HP 64146

7700 Series Emulator Softkey Interface

User's Guide

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Printing History

New editions are complete revisions of the manual. The date on the title page changes only when a new edition is published.

A software code may be printed before the date; this indicates the version level of the software product at the time the manual was issued. Many product updates and fixes do not require manual changes, and manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual revisions.

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Using This Manual

This manual introduces you to the HP 64146A/B 7700 Series Emulator as used with the Softkey Interface.

This manual:

- Shows you how to use emulation commands by executing them on a sample program and describing their results.
- Shows you how to use the emulator in-circuit (connected to a target system).
- Shows you how to configure the emulator for your development needs. Topics include: restricting the emulator to real-time execution, selecting a target system clock source.

This manual does not:

- Show you how to use every Softkey Interface command and option; the Softkey Interface is described in the *Softkey Interface Reference.*

For the most part, the HP 64146A and HP 64146B emulators all operate the same way. Differences of between the emulators are described where they exist. Both the HP 64146A and HP 64146B emulators will be referred to as the "HP 64146A/B 7700 Series emulator" or "7700 Series emulator". In the specific instances where HP 64146B emulator differs from HP 64146A emulator, it will be described as "HP 64146B emulator".

Organization

Chapter 1 Introduction to the 7700 Series Emulator. This chapter briefly introduces you to the concept of emulation and lists the basic features of the 7700 Series emulator.

Chapter 2 Getting Started. This chapter shows you how to use emulation commands by executing them on a sample program. This chapter describes the sample program and how to: load programs into the emulator, map memory, display and modify memory, display registers, step through programs, run programs, set software breakpoints, search memory for data, and use the analyzer.

Chapter 3 "In-Circuit" Emulation. This chapter shows you how to install the emulator probe into a target system and how to use the "in-circuit" emulation features.

Chapter 4 Configuring the Emulator. This chapter shows you how to restrict the emulator to real-time execution, select a target system clock source, allow background cycles to be seen by the target system.

Chapter 5 Using the Emulator. This chapter describes emulation topics which are not covered in the "Getting Started" chapter.

Appendix A Using the Foreground Monitor. This appendix describes the advantages and disadvantages of foreground and background monitors and how to use foreground monitors.

Appendix B Using the Format Converter. This appendix describes the usage of the file format converter.

Conventions

Example commands throughout the manual use the following conventions:

bold	Commands, options, and parts of command syntax.
bold italic	Commands, options, and parts of command syntax which may be entered by pressing softkeys.
normal	User specified parts of a command.
$	Represents the HP-UX prompt. Commands which follow the "$" are entered at the HP-UX prompt.
<RETURN>	The carriage return key.

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1

Introduction to the 7700 Series Emulator

Introduction

The topics in this chapter include:

- Purpose of the 7700 Series Emulator
- Features of the 7700 Series Emulator

Purpose of the 7700 Series Emulator

The HP 64146A/B 7700 Series Emulator is designed to replace the MELPS 7700 Series microprocessor in your target system so you can control operation of the processor in your application hardware (usually referred to as the *target system*). The emulator performs just like the MELPS 7700 Series microprocessor, but is a device that allows you to control the MELPS 7700 Series directly. These features allow you to easily debug software before any hardware is available, and ease the task of integrating hardware and software.

Note

In this manual, MELPS 7700 Series is referred to as 7700 Series.

