is incurred. T indicates only the task that incurred the breakpoint, while J indicates all of the tasks in that task's job. The default is T.
C	Continue task execution option. This option directs the Debugger not to "break" tasks that incur the breakpoint, and not to put them on the breakpoint list. When a task incurs such a breakpoint, the Debugger generates a breakpoint display, but the task continues to run.
D	Delete breakpoint option. This option directs the Debugger to delete the breakpoint after it is first incurred by a task. The Debugger generates a breakpoint display and, unless the C option is also specified, places the task that incurred the breakpoint on the breakpoint list.

DESCRIPTION

The DB command sets a breakpoint of the type indicated in the remainder of the command line. The name designated as the breakpoint variable can be used when altering or deleting the breakpoint.

EXAMPLES

```
DB .BP = 2DC3:0FF
*
```

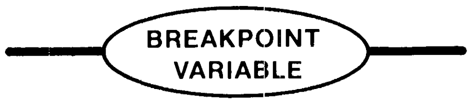
This command defines an execution breakpoint at address 2DC3:0FF and assigns the name .BP to this breakpoint. When a task incurs this breakpoint, only the task itself is placed on the breakpoint list.

```
DB .BPOINT = .MBOX S C
*
```

This command defines an exchange breakpoint at the mailbox whose token is specified by the numeric variable .MBOX. In a previous example, .MBOX had a value of 2F34; therefore the Debugger uses this value for the token.

EXAMINING A BREAKPOINT

This command displays information about a particular breakpoint. The syntax for this command is as follows:



PARAMETER

BREAKPOINT VARIABLE	The name of an existing breakpoint to be examined.

DESCRIPTION

The Debugger displays two kinds of output, depending on whether the specified breakpoint variable represents an execution or an exchange breakpoint. Exception breakpoints cannot be examined.

EXECUTION BREAKPOINT OUTPUT

If the designated breakpoint is an execution breakpoint, the Debugger sends the following display to the terminal:

```
     bp-var=xxxx:yyyy  z ops
```

where:

bp-var	The name of the breakpoint variable.
xxxx	Base portion of the breakpoint's address.
yyyy	Offset portion of the breakpoint's address.
z	Indicates whether a single task (T) is to be "broken" and placed on the breakpoint list or all tasks in a job (J) are to be suspended and placed on the breakpoint list, when the breakpoint is incurred.
ops	Indicates the breakpoint options. If any are present, they can be C (for Continue task) and/or D (for Delete breakpoint).

EXCHANGE BREAKPOINT OUTPUT

If the designated breakpoint is an exchange breakpoint, the Debugger sends the following display to the terminal:

```
     bp-var=xxxx a z ops
```

where:

bp-var	The name of the breakpoint variable.
xxxx	A token for the exchange at which the breakpoint is set.
a	Indicates the kind of breakpoint activity at the exchange, either S (for send), R (for receive), or SR (for both).
z	Indicates whether a single task (T) is to be "broken" and placed on the breakpoint list or all tasks in a job (J) are to be suspended and placed on the breakpoint list, when the breakpoint is incurred.
ops	Indicates the breakpoint options. If any are present, they can be C (for continue task) and/or D (for delete breakpoint).

EXAMPLES

```
     .BP
     BP=2DC3:00FF T
     *
```

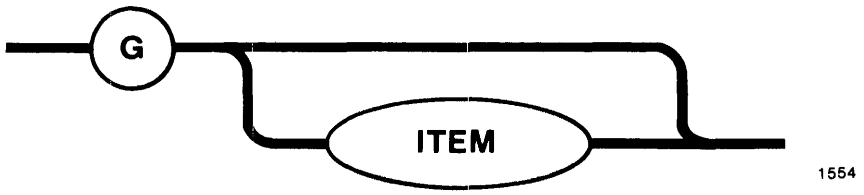
This command lists the address of the execution breakpoint associated with variable .BP. It also indicates that only the task is to be "broken" if a breakpoint is encountered.

```
     .BPOINT
     BPOINT=2F34 S T C
     *
```

This command lists the address of the exchange breakpoint associated with variable .BPOINT. The S, T, and C indicate that only tasks which send messages to the exchange will incur the breakpoint, only the task that incurs the breakpoint will be "broken", and the task will continue processing after incurring the breakpoint.

RESUMING TASK EXECUTION -- G

This command resumes execution of a task on the breakpoint list or the breakpoint task. The syntax for the G command is as follows:



PARAMETER

ITEM	A token for a task on the breakpoint list or the breakpoint task. If the given token is not for a task on the breakpoint list or the breakpoint task, an error message will be displayed. If this parameter is omitted, the breakpoint task is assumed.

DESCRIPTION

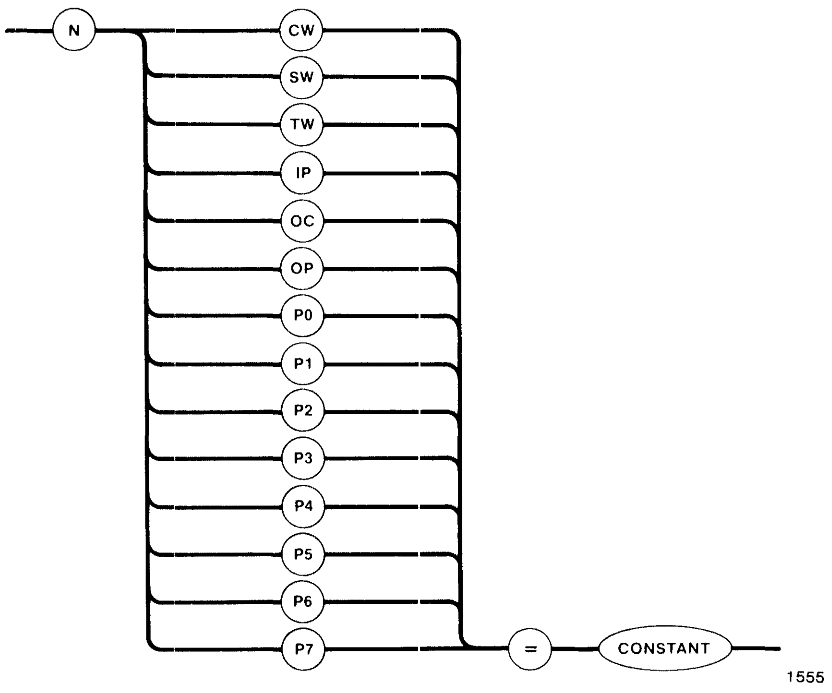
The G command applies to the breakpoint task if ITEM is not present. Otherwise, it applies to the task on the breakpoint list whose token is represented by ITEM.

The G command resumes execution of the designated task. If the task is in the broken state, it is made ready. If it is in the suspended state, its suspension depth is decreased by one.

If the G command is invoked without ITEM when there is no breakpoint task, an error message is displayed at the terminal.

ALTERING THE BREAKPOINT TASK'S NPX REGISTERS -- N

This command modifies the breakpoint task's Numeric Data Processor (NPX) register values. This command applies only to tasks that were specified at creation as having the ability to use the NPX. The syntax for this command is as follows:



PARAMETERS

CW, SW, TW, IP, OC, OP, P0 through P7	Names of the breakpoint task's NPX registers, as follows:

Name	Description
CW	Control Word
SW	Status Word
TW	Tag Word
IP	Instruction Pointer
OC	Operation Code
OP	Operand Pointer
P0-P7	Stack elements

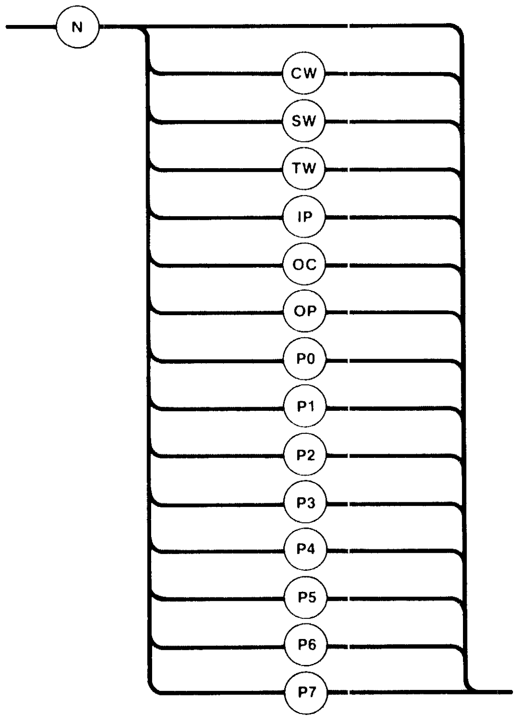
CONSTANT	A hexadecimal number which is used for the new register value. CONSTANT can specify an 80-bit value for registers P0 through P7, a 20-bit value for registers IP and OP, and a 16-bit value for the remaining registers. If this value is too large to fit in the specified register, the Debugger displays a SYNTAX ERROR message.

DESCRIPTION

This command requests that the breakpoint task's NPX register, as specified in the command request, be updated with the value of CONSTANT. This command applies only to tasks which were specified at creation as using the NPX.

VIEWING THE BREAKPOINT TASK'S NPX REGISTERS -- N

This command displays the breakpoint task's Numeric Data Processor (NPX) register values. This command applies only to tasks that were specified at creation as having the ability to use the NPX. The syntax for this command is as follows:



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PARAMETERS

CW, SW, TW, IP, OC, OP, P0 through P7 — Names of the breakpoint task's NPX registers, as follows:

Name	Description
CW	Control Word
SW	Status Word
TW	Tag Word
IP	Instruction Pointer
OC	Operation Code
OP	Operand Pointer
P0-P7	Stack elements

If no name is specified, the Debugger displays values for all registers.

DESCRIPTION

This command lists NPX register values for the breakpoint task. It applies only to tasks which were specified at creation as using the NPX. If the command is simply "N", then all of the breakpoint task's NPX registers are displayed, in the following format:

```
NCW = xxxx         NSW = xxxx         NTW = xxxx
NIP = xxxxx        NOC = xxx          NOP = xxxxx
NP0 = xxxxxxxxxxxxxxxxxxxx
NP1 = xxxxxxxxxxxxxxxxxxxx
NP2 = xxxxxxxxxxxxxxxxxxxx
NP3 = xxxxxxxxxxxxxxxxxxxx
NP4 = xxxxxxxxxxxxxxxxxxxx
NP5 = xxxxxxxxxxxxxxxxxxxx
NP6 = xxxxxxxxxxxxxxxxxxxx
NP7 = xxxxxxxxxxxxxxxxxxxx
NES = xxxx
```

The size of the field indicates the number of hexadecimal digits that the Debugger displays.