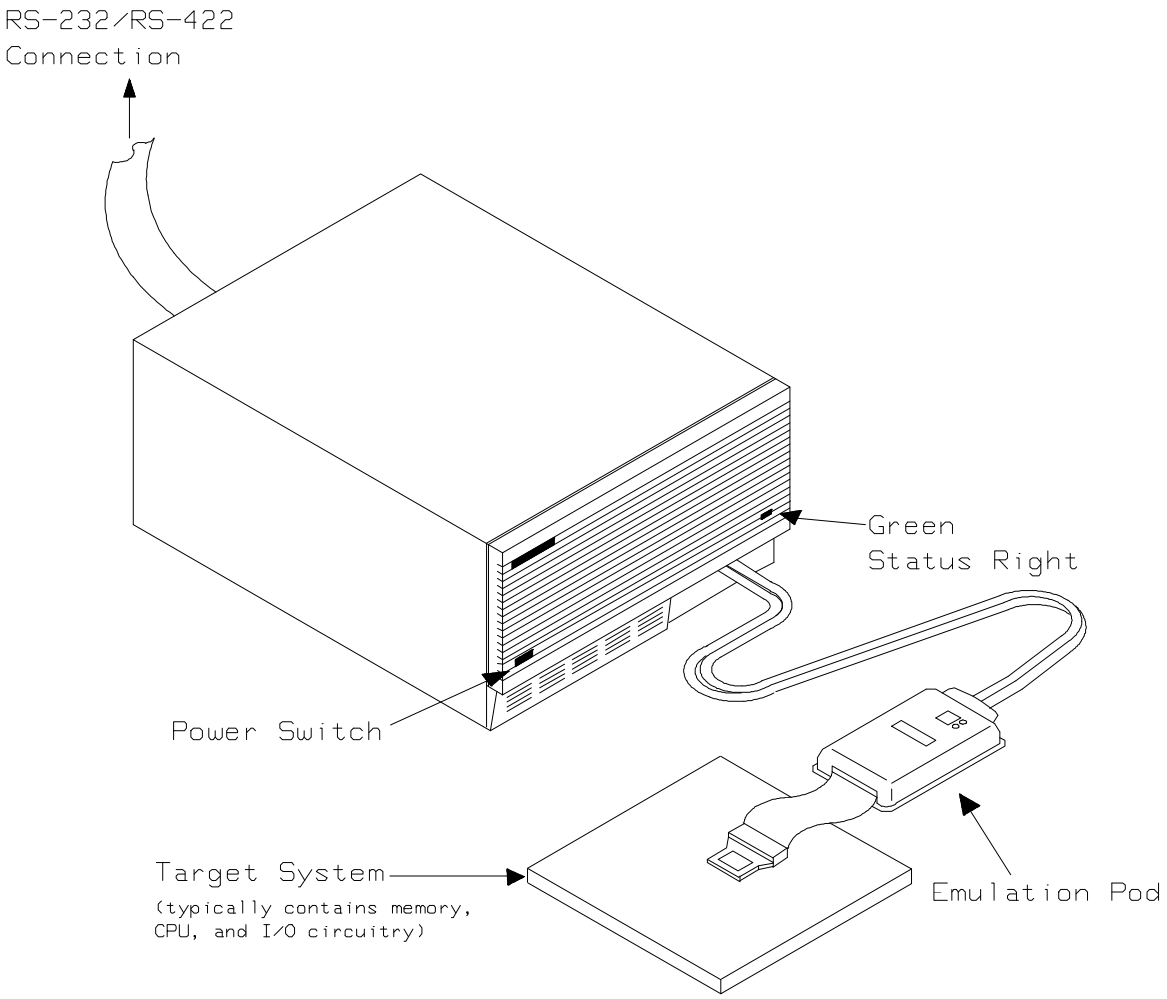

Figure 1-1. HP 64146 Emulator for MELPS 7700 Series

1-2 Introduction

Supported Microprocessors

A list of the supported 7700 Series microprocessors is shown in Table 1-1. You need to purchase appropriate emulation pod and emulation processor.

Processor		Clock	Emulation Processor	Emulation Pod
M37700/1	M2-xxxFP/SP	8	M37700SAFP	M37700T-HPD
	M2AxxxFP/SP	16		
	SFP/SP	8		
	SAFP/SP	16		
M37700/1	M4-xxxFP/SP	8	M37700S4AFP	
	M4AxxxFP/SP	16		
	S4FP/SP	8		
	S4AFP/SP	16		
M37702/3	M2-xxxFP/SP	8	M37702S1AFP	M37702T-HPD
	M2AxxxFP/SP	16		
	S1FP/SP	8		
	S1AFP/SP	16		
M37702/3	M4-xxxFP/SP	8	M37702S4AFP	
	M4AxxxFP/SP	16		
	S4FP/SP	8		
	S4AFP/SP	16		
M37702	M6LxxxFP	8	M37702S1BFP	M37702TL-HPD HP 641466-61002 (64146B)
M37702/3	M2BxxxFP/SP	25	M37702S1BFP	M37702TB-HPD HP 64146-61001 (64146A)
	S1BFP/SP	25		
M37702/3	M4BxxxFP/SP	25	M37702S4BFP	HP 64146-61002 (64146B)
	S4BFP/SP	25		
	M6BxxxFP	25		
M37704/5	M2-xxxFP/SP	8	M37704S1AFP	M37704T-HPD
	M2AxxxFP/SP	16		
	S1FP/SP	8		
	S1AFP/SP	16		
M37704	M3BxxxFP	25	M37704M4BFP	M37704TB-HPD
	M3BxxxFP	25		
M37710	M4BxxxFP	25	M37710M4BFP	M37710TL-HPD
	S4BFP	25		
M37720	S1FP	8	M37720S1AFP	M37720T-HPD
	S1AFP	16		
M37730	S2FP/SP	8	M37730S2AFP	M37730T-HPD
	S2AFP/SP	16		

Table 1-1. Supported Microprocessors

M37732	S4FP/SP	8	M37732S4AFP	M37732T-HPD
	S4AFP/SP	16		
M37780	STJ/FP	16	M37780STJ	M37780T-HPD
M37781	M4TxxxJ/FP	16	M37781M4TJ	M37781T-HPD
	E4TxxxJ/FP	16		
M37795	SJ	8	M37795SJ	M37795T-HPD
	STJ	8		
M37796	E4-xxxJ	8	M37796E4J	
	E4TxxxJ	8		

Table 1-1. Supported Microprocessors (Cont'd)

The HP 64146A emulator is provided with the following items.

- HP 64146-61001 emulation pod with M37702S1BFP emulation processor
- Adaptor for M37703 processor

The HP 64146B emulator is provided with the following items.

- HP 64146-61002 emulation pod with M37702S1BFP emulation processor
- Adaptor for M37703 processor

As you can see from Table 1-1, the HP 64146A/B emulator can emulate M37702/3M2 and M37702/3S1 processor by default. These emulation pods can be used with clock up to 25 MHz. Also, HP 64146B emulator can emulate M37702 M6L processor using default emulation pod, HP 64146-61002.

To emulate other processors of 7700 Series, you need to purchase appropriate emulation pod and/or emulation processor.

The HP 64146A/B #001 emulator is provided with no emulation pod. You need to purchase appropriate emulation pod and emulation processor listed in Table 1-1.

To purchase emulation pod or emulation processor, contact the address listed in the manual provided with your emulation pod.

The list of supported microprocessors in Table 1-1 is not necessarily complete. To determine if your microprocessor is supported or not, contact Hewlett-Packard.

Features of the 7700 Series Emulator

This section introduces you to the features of the emulator. The chapters which follow show you how to use these features.

Clock Speed

The HP 64146-61001 and HP 64146-61002 emulation pods generate internal clock of 1 MHz. These emulation pods can be used with target system clock up to 25 MHz.

The emulator can run with no wait state up to 25 MHz. When clock is faster than 16 MHz, you can use the emulator with one of the following methods.

- Insert one wait state by the RDY signal. The emulator can be configured to generate the RDY signal. Also, the emulator accepts RDY signal from the target system.
- Use the high speed access mode of the emulator. The emulator can run with no wait state. However, there is a limitation in the mapping of the emulation memory in this mode. Refer to Chapter 4 of this manual for more detail.

Emulation memory

The HP 64146A/B 7700 Series emulator is used with one of the following Emulation Memory Cards.

- HP 64726A 128K byte Emulation Memory Card
- HP 64727A 512K byte Emulation Memory Card
- HP 64728A 1M byte Emulation Memory Card
- HP 64729A 2M byte Emulation Memory Card

The emulation memory can be configured into 256 byte blocks. A maximum of 16 ranges can be configured as emulation RAM (eram), emulation ROM(erom), target system RAM (tram), target system ROM (trom), or guarded memory (grd). The HP 64146A/B 7700 Series

emulator will attempt to break to the emulation monitor upon accessing guarded memory; additionally, you can configure the emulator to break to the emulation monitor upon performing a write to ROM (which will stop a runaway program).

Analysis

The HP 64146A/B 7700 Series emulator is used with one of the following analyzers which allows you to trace code execution and processor activity.

- HP 64704 80-channel Emulation Bus Analyzer
- HP 64703 64-channel Emulation Bus Analyzer and 16-channel State/Timing Analyzer
- HP 64794A/C/D 80-channel 8K/64K/256K Emulation Bus Analyzer

The Emulation Bus Analyzer monitors the emulation processor using an internal analysis bus. The HP 64703 64-channel Emulation Bus Analyzer and 16-channel State/Timing Analyzer allows you to probe up to 16 different lines in your target system.

Foreground or Background Emulation Monitor

When you power up the emulator, or when you initialize it, the background monitor is used by default. You can also configure the emulator to use a foreground monitor. Before the background and foreground monitors are described, you should understand the function of the emulation monitor program.

The Function of the Monitor Program

The monitor program is the interface between the emulation system controller and the target system. The emulation system controller uses its own microprocessor to accept and execute emulation, system, and analysis commands. The monitor program is executed by the emulation processor.

The monitor program makes possible emulation commands which access target system resources. (The only way to access target system resource is through the emulation processor.) For example, when you enter a command to modify target system memory, it is the execution of monitor program instructions that cause the new values to be written to target system memory.

The Background Monitor

On emulator power-up, or after initialization, the emulator uses the background monitor program. The background monitor does not occupy processor address space.

The Foreground Monitor

You can configure the emulator to use a foreground monitor program. When a foreground monitor is selected it executes in the foreground emulator mode. The foreground monitor occupies processor memory space and executes as if it were part of your program.

Register Display and Modification

You can display or modify the 7700 Series internal register contents. This includes the ability to modify the program counter (PC) and the program bank register (PG) values so you can control where the emulator starts a program run.

Single-Step

When you are using the background monitor, you can direct the emulation processor to execute a single instruction or a specified number of instructions.

Breakpoints

You can set the emulator/analyzer interaction so the emulator will break to the monitor program when the analyzer finds a specific state or states, allowing you to perform post-mortem analysis of the program execution. You can also set software breakpoints in your program. This feature is realized by inserting BRK instructions into user program. Refer to the "Using Software Breakpoints" section of "Getting Started" chapter for more information.

Real Time Operation

Real-time signifies continuous execution of your program at full rated processor speed without interference from the emulator. (Such interference occurs when the emulator needs to break to the monitor to perform an action you requested, such as displaying target system memory.) Emulator features performed in real time include: running and analyzer tracing. Emulator features not performed in real time include: display or modify of target system memory; load/dump of target memory, display or modification of registers, and single step.

Coverage Measurements

Coverage memory is provided for the processor's external program memory space. This memory allows you to perform coverage measurements on programs in emulation memory.

Reset Support

The emulator can be reset from the emulation system under your control; or your target system can reset the emulation processor.

Watch Dog Timer

You can configure the emulator to disable the watch dog timer.

Limitations, Restrictions

Access to Internal RAM

Modifying internal RAM or SFR suspends user program execution.

Trace Internal RAM

Read data from the internal RAM or SFR is not traced correctly by the emulation analyzer.

Note

Write data is also not traced correctly, when the following conditions are met:

- The emulator is used with the M37795 emulation pod.
- The processor is operating in the memory expansion or microprocessor mode with 8 bit external bus.

DMA Support

Direct memory access to emulation memory is not allowed.

Watch Dog Timer in Background

Watch dog timer suspends count down while the emulator is running in background monitor.

Step Command with Foreground Monitor

Step command is not available when the emulator is used with a foreground monitor.

Step Command and Interrupts

When an interrupt occurs while the emulator is running in monitor, the emulator fails to do the first step operation. The emulator will display the mnemonic of the instruction which should be stepped, but the instruction is not actually executed. The second step operation will step the first instruction of the interrupt routine.

Emulation Commands in Stop/Wait Mode

When the 7700 microprocessor is in the stop or wait mode, emulation commands which access memory or registers will fail. You need to break the emulator into the monitor to use these commands. Once you break the emulator into the monitor, the stop or wait mode will be released.

Stack Address

In some versions of 7700 microprocessor, the stack can be located in Bank FF. However, the HP 64146A/B 7700 Series emulator doesn't support the feature. The stack must be located in Bank 0.

2

Getting Started

Introduction

This chapter will lead you through a basic, step by step tutorial designed to familiarize you with the use of the HP 64146A/B 7700 Series emulator with the Softkey Interface.

This chapter will:

- Tell you what must be done before you can use the emulator as shown in the tutorial examples.
- Describe the sample program used for this chapter's example.

This chapter will show you how to:

- Start up the Softkey Interface.
- Load programs into emulation and target system memory.
- Enter emulation commands to view execution of the sample program.

Before You Begin

Prerequisites

Before beginning the tutorial presented in this chapter, you must have completed the following tasks:

1. Connected the emulator to your computer. The *HP 64700 Series Installation/Service* manual shows you how to do this.

2. Installed the Softkey Interface software on your computer. Refer to the *HP 64700 Series Installation/Service* manual for instructions on installing software.

3. In addition, you should read and understand the concepts of emulation presented in the *Concepts of Emulation and Analysis* manual. The *Installation/Service* manual also covers HP 64700 system architecture. A brief understanding of these concepts may help avoid questions later.

4. Connected the emulator to the emulation probe as shown in Figure 2-1.

Caution

Turn off power of the emulator before inserting the cables to the emulation pod to avoid circuit damage.

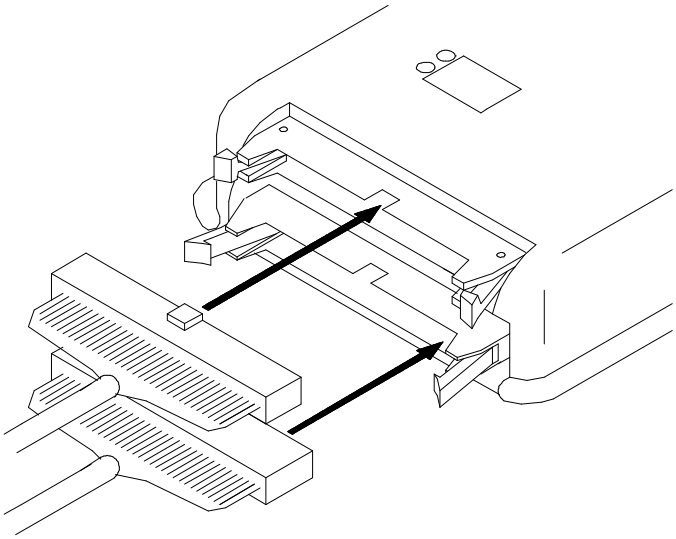

Figure 2-1. Connecting the Emulation Pod

A Look at the Sample Program

The sample program used in this chapter is listed in Figure 2-2. The program emulates a primitive command interpreter. The sample program is shipped with the Softkey Interface and may be copied from the following location.