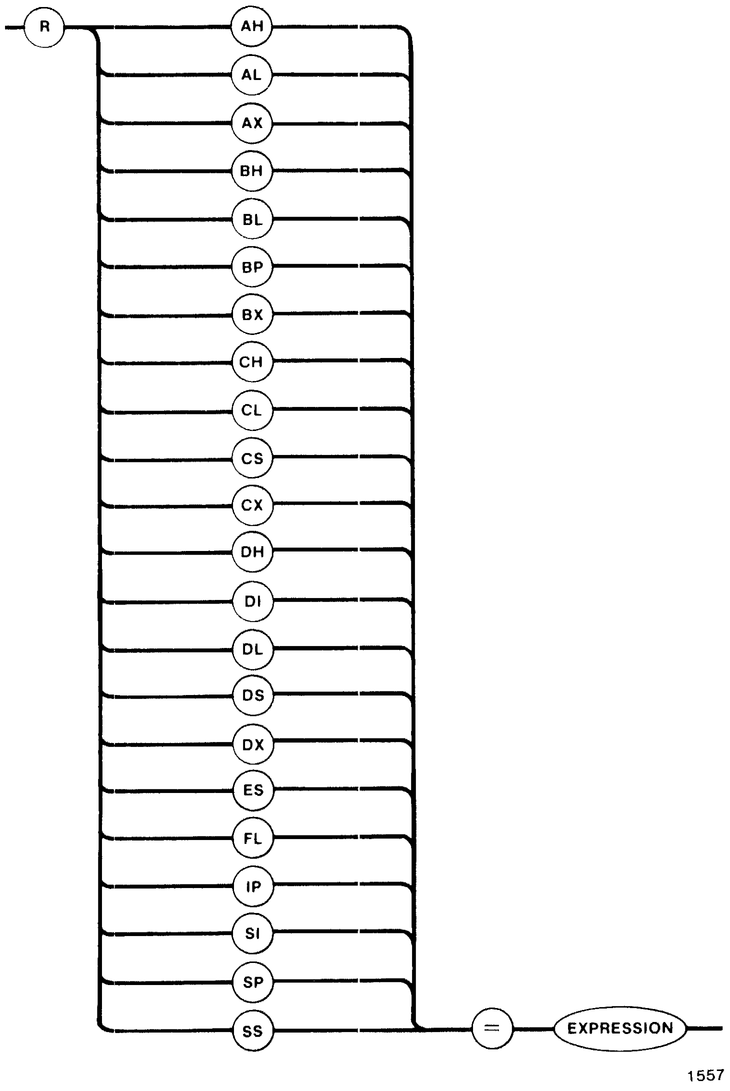
Registers P0 through P7 are 80-bit registers that the Debugger displays in temporary real format.

The NES field contains the value of the NPX Status Word if an NPX exception caused the breakpoint task to be broken. The value for this field, under all other circumstances, is NONE.

If the breakpoint task does not use the NPX, the Debugger returns an error message in response to this command.

ALTERING THE BREAKPOINT TASK'S REGISTERS -- R

This command alters one of the breakpoint task's CPU register values. The syntax for this command is as follows:



PARAMETERS

AH, AL, AX, BH, BL, BP, BX, CH, CL, CS, CX, DH, DI, DL, DS, DX, ES, FL, IP, SI,SP, SS	Names of the breakpoint task's CPU registers.

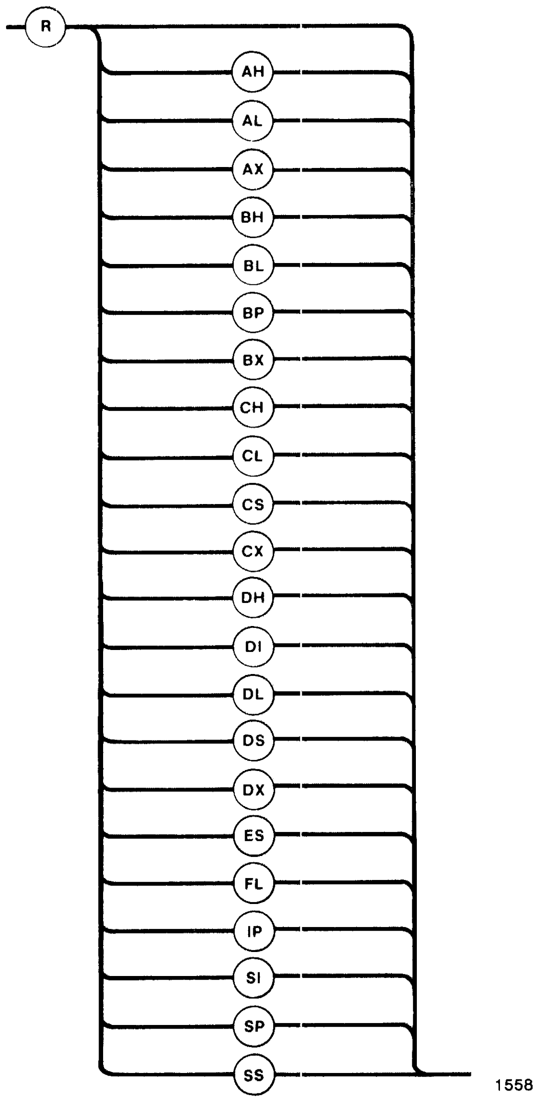
EXPRESSION	A Debugger expression whose value is used for the new register value. If this value is too large to fit in the designated register, the Debugger fills the register with the low-order bytes of the value.

DESCRIPTION

This command requests that the breakpoint task's register, as specified in the command request, be updated with the value of the EXPRESSION. However, if the breakpoint task is in the null breakpoint state, its register values cannot be altered by the R command.

VIEWING THE BREAKPOINT TASK'S REGISTERS -- R

This command lists one or all of the breakpoint task's CPU registers. The syntax for the R command is as follows:



PARAMETERS

AH, AL, AX, BH, BL, BP, BX, CH, CL, CS, CX, DH, DI, DL, DS, DX, ES, FL, IP, SI, SP, SS	Names of the breakpoint task's CPU registers. If no name is specified, the Debugger displays values for all registers.

DESCRIPTION

This command lists CPU register values for the breakpoint task. If the command is simply "R", then all of the breakpoint task's registers are displayed, in the following format:

```
        RAX=xxxx      RSI=xxxx      RCS=xxxx      RIP=xxxx
        RBX=xxxx      RDI=xxxx      RDS=xxxx      RFL=xxxx
        RCX=xxxx      RBP=xxxx      RSS=xxxx
        RDX=xxxx      RSP=xxxx      RES=xxxx
```

If the command has the form Ryy, where yy is the register name, then the contents of the specified register are displayed, either as:

```
          Ryy=xxxx
```

or as:

```
          Ryy=xx
```

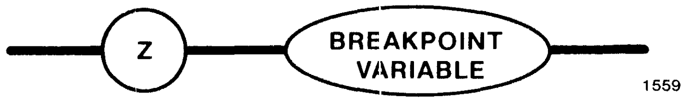
depending on whether yy is a byte-size register (like AH) or a word-size register (like AX).

If the breakpoint task is in the null breakpoint state, only its BP, SP, CS, DS, SS, IP, and FL register contents are displayed. The remaining register displays consist of question marks.

In certain circumstances the breakpoint task, when suspended, is in a state which prevents the Debugger from obtaining its register contents. If this is the case, the Debugger displays question marks for all registers.

DELETING A BREAKPOINT -- Z

This command deletes a breakpoint. The syntax for the Z command is as follows:



PARAMETER

BREAKPOINT VARIABLE	Name of an existing Debugger breakpoint to be deleted.

DESCRIPTION

The Z command deletes the specified breakpoint and removes the breakpoint variable name from the Debugger's symbol table.

EXAMPLE

```
Z .BP
*
```

This command deletes the breakpoint associated with the variable .BP and removes .BP from the Debugger's symbol table.

MEMORY COMMANDS

The commands in this section enable you to inspect or modify the contents of absolute memory locations. Figure 4-1 illustrates the syntax for all commands in this section.

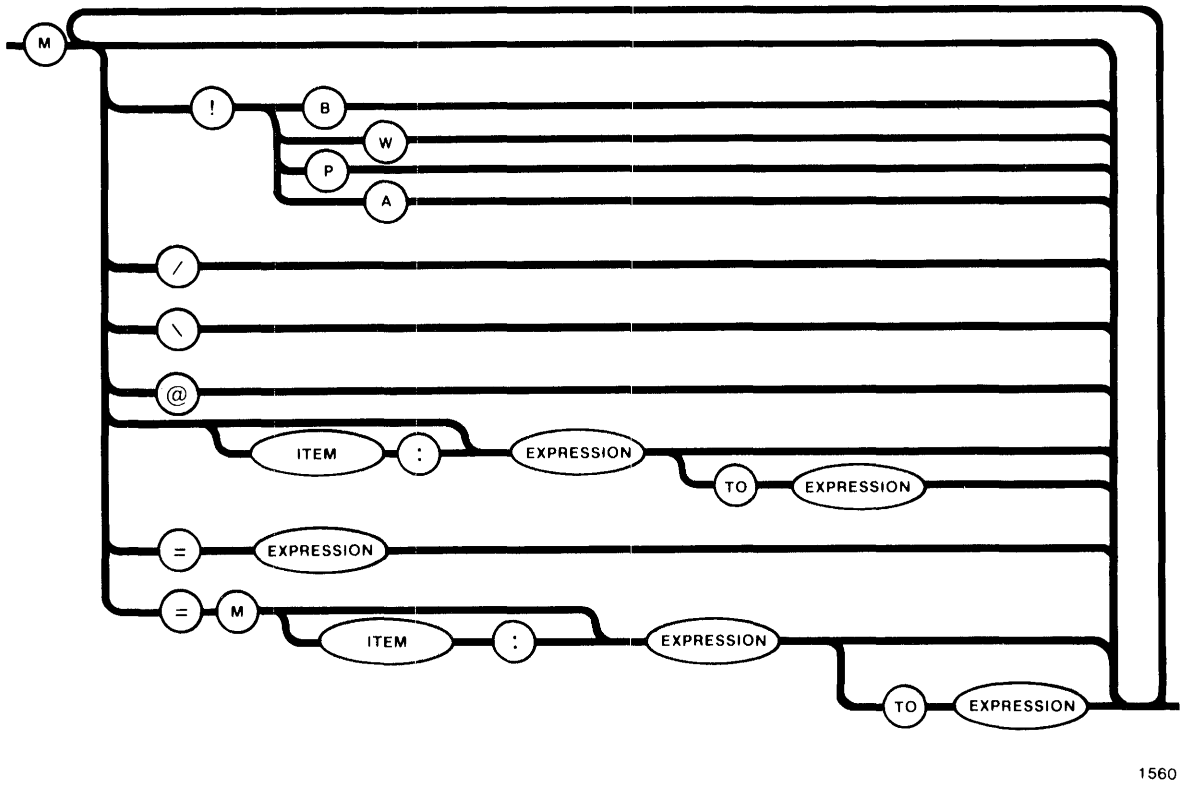


Figure 4-1. Syntax Diagram for Memory Commands

As Figure 4-1 illustrates, all memory commands begin with "M". There are a variety of parameters that can be specified with "M"; these parameters are grouped into the following basic options:

- Setting current display mode. This option begins with "!".
- Changing memory locations. This option includes the "=".
- Displaying memory locations. This option consists of the remaining parameters.

This section breaks up the description of the "M" command into these three groups and discusses the groups as separate commands. However, you can combine any number of "M" command options in a single command, as the syntax diagram in Figure 4-1 illustrates.

In the descriptions of these commands, frequent mention is made of the current display mode, the current segment base, the current offset, the current address, and the display of memory locations. This terminology is defined as follows:

- The current display mode determines the manner in which memory values are interpreted for display purposes. The possible modes are designated by the letters B, W, P, and A, and they stand, respectively, for byte, word, pointer, and ASCII. The effects of these modes are best explained in the context of an example. Suppose that memory locations 042B through 042E contain, respectively, the values 25, F3, 67, and 4C. If you ask for the display of the memory at location 042B, then the effects, which depend on the current display mode, are as follows:

Current Display Mode	Display
B	25
W	F325
P	4C67:F325
A	%

  Observe that words and pointers are displayed from high-order (high address) to low-order (low address).

  If a location contains a value which does not represent a printable ASCII character, and the current display mode is A, then the Debugger prints a period. The initial current display mode is B.

- The value of the current segment base is always the value of the most recently used CPU segment base. The initial value of the current segment base is 0.

- The current offset is a value the Debugger maintains and uses when reference is made to a memory location without explicitly citing an offset value. Except when the current offset has been modified by certain options of the M command, the current offset is always the value of the most recently used offset. The initial value of the current offset is 0.

- The current address is the iAPX 86 memory address computed from the combination of the current segment base and the current offset.

- When memory locations are displayed, the format is as follows:

  ```
  xxxx:yyyy=value
  ```

  where xxxx and yyyy are the current segment base and current offset, respectively, and value is a byte, word, pointer, or ASCII character, depending on the current display mode. If several contiguous memory locations are being requested in a single request, each line of display is as follows:

  ```
  xxxx:yyyy=value value value ... value
  ```

  where xxxx, yyyy, and value are as previously described, and xxxx:yyyy represent the address of the first value on that line.

  The first such line begins with the first address in the request and continues to the end of that (16-byte) paragraph. If additional lines are required to satisfy the request, each of them begins at an offset which is a multiple of 16 (10 hexadecimal).

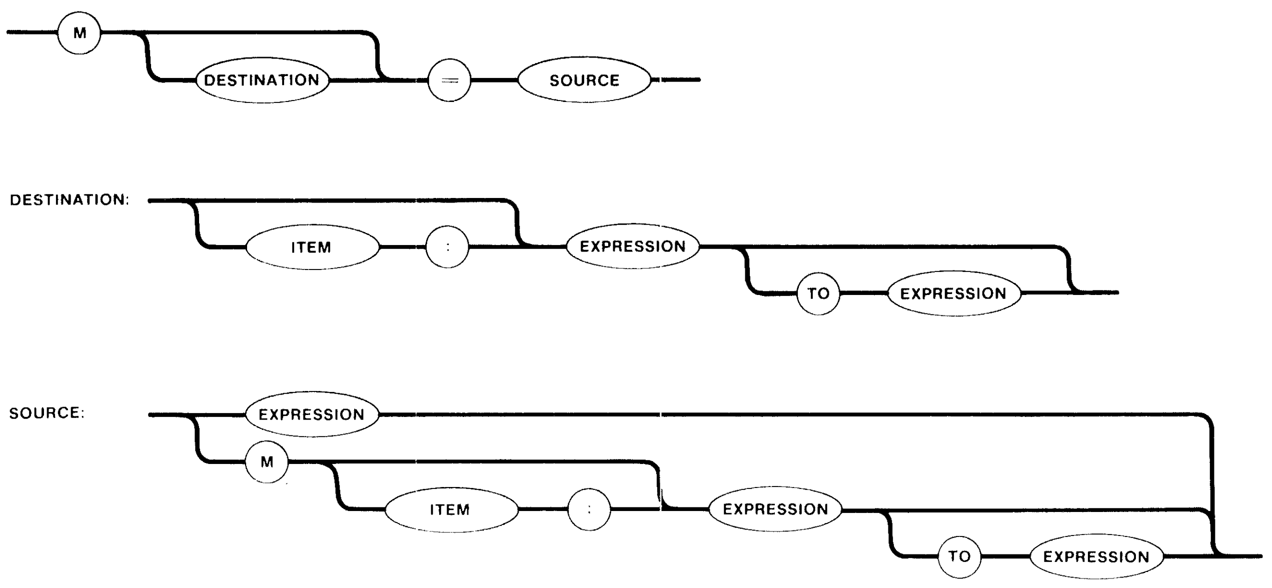
CHANGING MEMORY -- M

This command changes the contents of designated RAM locations.

CAUTION

Because the Debugger is generally used during system development, while your tasks, the Nucleus, the Debugger, and possibly other iRMX 86 components are in RAM, you should use these M command options with extreme care.

The syntax for this command is as follows:



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PARAMETERS

As shown in the syntax diagram, the parameters for this command are divided into DESTINATION and SOURCE parameters which are separated with an equal sign.

Destination Parameters

These parameters define the memory location or locations that are going to be changed. All parameters change the current offset, and some of them change the current base. The valid parameter combinations are as follows:

EXPRESSION	This form of the DESTINATION option implies that the address to be changed has the current base as its base value and the value of EXPRESSION as its offset.
ITEM:EX-PRESSION	This form of the DESTINATION option implies that the address to be changed has the value of ITEM as its base value and the value of EXPRESSION as its offset.
EXPRESSION TO EXPRESSION	This form of the DESTINATION option implies that a series of consecutive locations will be changed. The EXPRESSIONs determine the beginning and ending offsets, respectively. The current base is used as a base value. After memory has been changed, the current offset is set to the value of the second EXPRESSION.
ITEM:EX-PRESSION TO EXPRESSION	This form of the DESTINATION option is the same as the previous one, except that ITEM is used as the base value of the locations.

If no DESTINATION option is specified, the location specified by the current segment base and current offset is changed. However, if the previous command was a "Display Memory" command of the form:

```
M EXPRESSION TO EXPRESSION
```

the entire range of locations specified in that command is changed.

Source Parameters

These parameters define the information that will be placed into the DESTINATION memory. The valid parameter combinations are as follows:

EXPRESSION — This form of the SOURCE option can be used only if the current display mode is byte or word. It implies that the value represented by EXPRESSION will be copied into the byte or word at the current address. However, if the DESTINATION option (supplied or default) specified a range of locations, this option instead copies the value of EXPRESSION into each byte or word in DESTINATION.

Examples:

(1) When the DESTINATION option did not specify a range of values:

```
M = 4C
0400:0008 09
0400:0008 4C
*
```

This example changes the contents of the current location (0400:0008) from 09 to 4C. Notice that the Debugger displays both the old and the new contents of memory.

(2) When the DESTINATION option specified a range of values:

```
M 1 TO 4
0400:0001 06 07 08 09
*
M = 4C
0400:0001 06 07 08 09
0400:0001 4C 4C 4C 4C
*
```

In this example, because the previous command was an examination of a range of memory, the command to change memory changes the entire range of memory.

M EXPRESSION — This form of the SOURCE option uses the current segment base and the offset indicated by the value of EXPRESSION to compute an address. It copies the value at that computed address into the location specified by the current address.

However, if the DESTINATION option (supplied or default) specified a range of locations, the value at the computed address is instead copied to each of the locations in the destination field.

Examples:

(1) When the DESTINATION option did not specify a range of values:

```
M 9
0400:0009 11
*
M = M 6
0400:0009 11
0400:0009 4C
*
```

This example replaces the value in location 4000:0009 (11) with the value in location 4000:0006 (4C).

(2) When the DESTINATION option specified a range of values:

```
M 100
0400:0100 FF
*
M 100 TO 103 = M 6
0400:0100 FF A0 16
0400:0100 4C 4C 4C
*
```

In this example, the command to change memory included a DESTINATION option that specified a range of values. Thus the contents of location 0400:0006 (4C) are copied into each of the DESTINATION locations.

M ITEM:EXPRESSION	This form of the SOURCE option uses ITEM and EXPRESSION as base and offset, respectively, to compute an address. It copies the value at that computed address into the location specified by the current address. However, if the DESTINATION option (supplied or default) specified a range of locations, the value at the computed address is instead copied to each of the locations in the destination field.

Examples:

(1) When the DESTINATION option did not specify a range of values:

```
     M 9
     0400:0009 4C
     *
     M = M 300:2643
     0400:0009 4C
     0400:0009 21
     *
```

This example takes the value in location 0300:2643 (21) and copies it into the current location (0400:0009).

(2) When the DESTINATION option specified a range of values:

```
     M 100 TO 103 = M 300:2643
     0400:0100 4C 4C 4C 22
     0400:0100 21 21 21 21
     *
```

This example copies the contents of location 0300:2643 (21) into each of the locations specified in the DESTINATION option.

M EXPRESSION TO EXPRESSION	This form of the SOURCE option uses the current segment base and, in order, the offsets indicated by the EXPRESSIONs, to compute a beginning address and an ending address. It copies the sequence of values bounded by the computed addresses to the sequence of locations that begin at the current address. However, if the DESTINATION option (supplied or default) specified a range of locations, the sequence of values bounded by the computed addresses is copied to the destination field, with the source values being truncated or repeated as required.

Examples:

(1) When the DESTINATION option did not specify a range of values:

```
     M 400:104
     0400:0104 E1
     *
     M = M A TO C
     0400:0104 E1 F2 0A
     0400:0104 0B 0C 0D
     *
```

In this example, the contents of the range of locations specified in the SOURCE option (0400:000A - 0400:000C) are copied into the range of locations that begin with the current address (0400:0104).

(2) When the destination option specified a range of values:

```
     M 1 TO 4 = M A TO C
     0400:0001 4C 4C 4C 4C
     0400:0001 0B 0C 0D 0B  (first value
     *                        repeated)
```

This example copies the contents of three locations (0400:000A - 0400:000C) into four locations (0400:0001 - 0400:0004). Notice that the values start repeating; 0400:0001 contains the same value as 0400:0004 (0B).