/usr/hp64000/demo/emul/hp64146/cmd_rds.a77

Data Declarations

The "TABLE" section defines the messages used by the program to respond to various command inputs. These messages are labeled **Msg_A**,**Msg_B**, and **Msg_I**.

Initialization

The program instruction at the **Init** label initializes the stack pointer.

```
                .DP             0
                .DT             0
                .PUB            Init
                .PUB            Msgs
                .PUB            Cmd_Input
                .PUB            Msg_Dest

                .SECTION        BUFFER
;*******************************************************
; Command input byte.
;*******************************************************
Cmd_Input:      .BLKB           1
;*******************************************************
; Destination of the command messages.
;*******************************************************
Msg_Dest:       .BLKB           20H
                .BLKB           100H
Stack:

                .SECTION        TABLE
Msgs:
Msg_A:          .BYTE           'THIS IS MESSAGE A'
Msg_B:          .BYTE           'THIS IS MESSAGE B'
Msg_I:          .BYTE           'INVALID COMMAND'

                .SECTION        SAMPPROG
                .DATA           8
                .INDEX          16
;*******************************************************
; Set up the Stack Pointer.
;*******************************************************
Init:           LDX             #Stack
                TXS
                SEM
;*******************************************************
; Clear Previous command.
;*******************************************************
Clear_Input:    LDA             B,#00H
                STA             B,DT:Cmd_Input
;*******************************************************
; Read command input byte.  If no command has been entered,
; continue to scan for it.
;*******************************************************
Scan:           LDA             A,DT:Cmd_Input
                CMP             A,#00H
                BEQ             Scan

                .INDEX          8
;*******************************************************
; A command has been entered.  The destination area is
; cleared.
;*******************************************************
                SEP             X
Clear_Output:   LDX             #00H
                LDY             #20H
Clear_Loop:     STA             B,DT:Msg_Dest,X
                INX
                DEY
                BNE             Clear_Loop
```

Figure 2-2. Sample Program Listing

```
                .INDEX          16
;*********************************************************
;
; Check if the command entered is command A, command B,
; or invalid command.
;*********************************************************
;
                CLP             X
Process_Cmd:    CMP             A,#41H
                BEQ             Cmd_A
                CMP             A,#42H
                BEQ             Cmd_B
                BRA             Cmd_I
;*********************************************************
;
; Command A is entered.  A = the number of bytes in
; message A.  X = location of the message.  Jump to the
; routine which writes the message.
;*********************************************************
;
Cmd_A:          LDA             A,#11H
                LDX             #Msg_A
                BRA             Output
;*********************************************************
;
; Command B is entered.
;*********************************************************
;
Cmd_B:          LDA             A,#11H
                LDX             #Msg_B
                BRA             Output
;*********************************************************
;
; An invalid command is entered.
;*********************************************************
;
Cmd_I:          LDA             A,#0FH
                LDX             #Msg_I
;*********************************************************
;
; Message is written to the destination.  Y = location of
; the destination area.
;*********************************************************
;
Output:         LDY             #Msg_Dest
                MVN             0,0
;*********************************************************
;
; Go back and scan for next command.
;*********************************************************
;
                BRA             Clear_Input

                .END
```

Figure 2-2. Sample Program Listing (Cont'd)

Reading Input

The instruction at the **Clear_Input** label clears any random data or previous commands from the **Cmd_Input** byte. The **Scan** loop continually reads the **Cmd_Input** byte to see if a command is entered (a value other than 0 hex).

Processing Commands

When a command is entered, the **Clear_Output** routine clears the destination area. Then, the instructions from **Process_Cmd** to **Cmd_A** determine whether the command was "A", "B", or an invalid command.

If the command input byte is "A" (ASCII 41 hex), execution is transferred to the instructions at **Cmd_A**.

If the command input byte is "B" (ASCII 42 hex), execution is transferred to the instructions at **Cmd_B**.

If the command input byte is neither "A" nor "B", an invalid command has been entered, and execution is transferred to the instructions at **Cmd_I**.

The instructions at **Cmd_A**, **Cmd_B**, and **Cmd_I** each load accumulator A with the length of the message to be displayed and index register X with the starting location of the appropriate message. Then, execution transfers to **Output** which writes the appropriate message to the destination location, **Msg_Dest**.

After the message is written, the program branches back to read the next command.

The Destination Area

The "BUFFER" section declares memory storage for the command input byte, the destination area, and the stack area.

Sample Program Assembly

The sample program is written for and assembled/linked with Mitsubishi RASM77 Assembler and LINK77 Linkage Editor.

The sample program was assembled with the following command.

```
$ rasm77 -s cmd_rds.a77
```

Linking the Sample Program

The sample program can be linked with the following command and generates the absolute file. The contents of "cmd_rds.lnk" linkage editor subcommand file is shown in Figure 2-3.

```
$ link77 @\cmd_rds.lnk
```

```
cmd_rds
,
,SAMPPROG=C000 TABLE=C100 BUFFER=100
,-s -ms
```

Figure 2-3. Linkage Editor Command File

Generate HP Absolute file

To generate HP Absolute file for the Sofktey Interface, you need to use "**m77cnvhp**" absolute file format converter program. The m77cnvhp converter is provided with the Softkey Interface. To generate HP Absolute file, enter following command:

```
$ m77cnvhp cmd_rds <RETURN>
```

You will see that cmd_rds.X, cmd_rds.L, and cmd_rds.A are generated. These are sufficient throughout this chapter.

Note

You **must** specify **-s** option when you assemble and link your program. If this option isn't speicified, symbol file (.sym file) won't be generated, and the format converter cannot convert your program.

Entering the Softkey Interface

If you have installed your emulator and Softkey Interface software as directed in the *HP 64700 Series Emulators Softkey Interface Installation Notice*, you are ready to enter the interface. The Softkey Interface can be entered through the **pmon** User Interface Software or from the HP-UX shell.