M ITEM:EXPRESSION TO EXPRESSION — This form of the SOURCE option uses ITEM as a base and the EXPRESSIONs as offsets to compute a beginning and an ending address. The sequence of values bounded by the computed addresses is copied to the sequence of locations beginning at the current address. However, if the DESTINATION option (supplied or default) specified a range of values, the sequence of values bounded by the computed addresses is copied to the destination field, with the source values being truncated or repeated as required.

Examples:

(1) When the DESTINATION option did not specify a range of values:

```
     D .VALUE = 2643
     *
     M 1
     0400:0001 0B
     *
     M = M 300:.VALUE TO .VALUE + 4
     0400:0001 0B 0C 0D 0B 4C
     0400:0001 21 47 E2 C8 31
     *
```

In this example, the contents of the range of locations specified in the SOURCE option (0300:2643 - 0300:2647) are copied into the range of locations that begin with the current address (0400:0001).

(2) When the DESTINATION option specified a range of values:

```
M 101 TO 104
0400:0101 21 21 21 0B
*
M = M 300:2643 TO 2647
0400:0101 21 21 21 0B
0400:0101 21 47 E2 C8  (last value
*                       truncated)
```

This example copies the contents of five locations (0300:2643 - 0300:2647) into four locations (0400:0101 - 0400:0104). Notice that the value of the fifth location (0300:2647) is not copied.

DESCRIPTION

This command changes the contents of designated RAM locations. The DESTINATION options affect the current segment base and offset values. The SOURCE options do not affect these values.

When executing this command, the Debugger displays the contents of the designated locations, then updates the contents, and finally displays the new contents. Thus, if you inadvertently destroy some important data, the information you need to restore it is available.

This command copies data in the byte mode. The current display mode is not affected by these copying options.

NOTE

When using the M command, be aware of the following hazards:

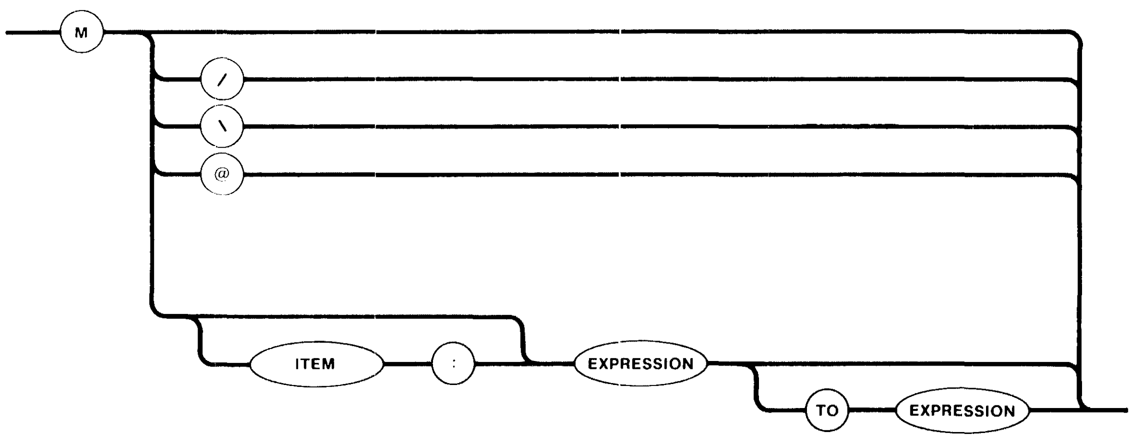
- It is possible for you to modify memory within iRMX 86 components, such as the Nucleus and Debugger. Doing so can jeopardize the integrity of your application system, and should therefore be avoided.

- It is possible to request that non-RAM memory locations be modified. If you attempt to read or write to a non-RAM location, nothing happens to memory and the displays indicate that the specified locations contain zeros.

- A memory request might cross segment boundaries. In processing such a request, the Debugger ignores such boundaries, so don't assume that a boundary will terminate a request.

EXAMINING MEMORY -- M

This command displays memory locations without changing their contents. The syntax for this command is as follows:



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PARAMETERS

To avoid confusion, this section lists examples of complete commands in explaining the parameters.

M/ This option increments the current offset according to the current display mode: by one for byte or ASCII, by two for word, or by four for pointer. Then it displays the contents of the new current address.

```
Example:  M/
          0400:0009 0A
          *
```

This example increments the current offset and displays the address and contents of the location.

M This option is just like M/, except that the current offset is decremented.

```
Example:  M
          0400:0008 08
          *
```

This example decrements the current offset and displays the address and contents of the location.

M

When used by itself, M is an abbreviated way of specifying M/ or M , whichever was used most recently. If neither has been used in the current Debugging session, M is interpreted as an M/ request.

Example:
```
M
0400:0007 08
*
M
0400:0006 07
*
```

Since M was used most recently, these commands decrement the current offset before displaying the address and contents of memory.

M@

This option sets the current offset equal to the value of the word beginning at the current address. Then the value at the adjusted current address is displayed.

Example:
```
M!B
*
M@
0400:0807 46
*
```

Even though byte mode was selected, this example sets the current offset equal to contents of the word at offset 07. From the previous example you can see that this word is indeed 0807.

M EXPRESSION

This option sets the current offset equal to the value of the EXPRESSION and displays the value at the new current address.

Example:
```
M 3
0400:0003 04
*
```

This example sets the current offset to 3 and displays the contents of that location.

M ITEM:EX-
PRESSION

This option is just like M EXPRESSION, except that ITEM is used as the base in the address calculation, and after the operation ITEM is the new current segment base.

Example:
```
M 300:2644
0300:2644 47
*
```

This example sets the current base to 300 and the current offset to 2644. It also displays the contents of that location.

M EXPRESSION TO EXPRESSION

This option displays the values of a series of consecutive locations. The EXPRESSIONs determine the beginning and ending offsets, respectively; the second EXPRESSION must be greater than the first. The current segment base is used as a base. After displaying the locations, the Debugger sets the current offset to the value of the second expression. If the specified range of locations is incompatible with the current display mode --- for example, an odd number of locations is not compatible with the word or pointer modes --- then all words or pointers that lie partially or totally inside the range are displayed.

```
Examples: (1) M 4 TO 6
              0300:0004 15 26 37
               *
          (2) M!W
               *
              M 4 TO 6
              0300:0004 2615 4837
               *
```

These examples display a consecutive series of memory locations in both byte and word mode. Notice that the base set in the last example (300) is still used.

M ITEM:EXPRESSION TO EXPRESSION

This option is just like M EXPRESSION TO EXPRESSION, except that ITEM is used as a base in the address calculation, and after the operation ITEM is the new segment base.

```
Example:  M!B
          *
          D .MEM = 100
          *
          M 400:.MEM TO .MEM +4
          0400:0100 FF A0 16 22 E1
          *
```

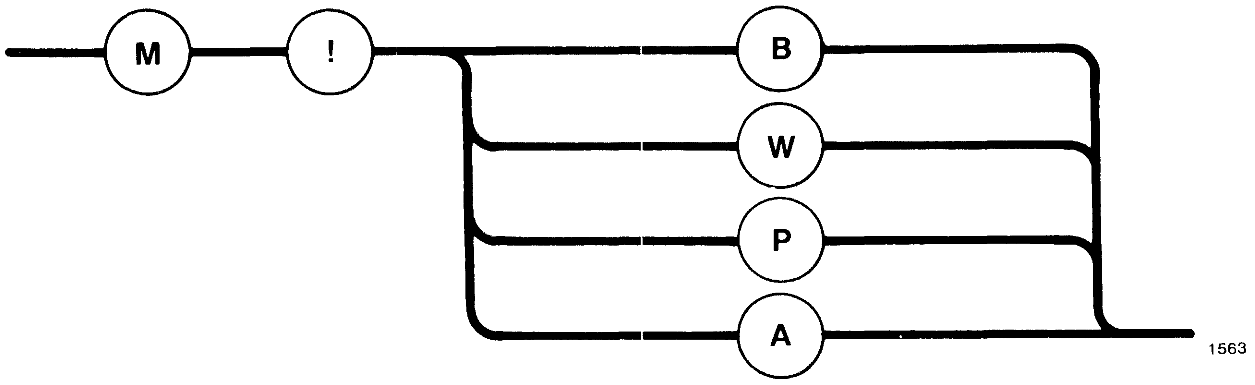
After setting the output mode to byte and defining a numeric variable .MEM, this example sets the base to 400 and displays five consecutive memory locations beginning with offset 100 (.MEM). Upon completion of this example, the current offset is 400 and the current base is 104.

DESCRIPTION

This command displays the contents of memory without disturbing those contents. Be aware, however that all of the options change the current offset, and some of them change the current segment base. None changes the current display mode.

SETTING THE CURRENT DISPLAY MODE -- M

This command specifies the way in which the Debugger will display output. The syntax for the M command is as follows:



PARAMETERS

!	Indicates that the display mode is being changed.
B, W, P, A	Specifies the mode of display. B indicates byte mode, W indicates word mode, P indicates pointer mode, and A indicates ASCII mode.

DESCRIPTION

This command sets the display mode for further Debugger output. When the Debugger next displays memory, it will display the memory according to the mode specified with this command.

EXAMPLES

```
M!B
*
```

This command instructs the Debugger to display all further output in byte mode.

```
M!W
*
```

This command instructs the Debugger to display all further output in word mode.

COMMANDS TO INSPECT SYSTEM OBJECTS

The commands in this section allow you to examine iRMX 86 objects in detail. They give specific information about the Nucleus object types. Figure 4-2 illustrates the general syntax for all the commands in this section.

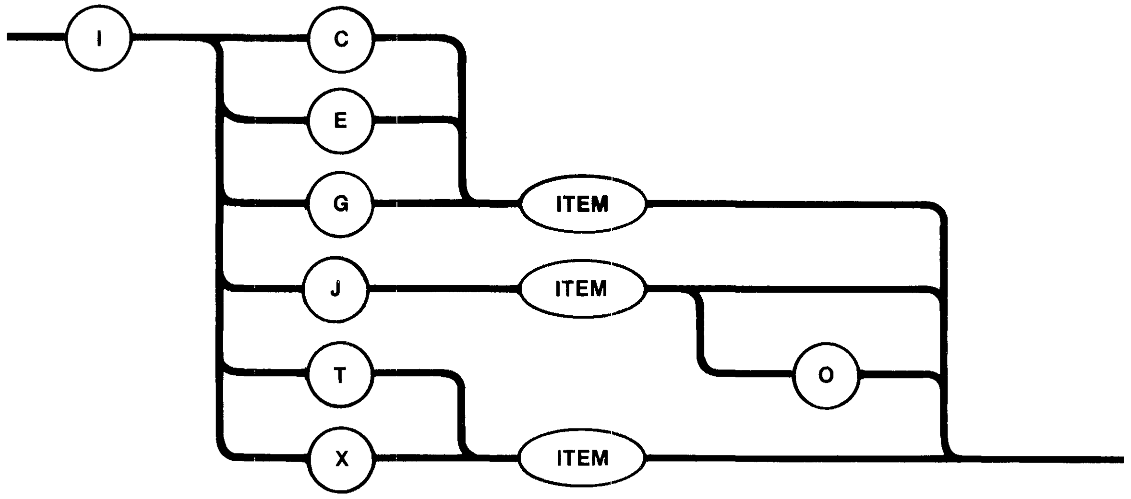


Figure 4-2. Syntax Diagram For Inspecting System Objects

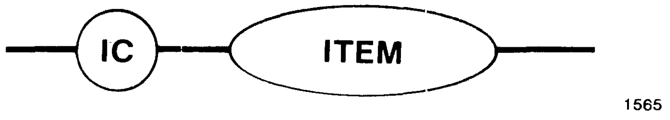
The second letter of the command indicates the type of object to inspect, as follows:

J	Job
T	Task
E	Exchange
G	Segment
C	Composite
X	Extension

The remainder of this section describes the commands in detail.

INSPECTING A COMPOSITE -- IC

This command displays the principal attributes of the specified composite. The syntax for the IC command is as follows:



PARAMETER

ITEM	Token for the composite object to be inspected.

DESCRIPTION

The IC command displays the principal attributes of the composite object whose token is represented by ITEM. Figure 4-10 depicts the form of the display produced by IC.

```
                ----- iRMX86 COMPOSITE REPORT -----
COMPOSITE TOKEN       bbbb            CONTAINING JOB        gggg
EXTENSION TOKEN       cccc            # TOKEN SLOTS         hhhh
TOKEN(S)    ffffJ/dddde  ffffJ/dddde  ffffJ/dddde  ffffJ/dddde

NAME(S)   aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
            aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
```

Figure 4-3. An iRMX™ 86 Composite Report

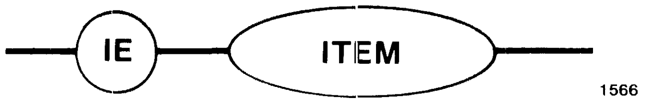
The following describes the fields in Figure 4-3:

Field	Meaning
aaaaaaaaaaaa	Each such field contains a name under which the composite is cataloged in the object directory of either the job containing the composite or the root job. If the composite is not cataloged in either directory, "NONE FOUND" is displayed here.
bbbb	Hexadecimal token for the composite.

Field	Meaning
cccc	Hexadecimal token for the extension that represents license to create this type of composite.
dddd	Hexadecimal token for one of the components of the composite object.
e	Single letter that indicates the type of object dddd. This field can have any of the following values:
	C composite
	G segment
	J job
	M mailbox
	R region
	S semaphore
	T task
	X extension
	* a task whose stack has overflowed or whose code was loaded by the iRMX 86 Application Loader
ffff	Hexadecimal token for the job that contains object dddd.
gggg	Hexadecimal token for the job that contains composite object bbbb.
hhhh	Hexadecimal value specifying the maximum allowable number of component objects that the composite object can comprise.

INSPECTING AN EXCHANGE -- IE

This command displays the principal attributes of a mailbox, semaphore, or region whose token is specified. The syntax of the IE command is as follows:



PARAMETER

ITEM	Token for the exchange to be inspected.

DESCRIPTION

The IE command displays the principal attributes of the mailbox, semaphore, or region whose token is represented by ITEM. It produces three kinds of output, one for each kind of exchange.

Mailbox Display

Figure 4-4 depicts the form of display produced by IE for a mailbox.

```
                ----- iRMX86 MAILBOX REPORT -----
MAILBOX TOKEN         bbbb        CONTAINING JOB          hhhh
# TASKS WAITING       cccc        # OBJECTS WAITING       iiii
FIRST WAITING  ddddf/eeeef        QUEUE DISCIPLINE     jjjjjjj
CACHE SIZE            gggg

NAME(S)  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
          aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
```

Figure 4-4. An iRMX™ 86 Mailbox Report

The following describes the fields in Figure 4-4:

Field	Meaning
aaaaaaaaaaaa	Each such field contains a name under which the mailbox is cataloged in the object directory of either the mailbox's containing job or the root job. If the mailbox is not cataloged in either directory, "NONE FOUND" is displayed here.
bbbb	Hexadecimal token for the mailbox.
cccc	Number, in hexadecimal, of tasks in the mailbox's task queue.
dddd	Token for the containing job of either the first task waiting in the task queue or the first object waiting in the object queue. Because at least one of these queues is empty, dddd is not ambiguous. If both queues are empty, dddd is absent.
eeee	Token for either the first task waiting in the task queue or the first object waiting in the object queue. Because at least one of these queues is empty, eeee is not ambiguous. If both queues are empty, eeee is 0000.
f	Single letter that indicates the type of the first task waiting in the task queue or the first object waiting in the object queue. Because at least one of these queues is empty, f is not ambiguous. If both queues are empty, f is blank. Otherwise, f has one of the following values: C composite; G segment; J job; M mailbox; R region; S semaphore; T task; X extension
gggg	Number, in hexadecimal, of objects that the mailbox's high performance object queue is capable of holding.
hhhh	Hexadecimal token for the job containing the mailbox.

Field	Meaning
iiii	Number, in hexadecimal, of objects in the mailbox's object queue.
jjjjjjj	Description of the manner in which waiting tasks are queued in the mailbox's task queue. The possible values are FIFO and PRIORITY.

Semaphore Display

Figure 4-5 depicts the form of the display produced by IE for a semaphore.

```
                 ----- iRMX86 SEMAPHORE REPORT -----
SEMAPHORE TOKEN       bbbb          CONTAINING JOB         gggg
# TASKS WAITING       cccc          QUEUE DISCIPLINE   hhhhhhhh
CURRENT VALUE         dddd          MAXIMUM VALUE          iiii
FIRST WAITING    eeeeJ/ffffT

NAME(S)  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
         aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
```

Figure 4-5. An iRMX™ 86 Semaphore Report

The following describes the fields in Figure 4-5:

Field	Meaning
aaaaaaaaaaaa	Each such field contains a name under which the semaphore is cataloged in the object directory of either the semaphore's containing job or the root job. If the semaphore is not cataloged in either directory, "NONE FOUND" is displayed here.
bbbb	Hexadecimal token for the semaphore.
cccc	Number, in hexadecimal, of tasks waiting in the queue.
dddd	Number, in hexadecimal, of units currently in the custody of the semaphore.
eeee	Hexadecimal token for the containing job of the first waiting task. It is absent if no tasks are waiting.

Field	Meaning
ffff	Hexadecimal token for the first waiting task. It is 0000 if no tasks are waiting.
gggg	Hexadecimal token for the semaphore's containing job.
hhhhhhhh	Description of the manner in which waiting tasks are queued in the semaphore's task queue. The possible values are FIFO and PRIORITY.
iiii	Maximum allowable number, in hexadecimal, of units that the semaphore may have in its custody.

Region Display

Figure 4-6 depicts the form of display produced by IE for a region.

```
                  ----- iRMX86 REGION REPORT -----
   REGION TOKEN           bbbb        CONTAINING JOB        eeee
   # TASKS WAITING        cccc        QUEUE DISCIPLINE  ffffffff
   TASK IN REGION         dddd        FIRST WAITING         gggg

   NAME(S)  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
            aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
```

Figure 4-6. An iRMX™ 86 Region Report

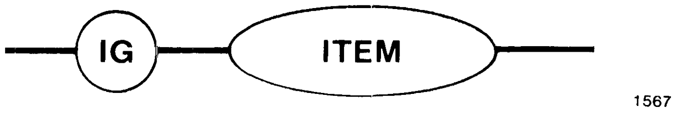
The following describes the fields in Figure 4-7:

Field	Meaning
aaaaaaaaaaaa	Each such field contains a name under which the region is cataloged in the object directory of either the job containing the region or the root job. If the region is not cataloged in either directory, "NONE FOUND" is displayed here.
bbbb	Hexadecimal token for the region.
cccc	Number, in hexadecimal, of tasks awaiting access to the data protected by the region.

Field	Meaning
dddd	Hexadecimal token for the task that currently has access.
eeee	Hexadecimal token for the job that contains the region.
ffffffff	Manner in which waiting tasks are queued at the region. Possible values are FIFO, PRIORITY, and INVALID.

INSPECTING A SEGMENT -- IG

This command displays the principal attributes of the specified segment. The syntax for the IG command is as follows:



PARAMETER

ITEM	Token for the segment to be inspected.

DESCRIPTION

The IG command displays the principal attributes of the segment whose token is represented by ITEM. Figure 4-7 depicts the form of the display produced by IG.

```
                 ----- iRMX86 SEGMENT REPORT -----
SEGMENT TOKEN          bbbb            CONTAINING JOB        dddd
SEGMENT BASE           cccc            SEGMENT LENGTH       eeeee

NAME(S)  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
         aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
```

Figure 4-7. An iRMX™ 86 Segment Report

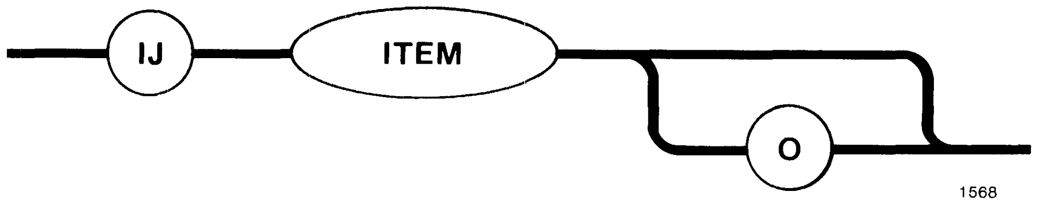
The following describes the fields in Figure 4-7:

Field	Meaning
aaaaaaaaaaaa	Each such field contains a name under which the segment is cataloged in the object directory of either the segment's containing job or the root job. If the segment is not cataloged in either directory, "NONE FOUND" is displayed here.
bbbb	Hexadecimal token for the segment.

Field	Meaning
cccc	Base address of the segment.
dddd	Hexadecimal token for the job that contains the segment.
eeeee	Number, in hexadecimal, of bytes in the segment.

INSPECTING A JOB -- IJ

This command lists the principal attributes of a specified job. The syntax for the IJ command is as follows:



PARAMETERS

ITEM	A token for the job to be inspected.
O	If this option is included, the job's object directory is also listed. If omitted, the object directory is not listed.

DESCRIPTION

The IJ command lists the principal attributes of a job whose token is represented by ITEM. It also lists the object directory if the O option is included. If there is a large number of entries in the object directory, the control-O character can be used to prevent data from rolling off the screen. The control-O special character is described in Chapter 2.