From the "pmon" User Interface

If **/usr/hp64000/bin** is specified in your PATH environment variable, you can enter the **pmon** User Interface with the following command.

```
$ pmon <RETURN>
```

If you have not already created a measurement system for the 7700 Series emulator, you can do so with the following commands. First you must initialize the measurement system with the following command.

```
MEAS_SYS msinit <RETURN>
```

After the measurement system has been initialized, enter the configuration interface with the following command.

```
msconfig <RETURN>
```

To define a measurement system for the 7700 Series emulator, enter:

```
make_sys emm77 <RETURN>
```

Now, to add the emulator to the measurement system, enter:

```
add <module_number> naming_it m77 <RETURN>
```

Enter the following command to exit the measurement system configuration interface.

```
end <RETURN>
```

If the measurement system and emulation module are named "emm77" and "m77" as shown above, you can enter the emulation system with the following command:

```
emm77 default m77 <RETURN>
```

If this command is successful, you will see a display similar to Figure 2-4. The status message shows that the default configuration file has been loaded. If the command is not successful, you will be given an error message and returned to the **pmon** User Interface. Error messages are described in the *Softkey Interface Reference* manual.

For more information on creating measurements systems, refer to the *Softkey Interface Reference* manual.

From the HP-UX Shell

If **/usr/hp64000/bin** is specified in your PATH environment variable, you can also enter the Softkey Interface with the following command.

```
$ emul700 <emul_name> <RETURN>
```

The "emul_name" in the command above is the logical emulator name given in the HP 64700 emulator device table (/usr/hp64000/etc/64700tab).

If this command is successful, you will see a display similar to Figure 2-4. The status message shows that the default configuration file has been loaded. If the command is not successful, you will be given an error message and returned to the HP-UX prompt. Error messages are described in the *Softkey Interface Reference* manual.

```
                    HPB64146-19003 A.04.00  20Aug92
                     M37700 EMULATION SERIES 64700

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     HEWLETT-PACKARD Company , 3000 Hanover St. , Palo Alto, CA94304-1181


STATUS:   Loaded configuration file_____________________________________...R....


  run     trace     step   display          modify   break    end    ---ETC--
```

Figure 2-4. Softkey Interface Display

On-Line Help

There are two ways to access on-line help in the Softkey Interface. The first is by using the Softkey Interface help facility. The second method allows you to access the firmware resident Terminal Interface on-line help information.

Softkey Driven Help

To access the Softkey Interface on-line help information, type either "help" or "?" on the command line; you will notice a new set of softkeys. By pressing one of these softkeys and <RETURN>, you can cause information on that topic to be displayed on your screen. For example, you can enter the following command to access "system command" help information.

```
---SYSTEM COMMANDS & COMMAND FILES---

?                          displays the possible help files
help                       displays the possible help files

!                          fork a shell (specified by  shell variable SH)
!<shell cmd>               fork a shell and execute a shell command
cd <directory>             change the working directory
pwd                        print the working directory
cws <SYMB>                 change the working symbol - the working symbol also
                              gets updated when displaying local symbols and
                              displaying memory mnemonic
pws                        print the working symbol

<FILE> p1 p2 p3 ...        execute a command file passing parameters p1, p2, p3
                              see "COMMAND FILES EXAMPES" below for more detail
log_commands to <FILE>     logs the next sequence of commands to file <FILE>
log_commands off           discontinue logging commands
name_of_module             get the "logical" name of this module (see 64700tab.net)

--More--(20%)
```

```
? system_commands <RETURN>
```

The help information is scrolled on to the screen. If there is more than a screenful of information, you will have to press the space bar to see the next screenful, or the <RETURN> key to see the next line, just as you do with the HP-UX **more** command. After all the information on the particular topic has been displayed (or after you press "q" to quit scrolling through information), you are prompted to press <RETURN> to return to the Softkey Interface.

Pod Command Help

To access the emulator's firmware resident Terminal Interface help information, you can use the following commands.

```
display pod_command <RETURN>
pod_command 'help m' <RETURN>
```

```
Pod Commands
  Time              Command
10:00:00 help m

  m - display or modify processor memory space
    m <addr>               - display memory at address
    m -d<dtype> <addr>     - display memory at address with display option
    m <addr>..<addr>       - display memory in specified address range
    m -dm <addr>..<addr>   - display memory mnemonics in specified range
    m <addr>..             - display 128 byte block starting at address A
    m <addr>=<value>       - modify memory at address to <value>
    m -d<dtype> <addr>=<value>       - modify memory with display option
    m <addr>=<value>,<value>         - modify memory to data sequence
    m <addr>..<addr>=<value>,<value> - fill range with repeating sequence
  --- VALID <dtype> MODE OPTIONS ---
    b - display size is 1 byte(s)
    w - display size is 2 byte(s)
    m - display processor mnemonics

STATUS:   M37700--Running in monitor_____________________________________........


  run     trace     step   display           modify   break    end    ---ETC--
```

The command enclosed in string delimiters (", ', or ^) is any Terminal Interface command, and the output of that command is seen in the pod_command display. The Terminal Interface help (or ?) command may be used to provide information on any Terminal Interface command or any of the emulator configuration options (as the example command above shows).

Configuring the Emulator

You need to configure the emulator for this tutorial. To configure the emulator, type the following command to get into the configuration session.

```
modify configuration <RETURN>
```

Trace the following answer to configure the emulator. Details of each question will be described later.

```
Micro-processor clock source? internal
Enter monitor after configuration? yes
Restrict to real-time runs? no
Reconfigure emulator? yes
Micro-processor group? <chip group>
Micro-processor type? <chip type>
```

Select the chip group and chip type you are going to emulate. Appropriate chip group and chip type are listed in Table 2-1.

Note

If your processor is not listed in Table 2-1, refer to chapter 4 of this manual for information on configuring the emulator.

```
Processor node? single
Modify reset value for Stack Pointer? no
Modify memory configuration?
```

When you are going to emulate a processor which have no internal RAM, answer "yes" to this question, and map 100 hex through FFF hex as emulation RAM. Refer to chapter 4 of this manual for information on memory mapping.