Figure 4-8 depicts the form of the display produced by the IJ command.

```
                   ----- iRMX86 JOB REPORT -----
JOB TOKEN             bbbb       PARENT JOB              jjjj
POOL MAXIMUM          cccc       POOL MINIMUM            kkkk
CURRENT ALLOCATED     dddd       CURRENT UNALLOCATED     llll
CURRENT # OBJECTS     eeee       CURRENT # TASKS         mmmm
MAXIMUM # OBJECTS     ffff       MAXIMUM # TASKS         nnnn
CURRENT # CHILD JOBS  gggg       DELETION PENDING         ppp
EXCEPTION MODE        hhhh       EXCEPTION HANDLER  qqqq:rrrr
MAXIMUM PRIORITY      iiii

NAME(S)  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
         aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa

                   ----- OBJECT DIRECTORY -----
MAXIMUM SIZE          uuuu        VALID ENTRIES          vvvv
NAME         TOKEN    NAME         TOKEN     NAME         TOKEN
ssssssssssss tttt     ssssssssssss tttt      ssssssssssss tttt
```

Figure 4-8. An iRMX™ 86 Job Report

The following describes the fields in Figure 4-8:

Field	Meaning
aaaaaaaaaaaa	Each such field contains a name under which the job is cataloged in the object directory of either the job's parent job or the root job. If the job is not cataloged in either directory, "NONE FOUND" is printed here.
bbbb	Hexadecimal token for the job.
cccc	Maximum number, in hexadecimal, of 16-byte paragraphs that the job's pool can contain.
dddd	Number of paragraphs that have been either allocated to tasks in the job or lent to child jobs.
eeee	Number, in hexadecimal, of existing objects in job bbbb.
ffff	Maximum number, in hexadecimal, of objects that can exist simultaneously in job bbbb.
gggg	Number, in hexadecimal, of existing jobs that are offspring of job bbbb.

Field	Meaning
hhhh	Exception mode for the job's default exception handler. Possible values are as follows:

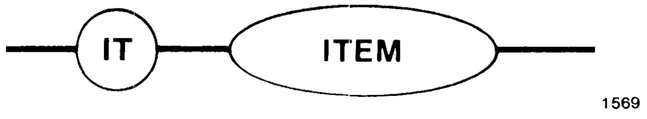
Value	When to Pass Control To Exception Handler
0	Never
1	On programmer errors only
2	On environmental conditions only
3	On all exceptional conditions
INVALID	Never

Field	Meaning
iiii	Hexadecimal value that indicates the maximum (numerically lowest) allowable priority for tasks in the job.
jjjj	Hexadecimal token for the parent of job bbbb. If job bbbb is the root job, however, jjjj is "ROOT".
kkkk	Minimum number, in hexadecimal, of 16-byte paragraphs that the job's pool can contain.
llll	Number, in hexadecimal, of unused 16-byte paragraphs in the job's initial pool.
mmmm	Number, in hexadecimal, of tasks currently in the job.
nnnn	Maximum number, in hexadecimal, of tasks that can exist simultaneously in job bbbb.
ppp	Indicator which tells whether a task has attempted to delete the job but was unsuccessful because the job has obtained protection from the DISABLE$DELETION system call. The possible values of ppp are YES and NO.
qqqq	Base, in hexadecimal, of the start address of the job's default exception handler.
rrrr	Hexadecimal offset, relative to qqqq, of the start address of the job's default exception handler.
ssssssssssss	Each such field contains the name under which an object is cataloged in the job's object directory. If there are no entries in the object directory, these fields are blank.
tttt	Each such field contains a token, in hexadecimal, of the object whose name (in the directory) appears next to it.

Field	Meaning
uuuu	Maximum allowable number, in hexadecimal, of entries in the job's object directory.
vvvv	Number, in hexadecimal, of entries currently in the job's object directory.

INSPECTING A TASK -- IT

This command lists the principal attributes of a specified task. The syntax for the IT command is as follows:



PARAMETER

ITEM	Token for the task to be inspected.

DESCRIPTION

The IT command displays the principal attributes of the task whose token is represented by ITEM. Figure 4-9 depicts the form of display produced by IT.

```
                  ----- iRMX86 TASK REPORT -----
TASK TOKEN                bbbb     CONTAINING JOB              kkkk
STACK SEGMENT BASE        cccc     STACK SEGMENT OFFSET        1111
STACK SEGMENT SIZE        dddd     STACK SEGMENT LEFT          mmmm
CODE SEGMENT BASE         eeee     DATA SEGMENT BASE           nnnn
INSTRUCTION POINTER       ffff     TASK STATE              pppppppp
STATIC PRIORITY           gggg     DYNAMIC PRIORITY            qqqq
SUSPENSION DEPTH          hhhh     SLEEP UNITS REQUESTED       rrrr
EXCEPTION MODE            iiii     EXCEPTION HANDLER      ssss:tttt
NPX TASK                  jjj
NAME(S)  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
         aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
```

Figure 4-9. An iRMX™ 86 Task Report

The following describes the fields in Figure 4-9:

Field	Meaning
aaaaaaaaaaaa	Each such field contains a name under which the task is cataloged in the object directory of either the task's containing job or the root job. If the job is not cataloged in either directory, "NONE FOUND" is displayed here.

Field	Meaning
bbbb	Hexadecimal token for the task.
cccc	Base address, in hexadecimal, of the task's stack segment.
dddd	Size, in bytes, of the task's stack segment.
eeee	Base address, in hexadecimal, of the task's code segment.
ffff	Current value, in hexadecimal, of the task's instruction pointer.
gggg	Hexadecimal priority of the task.
hhhh	Current number, in hexadecimal, of "suspends" against the task. Before the task can be made ready, each "suspend" must be countered with a "resume".
iiii	Exception mode for the task's exception handler. Possible values are as follows:

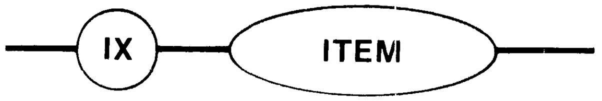
Value	When to Pass Control To Exception Handler
0	Never
1	On programmer errors only
2	On environmental conditions only
3	On all exceptional conditions

Field	Meaning
jjj	Indicator which tells whether the task uses the NPX. The possible values of jjj are YES and NO.
kkkk	Hexadecimal token for the task's containing job.
llll	Hexadecimal offset, relative to cccc, of the task's stack segment.
mmmm	Hexadecimal number of bytes currently available in the task's stack.
nnnn	Base address, in hexadecimal, of the task's data segment.
pppppppp	Current execution state of the task. Possible values are "READY", "ASLEEP", "SUSPENDED", "ASLEEP/SUSP", "BROKEN", and "INVALID".
qqqq	A temporary, hexadecimal priority that is sometimes assigned to the task by the Nucleus. This is done to improve system performance.

Field	Meaning
rrrr	If the task is asleep or asleep/suspended, this is the number of 1/100 second sleep units that the task requested just prior to going to sleep. If the task is ready or suspended, qqqq is 0000.
ssss	Base, in hexadecimal, of the start address of the task's exception handler.
tttt	Hexadecimal offset, relative to ssss, of the start address of the task's exception handler.

INSPECTING AN EXTENSION -- IX

This command displays the principal attributes of the specified extension object. The syntax for the IX command is as follows:



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PARAMETER

ITEM	Token for the extension object to be inspected.

DESCRIPTION

The IX command displays the principal attributes of the extension whose token is represented by ITEM. Figure 4-10 depicts the form of the display produced by IX.

```
                 ----- iRMX86 EXTENSION REPORT -----
     EXTENSION TOKEN        bbbb          CONTAINING JOB        dddd
     TYPE CODE              cccc          DELETION MAILBOX      eeee

     NAME(S)  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
              aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa  aaaaaaaaaaaa
```

Figure 4-10. An iRMX™ 86 Extension Report

The following describes the fields in Figure 4-10:

Field	Meaning
aaaaaaaaaaaa	Each such field contains a name under which the extension is cataloged in the object directory of either the job containing the extension or the root job. If the extension is not cataloged in either directory, "NONE FOUND" is displayed here.
bbbb	Hexadecimal token for the extension.

Field	Meaning
cccc	Hexadecimal type code associated with composite objects licensed by this extension.
dddd	Hexadecimal token for the job containing this extension.
eeee	Hexadecimal token for the deletion mailbox associated with the extension. If there is no deletion mailbox for the extension, "NONE" is displayed here.

COMMANDS TO VIEW OBJECT LISTS

The commands in this section allow you to view lists of iRMX 86 objects. Figure 4-11 illustrates the general syntax for commands in this section.

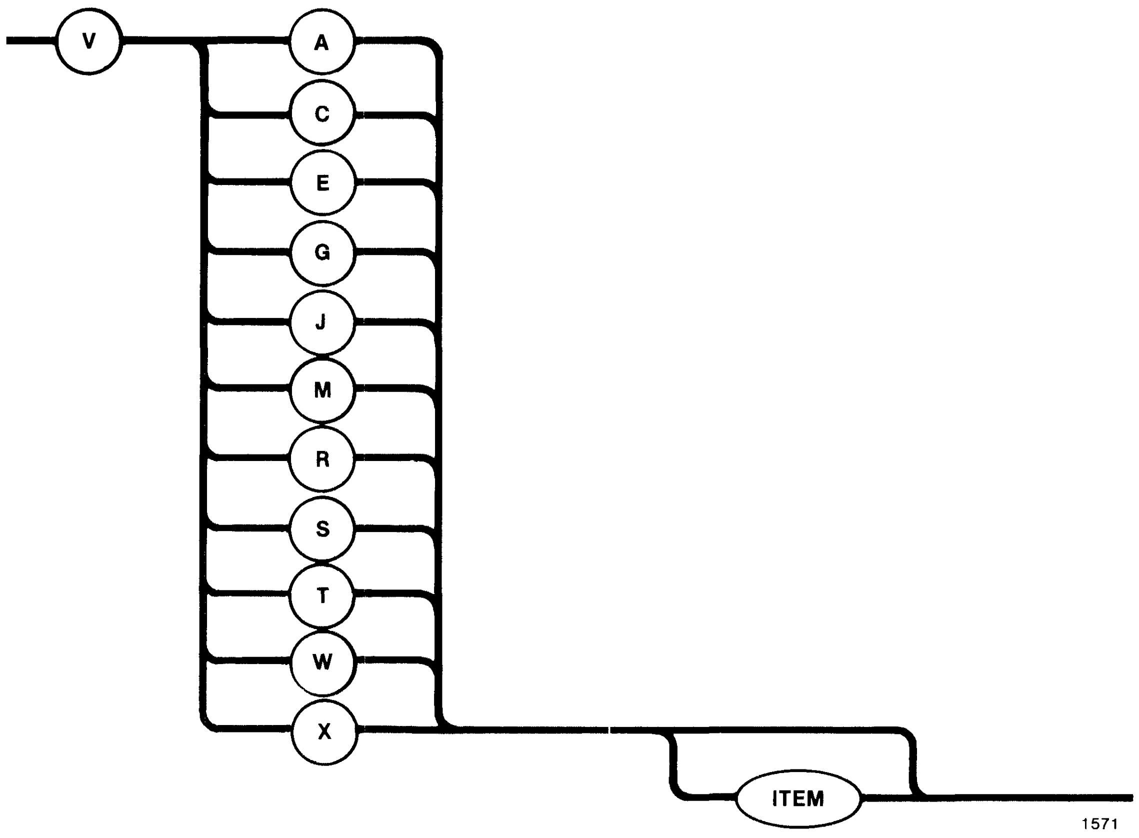


Figure 4-11. Syntax Diagram For Viewing iRMX™ 86 Object Lists

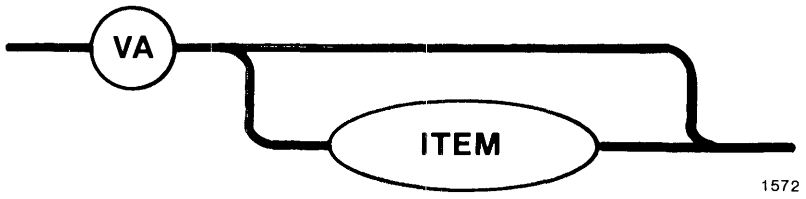
The second letter of the command indicates the type of object list to display, as follows:

J	Jobs
T	Tasks
R	Ready tasks
S	Suspended tasks
A	Asleep tasks
E	Exchanges
W	Waiting Task queues
M	Mailbox queues
G	Segments
C	Composites
X	Extensions

The remainder of this section describes the commands in detail.

VIEWING THE ASLEEP TASKS -- VA

This command displays a list of asleep tasks. The syntax for the VA command is as follows:



PARAMETER

ITEM	Token for a job. If this option is included, the Debugger lists only those asleep tasks that are contained in the specified job. If this option is omitted, all asleep tasks in the system are listed.

DESCRIPTION

The VA command displays suspended tasks as:

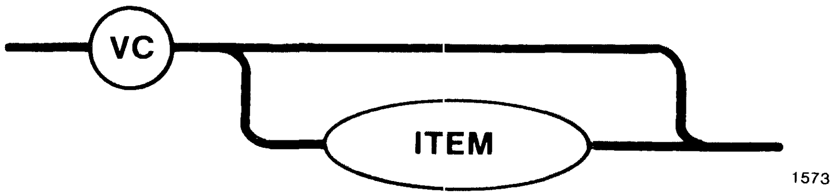
```
SA = jjjjJ/ttttT  jjjjJ/ttttT ... jjjjJ/ttttT
```

where:

tttt	Token of an asleep task.
jjjj	Token for the job containing the task. An asterisk following the task token indicates that the task has overflowed its stack.

VIEWING COMPOSITES -- VC

This command displays a list of composite objects. The syntax for the VC command is as follows:



PARAMETER

ITEM	Token for a job. If this option is included, the Debugger lists only the composite objects contained in the specified job. If this option is omitted, all composite objects in the system are displayed.

DESCRIPTION

The VC command displays composite objects as:

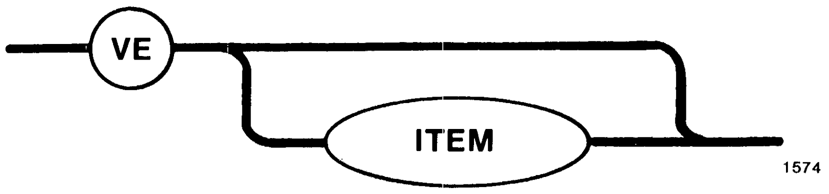
```
CL = jjjjJ/ccccC jjjjJ/ccccC ... jjjjJ/ccccC
```

where:

cccc	Token for a composite object.
jjjj	Token for the job containing the composite object.

VIEWING EXCHANGES -- VE

This command displays a list of exchanges. The syntax for the VE command is as follows:



PARAMETER

ITEM	Token for a job. If this option is included, the Debugger lists only those exchanges that are contained in the specified job. If this option is omitted, all exchanges in the system are listed.

DESCRIPTION

The VE command lists exchanges as:

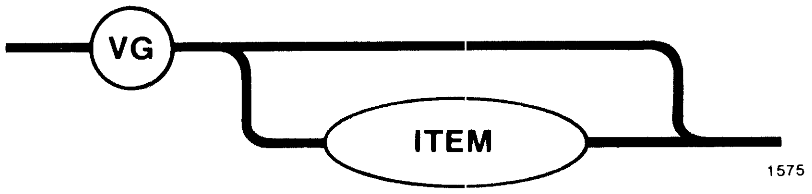
```
    EL = jjjjJ/xxxxt jjjjJ/xxxxt ... jjjjJ/xxxxt
```

where:

xxxx	Token for an exchange.
t	Type of the exchange (M for mailbox, S for semaphore, or R for region).
jjjj	Token for the job containing the exchange.

VIEWING SEGMENTS -- VG

This command displays a list of segments. The syntax for the VG command is as follows:



PARAMETER

ITEM	Token for a job. If this option is included, the Debugger lists only the segments contained in the specified job. If this option is omitted, all segments in the system are displayed.

DESCRIPTION

The VG command displays segments as:

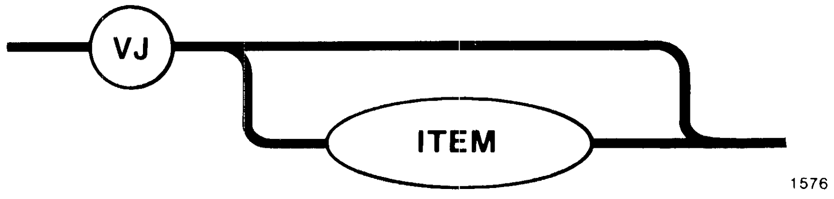
```
    GL = jjjjJ/ggggG jjjjJ/ggggG ... jjjjJ/ggggG
```

where:

gggg	Token for a segment.
jjjj	Token for the job containing the segment.

VIEWING JOBS -- VJ

This command displays a list of jobs. The syntax for the VJ command is as follows:



PARAMETER

ITEM	Token for a job. If this option is included, the Debugger lists only those jobs that are children of the specified job. If this option is omitted, all jobs in the system are listed.

DESCRIPTION

The VJ command displays jobs as:

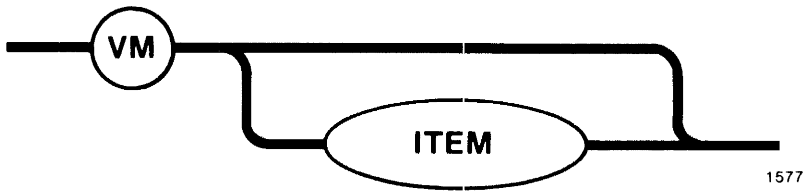
```
    JL = ppppJ/jjjjJ ppppJ/jjjjJ ... ppppJ/jjjjJ
```

where:

jjjj	Job token.
pppp	Token of its parent job. If the job designated by jjjj is the root job, then "ROOT" replaces "ppppJ".

VIEWING MAILBOX OBJECT QUEUES -- VM

This command displays object queues at mailboxes. The syntax for the VM command is as follows:



PARAMETER

ITEM	Token for a mailbox or a job. If you specify a mailbox token for this option, the Debugger lists only the object queue associated with the specified mailbox. If you specify a job token for this option, the Debugger lists all object queues in the specified job. If you omit this option, the Debugger displays object queues for all exchanges in the system.

DESCRIPTION

The VM command displays object queues at mailboxes as:

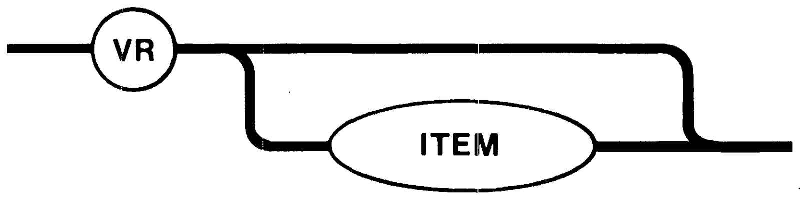
```
ML jjjjJ/mmmmM = jjjjJ/oooot jjjjJ/oooot ... jjjjJ/oooot
ML jjjjJ/mmmmM = jjjjJ/oooot jjjjJ/oooot ... jjjjJ/oooot

                     .
                     .
                     .

ML jjjjJ/mmmmM = jjjjJ/oooot jjjjJ/oooot ... jjjjJ/oooot
```

where:

mmmm	Token for a mailbox.
oooo	Token for an object in that mailbox's object queue.
t	Type of the object (J for job, T for task, M for mailbox, S for semaphore, and G for segment).
jjjj	Token for the job containing the mailbox or object.

VIEWING READY TASKS -- VR

This command displays a list of ready tasks. The syntax for the VR command is as follows:



1578

PARAMETER

ITEM	Token for a job. If this option is included, the Debugger lists, in priority order, the ready tasks that are contained in the specified job. If this option is omitted, all ready tasks in the system are listed in order of priority.

DESCRIPTION

The VR command displays ready tasks as:

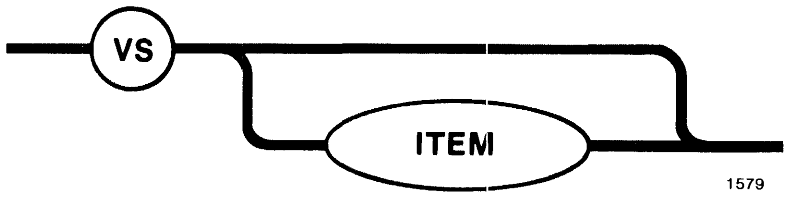
```
    RL = jjjjJ/ttttT jjjjJ/ttttT ... jjjjJ/ttttT
```

where:

tttt	Token of a ready task.
jjjj	Token for the job containing the task. An asterisk following a task token indicates that the task has overflowed its stack.

VIEWING SUSPENDED TASKS -- VS

This command displays a list of suspended tasks. The syntax for the VS command is as follows:



PARAMETER

ITEM	Token for a job. If this option is included, the Debugger lists only those suspended tasks that are contained in the specified job. If this option is omitted, all suspended tasks in the system are listed.