When you are going to emulate a processor which have internal RAM, answer "no" to this question.

```
Modify emulator pod configuration? no
Modify debug/trace options? no options? no
Modify simulated I/O configuration? no
Modify interactive measurement specification? no
Configuration file name? cmd_rds
```

<chip_name>	Processor
7700M2	M37700M2-xxxFP M2AxxxFP M37701M2-xxxSP M2AxxxSP
7700M4	M37700M4-xxxFP M4AxxxFP M37701M4-xxxSP M4AxxxSP
7700S	M37700SFP SAFP M37701SSP SASP
7700S4	M37700S4FP S4AFP M37701S4SP S4ASP
7702M2	M37702M2-xxxFP M2AxxxFP M2BxxxFP M37703M2-xxxSP M2AxxxSP M2BxxxSP
7702M4	M37702M4-xxxFP M4AxxxFP M4BxxxFP M37703M4-xxxSP M4AxxxSP M4BxxxSP
7702M6	M37702M6BxxxFP M6LxxxFP
7702S1	M37702S1FP S1AFP S1BFP M37703S1SP S1ASP S1BSP
7702S4	M37702S4FP S4AFP S4BFP M37703S4SP S4ASP S4BSP

<chip_name>	Processor
7704M2	M37704M2-xxxFP M2AxxxFP M37705M2-xxxSP M2AxxxSP
7704M3	M37704M3BxxxFP
7704M4	M37704M4BxxxFP
7704S1	M37704S1FP S1AFP M37705S1SP S1ASP
7710M4	M37710M4BxxxFP
7710S4	M37710S4BFP
7720S1	M37720S1FP S1AFP
7730S2	M37730S2FP S2AFP S2SP S2ASP
7732S4	M37732S4FP S4AFP
7780S	M37780STJ STFP
7781M4	M37781M4TxxxJ M4TxxxFP
7781E4	M37781E4TxxxJ E4TxxxFP
7795S	M37795SJ STJ
7796E4	M37796E4-xxxJ E4TxxxJ E4TxxxFP

Table 2-1. Chip Group and Chip Type for Configuration

Loading Absolute Files

The "load" command allows you to load absolute files into emulation or target system memory. If you wish to load only that portion of the absolute file that resides in memory mapped as emulation RAM or ROM, use the "load emul_mem" syntax. If you wish to load only the portion of the absolute file that resides in memory mapped as target RAM, use the "load user_mem" syntax. If you want both emulation and target memory to be loaded, do not specify "emul_mem" or "user_mem". For example:

```
load cmd_rds <RETURN>
```

Displaying Symbols

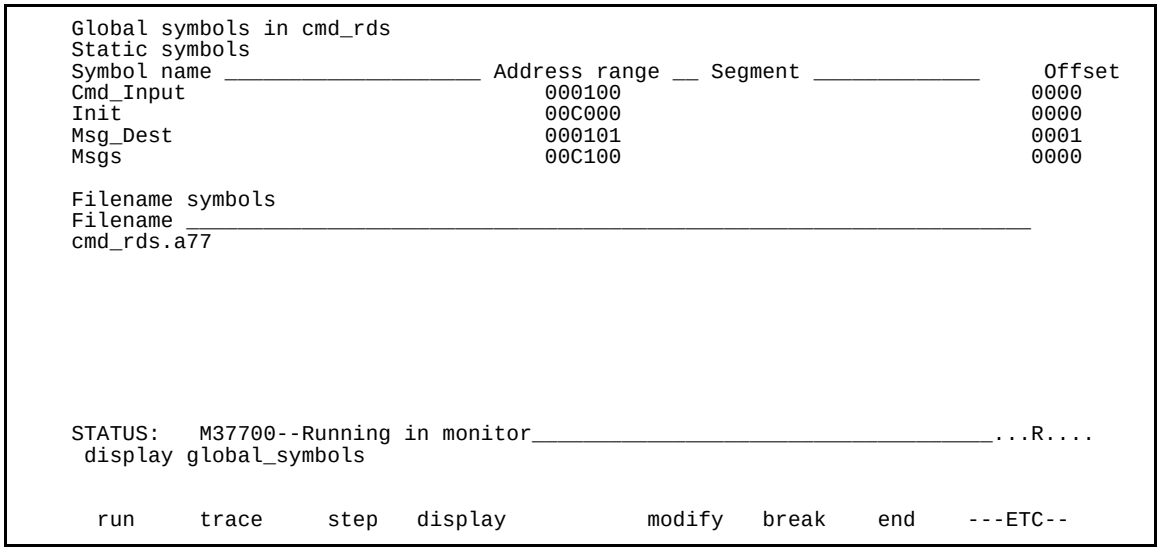
When you load an absolute file into memory (unless you use the "nosymbols" option), symbol information is loaded. Both global symbols and symbols that are local to a source file can be displayed.

Global

To display global symbols, enter the following command.

```
display global_symbols <RETURN>
```

Listed are: address ranges associated with a symbol.



Local When displaying local symbols, you must include the name of the source file in which the symbols are defined. For example,

```
display local_symbols_in cmd_rds.a77:
<RETURN>
```

```
Symbols in cmd_rds.a77:
Static symbols
Symbol name _____________________ Address range __ Segment _____________ Offset
Cear_Input                            00C005                                0005
Clear_Loop                            00C019                                0019
Clear_Output                          00C015                                0015
Cmd_A                                 00C02D                                002D
Cmd_B                                 00C034                                0034
Cmd_I                                 00C03B                                003B
Cmd_Input                             000100                                0000
Init                                  00C000                                0000
Msg_A                                 00C100                                0000
Msg_B                                 00C111                                0011
Msg_Dest                              000101                                0001
Msg_I                                 00C122                                0022
Msgs                                  00C100                                0000
Output                                00C040                                0040
Process_Cmd                           00C023                                0023

STATUS:   M37700--Running in monitor_____________________________________...R....
 display local_symbols_in cmd_rds.a77:


  run     trace     step   display           modify   break    end    ---ETC--
```

Displaying Memory in Mnemonic Format

You can display, in mnemonic format, the absolute code in memory. To display memory in mnemonic format from the address of label **Init**, enter the following command:

```
display memory Init mnemonic options m0x0
<RETURN>
```

You need to specify the values of M flag and X flag at the staring address of mnemonic memory display. When the inverse-assembler encounters an instruction which changes M flag and/or X flag (SEM, CLM, SEP X, etc..), the value set by the instruction is used to continue disassembling memory contents.

Note

When you use <PGUP> or <PREV> key to see the previous lines of memory display, disassembled mnemonic may not be accurate.

```
Memory  :mnemonic :file = cmd_rds.a77:
  address   data
    00C000  A22102      LDX #0221H
    00C003  9A          TXS
    00C004  F8          SEM
    00C005  42A900      LDA B,#00H
    00C008  428D0001    STA B,0100H
    00C00C  AD0001      LDA A,0100H
    00C00F  C900        CMP A,#00H
    00C011  F0F9        BEQ 00C00CH
    00C013  E210        SEP #10H
    00C015  A200        LDX #00H
    00C017  A020        LDY #20H
    00C019  429D0101    STA B,0101H,X
    00C01D  E8          INX
    00C01E  88          DEY
    00C01F  D0F8        BNE 00C019H
    00C021  C210        CLP #10H

STATUS:   M37700--Running in monitor_____________________________________...R....
 display memory Init mnemonic options m0x0


  run     trace     step   display          modify   break    end    ---ETC--
```

Displaying Memory with Symbols

You can include symbol information in memory display.

```
set symbols on <RETURN>
```

Note

The "set" command is effective only to the window in which the command is invoked. You need to use this command at each window.

```
Memory  :mnemonic :file = cmd_rds.a77:
  address  label          data
   00C000     :Init      A22102      LDX #0221H
   00C003                9A          TXS
   00C004                F8          SEM
   00C005  :Clear_Input  42A900      LDA B,#00H
   00C008                428D0001    STA B,DT:0100H
   00C00C  cmd_rds:Scan  AD0001      LDA A,DT:0100H
   00C00F                C900        CMP A,#00H
   00C011                F0F9        BEQ cmd_rds.a77:Scan
   00C013                E210        SEP #10H
   00C015  Clear_Output  A200        LDX #00H
   00C017                A020        LDY #20H
   00C019  c:Clear_Loop  429D0101    STA B,DT:0101H,X
   00C01D                E8          INX
   00C01E                88          DEY
   00C01F                D0F8        BNE cmd_r:Clear_Loop
   00C021                C210        CLP #10H

STATUS:   M37700--Running in monitor_____________________________________...R....
 set symbols on


  run     trace     step   display          modify   break    end    ---ETC--
```

Running the Program

The "run" command lets you execute a program in memory. Entering the "run" command by itself causes the emulator to begin executing at the current program counter address. The "run from" command allows you to specify an address at which execution is to start. For example to run the sample program from the address of **Init** label,

```
run from Init <RETURN>
```

Note

The **run from transfer_address** command is not available in the 7700 Series Softkey Interface.

Displaying Memory in Blocked Format

You can display memory locations in blocked format. For example, to display the **Msg_Dest** locations of the sample program in blocked byte format, enter the following command.

```
display memory Msg_Dest repetitively blocked
bytes <RETURN>
```

Modifying Memory

The sample program simulates a primitive command interpreter. Commands are sent to the sample program through a byte sized memory location labeled **Cmd_Input**. You can use the modify memory feature to send a command to the sample program. For example, to enter the command "A" (41 hex), use the following command.

```
modify memory Cmd_Input bytes to 41h <RETURN>
```

Or:

```
modify memory Cmd_Input string to 'A'
<RETURN>
```

(Single character strings are allowed in expressions.)

As you can see, the memory display is automatically updated, and shows that the "THIS IS MESSAGE A" message is written to the destination locations.

```
 Memory  :bytes :blocked :update
   address       data       :hex                                    :ascii
    000101-08    54   48   49   53   20   49   53   20      T H I S    I S
    000109-10    4D   45   53   53   41   47   45   20      M E S S  A G E
    000111-18    41   00   00   00   00   00   00   00      A . . .  . . . .
    000119-20    00   00   00   00   00   00   00   00      . . . .  . . . .
    000121-28    00   00   00   00   00   00   00   00      . . . .  . . . .
    000129-30    00   00   00   00   00   00   00   00      . . . .  . . . .
    000131-38    00   00   00   00   00   00   00   00      . . . .  . . . .
    000139-40    00   00   00   00   00   00   00   00      . . . .  . . . .
    000141-48    00   00   00   00   00   00   00   00      . . . .  . . . .
    000149-50    00   00   00   00   00   00   00   00      . . . .  . . . .
    000151-58    00   00   00   00   00   00   00   00      . . . .  . . . .
    000159-60    00   00   00   00   00   00   00   00      . . . .  . . . .
    000161-68    00   00   00   00   00   00   00   00      . . . .  . . . .
    000169-70    00   00   00   00   00   00   00   00      . . . .  . . . .
    000171-78    00   00   00   00   00   00   00   00      . . . .  . . . .
    000179-80    00   00   00   00   00   00   00   00      . . . .  . . . .

STATUS:   M37700--Running user program_____________________________...R....
 display memory Cmd_Input bytes to 41h


  run     trace     step   display          modify   break    end    ---ETC--
```

Note

Modifying/displaying internal RAM or SFR suspends user program execution. This is because the emulator uses internal RAM and SFR of emulation processor to perform emulation. However, you can configure the emulator so that write cycles are performed to both internal RAM (or SFR) and emulation memory. If you do this, you can display the data written to emulation memory without suspending user program execution. Refer to chapter 4 and chapter 5 of this manual for more details.

Breaking into the Monitor

The "break" command allows you to divert emulator execution from the user program to the monitor. You can continue user program execution with the "run" command. To break emulator execution from the sample program to the monitor, enter the following command.

```
break <RETURN>
```

Using Software Breakpoints

Software breakpoints are provided with an 7700 Series BRK instruction. When you define or enable a software breakpoint, the emulator will replace the opcode at the software breakpoint address with a BRK instruction.

Note

You must set software breakpoints only at memory locations which contain instruction opcodes (not operands or data). If a software breakpoint is set at a memory location which is not an instruction opcode, the software breakpoint instruction will never be executed and the break will never occur.

Note

Because software breakpoints are implemented by replacing opcodes with BRK instructions, you cannot define software breakpoints in target ROM.

Note

Software breakpoints should not be set, cleared, enabled, or disabled while the emulator is running user code. If any of these commands are entered while the emulator is running user code, and the emulator is executing code in the area where the breakpoint is being modified, program execution may be unreliable.

When software breakpoints are enabled and emulator detects a fetching the BRK instruction, it generates a break to background request which as with the "processor break" command. Since the system controller knows the locations of defined software breakpoints, it can determine whether the BRK instruction is software breakpoints or opcode in your target program.