DESCRIPTION

The VS command displays suspended tasks as:

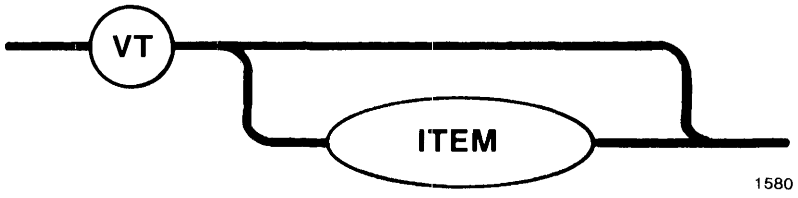
```
    SL = jjjjJ/ttttT jjjjJ/ttttT ... jjjjJ/ttttT
```

where:

tttt	Token of a suspended task.
jjjj	Token for the job containing the task. An asterisk following a task token indicates that the task has overflowed its stack.

VIEWING TASKS -- VT

This command displays a list of tasks. The syntax for the VT command is as follows:



PARAMETER

ITEM	Token for a job. If this option is included, the Debugger lists only those tasks that are contained in the specified job. If this option is omitted, all tasks in the system are listed.

DESCRIPTION

The VT command displays tasks as:

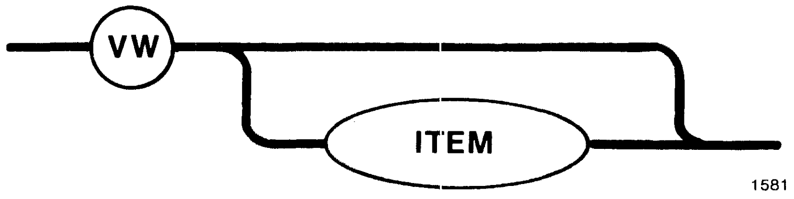
```
     TL = jjjjJ/ttttT jjjjJ/ttttT ... jjjjJ/ttttT
```

where:

tttt	Task token.
jjjj	Token for the job that contains the task. An asterisk following a task token indicates that the task has overflowed its stack.

VIEWING WAITING TASK QUEUES -- VW

This command displays the waiting task queues at exchanges. The syntax for the VW command is as follows:



PARAMETER

ITEM	Token for an exchange or a job. If you specify an exchange token for this option, the Debugger lists only the task queue associated with the specified exchange. If you specify a job token for this option, the Debugger lists all task queues in the specified job. If you omit this option, the Debugger displays task queues for all exchanges in the system.

DESCRIPTION

The VW command displays task queues at exchanges as:

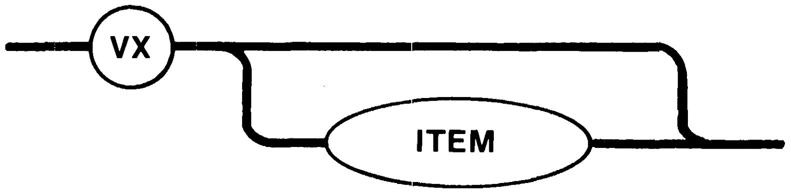
```
    WL jjjjJ/xxxxt = jjjjJ/ttttT jjjjJ/ttttT ... jjjjJ/ttttT
    WL jjjjJ/xxxxt = jjjjJ/ttttT jjjjJ/ttttT ... jjjjJ/ttttT

                      .
                      .
                      .

    WL jjjjJ/xxxxt = jjjjJ/ttttT jjjjJ/ttttT ... jjjjJ/ttttT
```

where:

xxxx	Token for an exchange.
t	Type of the exchange (M for mailbox, S for semaphore, or R for region).
tttt	Token for a task which is queued at that exchange.
jjjj	Token for the job containing the task. An asterisk indicates that either the task has overflowed its stack or the task was loaded by the Application Loader.

VIEWING EXTENSIONS -- VX

This command displays either a list of extension objects or a list of composite objects associated with a particular extension object. The syntax for the VX command is as follows:



1582

PARAMETER

ITEM	Token for an extension object. If this option is included, the Debugger lists all composite objects associated with the specified extension object. If this object is omitted, the Debugger lists all extension objects in the system.

DESCRIPTION

If the ITEM parameter is omitted, the VX command displays extension objects as follows:

```
    XL = jjjjJ/xxxxX jjjjJ/xxxxX ... jjjjJ/xxxxX
```

where:

xxxx	Token for an extension object.
jjjj	Token for the job containing the extension.

If the ITEM option is included, the VX command lists the composite objects associated with a particular extension object as follows:

```
    XL jjjjJ/xxxxX = kkkkJ/ccccC kkkkJ/ccccC ... kkkkJ/ccccC
```

where:

xxxx	Token for the extension object.

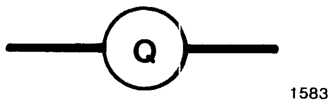
jjjj	Token for the job containing the extension.
cccc	Token for the composite object that is associated with the specified extension.
kkkk	Token for the job containing the composite object.

COMMANDS TO EXIT THE DEBUGGER

The Q command described in this section allows you to exit the Debugger and resume processing.

EXITING THE DEBUGGER -- Q

This command exits the Debugger. The syntax for the Q command is as follows:



DESCRIPTION

The Q command deactivates the Debugger. When a debugging session is terminated, the tables and lists the Debugger maintains are not destroyed. Q also displays the message "EXIT iRMX 86 DEBUGGER".

***

CHAPTER 5 CONFIGURATION

The Debugger is a configurable layer of the Operating System. It contains several options that you can adjust to meet your specific needs. To make configuration choices, Intel provides three kinds of information:

- A list of configurable options.
- Detailed information about the options.
- Procedures to allow you to specify your choices.

The balance of this chapter provides the first category of information. To obtain the second and third categories of information, refer to the iRMX 86 CONFIGURATION GUIDE.

Debugger configuration is almost identical to Terminal Handler configuration (except that only one Debugger can be present in the application system). Debugger configuration involves selecting characteristics of the Debugger's Terminal Handler and specifying information about the processor board and the terminal. The following sections describe the configurable options available on the Debugger.

BAUD RATE

You can set the baud rate for the Debugger's Terminal Handler to any of the following values:

```
  110
  150
  300
  600
 1200
 2400
 4800
 9600
19200
```

The default baud rate for the Debugger's Terminal Handler is 9600.

BAUD COUNT

The baud count provides a way to calculate internal timer values given the clock input frequency. The baud count sets the limits on the baud rate attributes of the Debugger's Terminal Handler. If your system's programmable interval timer (PIT) has a clock input frequency other than 1.2288 megahertz, you must set the baud count. The default value for the baud count is 4.

RUBOUT MODE AND BLANKING CHARACTER

There are two ways to rubout a character:

- Copying mode
- Blanking mode

In the copying mode, the character being deleted from the current line is re-echoed to the display. For example, entering "CAT" and then striking RUBOUT three times results in the display "CATTAC".

In the blanking mode, the deleted character is replaced on the CRT screen with the blanking character. For example, entering "CAT" and then striking RUBOUT three times deletes all three characters from the display.

The copy mode is the default mode. The default blanking character for the blanking mode is a space (20H).

USART

The USART is a device that, depending upon the application, can be used either to convert serial data to parallel data or to convert parallel data to serial data. The Debugger's Terminal Handler requires a 8251A USART as a terminal controller. You can specify:

- The port address of the USART. The default value for the port address is 0D8H.
- The interval between the port addresses for the USART.
- The number of bits of valid data per character that can be sent from the USART. The default value for the number of bits is 7.

PIT

You can specify the following information about the programmable interval timer (PIT):

- The port address of the PIT. The default value for the port address is ODOH.
- The interval between the port addresses for the PIT.
- The number of the PIT counter connected to the USART clock input. The default value is 2.

MAILBOX NAMES

You can change the default names of both the input mailbox (RQTHNORMIN) and the output mailbox (RQTHNORMOUT). The new names must not be over 12 alphanumeric characters in length.

INTERRUPT LEVELS

You can specify the interrupt levels used by the Debugger's Terminal Handler for input and output. You choose interrupt levels by selecting a value that corresponds to a particular interrupt value. The default value for the input interrupt level is 68H and the default value for the output interrupt level is 78H.

***

APPENDIX A
ERROR MESSAGES

This appendix lists the error messages that can occur when you enter Debugger commands. Since the Debugger reads commands on a line-by-line basis, it will not issue an error message for a command until you terminate the command with an end-of-line character (carriage return or line feed). Then, if the Debugger detects an error, it generates a display of the following form:

```
command portion #
error message
```

where command portion consists of the command up to the point where the Debugger detected the error, and error message consists of one of the following:

Message	Description
ATTEMPT TO MODIFY NON-RAM LOCATION	You tried to define a breakpoint at a non-RAM memory location.
BREAKPOINT TASK NOT AN NDP TASK	You specified the N command, but the breakpoint task was not designated as an Numeric Processor Extension task at its creation.
COMMAND TOO COMPLEX	In order to process your commands, the Debugger maintains a semantic stack, on which it places all the semantic entities of your command. Your command was too complex and overflowed this stack. To correct this problem, you should first define numeric variables for some of your more complex expressions, and then use these variables in your command in place of the expressions.
DEBUGGER POOL TOO SMALL	In order to process your command, the Debugger tried to create an iRMX 86 segment. However, there was not enough free space in the system to create this segment.
DUPLICATE SYMBOL	You attempted to define a numeric or breakpoint variable name that was already defined.

Message	Description
EXECUTION BREAKPOINT ALREADY DEFINED	You attempted to define (or redefine) an execution breakpoint at an address which already specifies an execution breakpoint. This breakpoint may have been set up by the Debugger or by the iSBC 957B Monitor and must be deleted before a new one can use this location.
INTERRUPT TASK NOT ON BREAKPOINT LIST	You attempted to make an interrupt task the current breakpoint task without first suspending that interrupt task. An interrupt task can only be made the current breakpoint task by first incurring a breakpoint.
INVALID TASK STATE	The Nucleus-maintained task descriptor contains inconsistent information. You have probably overwritten this area of memory. It is unlikely that the task can continue to run.
INVALID TOKEN	You specified a token for a different kind of object than that required by the command.
ITEM NOT FOUND	You tried to delete or change a nonexistent numeric variable.
NO BREAKPOINT TASK	You entered the R or N command without first establishing a breakpoint task.
SYNTAX ERROR	The command is syntactically incorrect.
TASK NOT ON BREAKPOINT LIST	You tried to remove a task from the breakpoint list with the G command when the task was not on the list.
TASK NOT SUSPENDABLE. WILL BE BROKEN WHEN SUSPENDABLE	You entered the BT command to establish a breakpoint task, but the Debugger could not suspend the task in its current state (for example, the task currently has access to a region). The Debugger will suspend the task when it becomes possible to do this.
UNDEFINED SYMBOL	The Debugger was unable to find the specified symbol in the local symbol table, the object directory of the breakpoint task's job, or the root object directory.

UNKNOWN BREAKPOINT iAPX 86, 88 MONITOR NOT CONFIGURED	The Debugger encountered a breakpoint for which it had no record. It tried to pass the breakpoint to the Monitor but could not because the Monitor is not included in your system.

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Primary references are underscored.

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