If it is a software breakpoint, execution breaks to the monitor,and the BRK instruction is replaced by the original opcode. A subsequent run or step command will execute from this address.

If the BRK instruction is opcode of your target program, execution still breaks to the monitor, and an "Undefined software breakpoint" status message is displayed.

When software breakpoints are disabled, the emulator replaces the special code with the original opcode.

Up to 32 software breakpoints may be defined.

Enabling/Disabling Software Breakpoints

When you initially enter the Softkey Interface, software breakpoints are disabled. To enable the software breakpoints feature, enter the following command.

```
modify software_breakpoints enable <RETURN>
```

When software breakpoints are enabled and you set a software breakpoint, the 7700 BRK instruction will be placed at the address specified. When the BRK instruction is executed, program execution will break into the monitor.

Setting a Software Breakpoint

To set a software breakpoint at the address of the **Cmd_I** label, enter the following command.

```
modify software_breakpoints set
cmd_rds.a77:Clear_Output <RETURN>
```

Notice that when using local symbols in expressions, the source file in which the local symbol is defined must be included.

After the software breakpoint has been set, enter the following commands to display memory and see if the software breakpoint was correctly inserted.

```
display memory Init mnemonic options m0x0
<RETURN>
```

```
 Memory  :mnemonic :file = cmd_rds.a77:
   address  label          data
    00C000     :Init      A22102      LDX #0221H
    00C003                9A          TXS
    00C004                F8          SEM
    00C005  :Clear_Input  42A900      LDA B,#00H
    00C008                428D0001    STA B,0100H
    00C00C  cmd_rds:Scan  AD0001      LDA A,0100H
    00C00F                C900        CMP A,#00H
    00C011                F0F9        BEQ cmd_rds.a77:Scan
    00C013                E210        SEP #10H
*   00C015  Clear_Output  0000        BRK
    00C017                A020        LDY #20H
    00C019  c:Clear_Loop  429D0101    STA B,0101H,X
    00C01D                E8          INX
    00C01E                88          DEY
    00C01F                D0F8        BNE cmd_r:Clear_Loop
    00C021                C210        CLP #10H

STATUS:   M37700--Running in monitor_____________________________________...R....
 display memory Init mnemonic options m0x0


  run     trace     step   display          modify   break    end    ---ETC--
```

As you can see, the software breakpoint is shown in the memory display with an asterisk, and the instruction at the address is replaced with a BRK instruction.

Note

When a software breakpoint is inserted, the mnemonic in memory display may not be accurate.

Enter the following command to run the sample program again.

```
run from Init <RETURN>
```

Now, modify the command input byte to an invalid command for the sample program.

```
modify memory Cmd_Input bytes to 75h <RETURN>
```

You will see the address field of a line is inversed. The inversed address field shows that the Program Counter is now at the address.

A message on the status line shows that the software breakpoint has been hit. The status line also shows that the emulator is now executing in the monitor.

When software breakpoints are hit, they become inactivated. To reactive the breakpoint so that is "pending", you must reenter the "modify software_breakpoints set" command.

Clearing a Software Breakpoint

To remove software breakpoint defined above, enter the following command.

```
modify software_breakpoints clear
cmd_rds.a77:Clear_Output <RETURN>
```

The breakpoint is removed from the list, and the original opcode is restored if the breakpoint was pending.

To clear all software breakpoints, you can enter the following command.

```
modify software_breakpoints clear <RETURN>
```

Stepping Through the Program

The step command allows you to step through program execution an instruction or a number of instructions at a time. Also, you can step from the current program counter or from a specific address. To step through the example program from the address of the software breakpoint set earlier, enter the following command.

```
step <RETURN>, <RETURN>, <RETURN>, ...
```

You will see the inverse-video moves according to the step execution. You can continue to step through the program just by pressing the <RETURN> key; when a command appears on the command line, it may be entered by pressing <RETURN>.

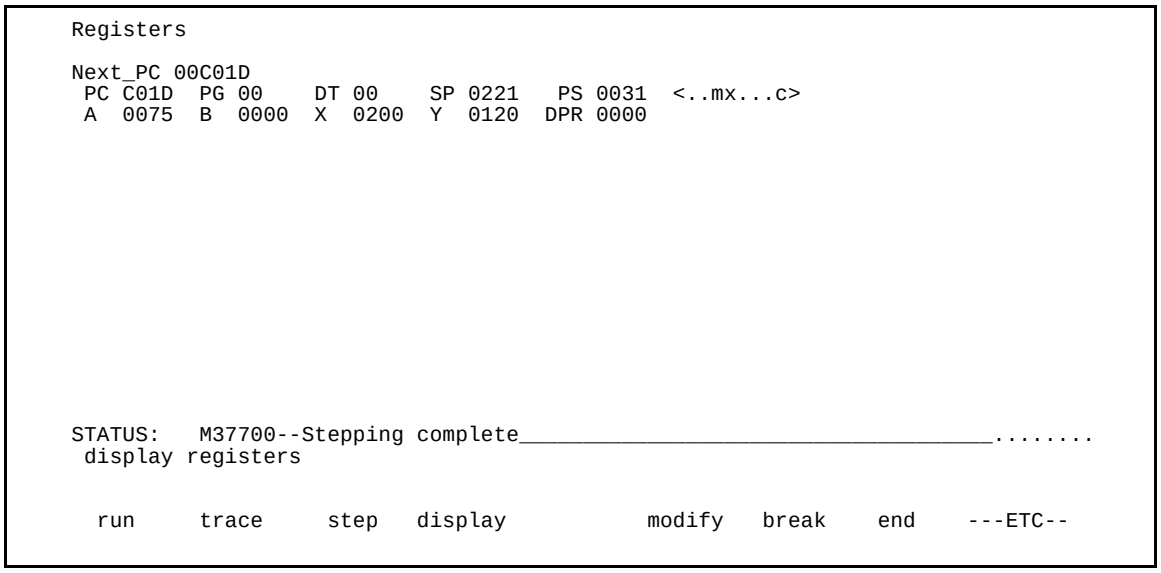
Note

When the emulator performs step execution, all memory access is performed by byte access.

Displaying Registers

Enter the following command to display registers. You can display the basic registers class, or an individual register.

```
display registers <RETURN>
```



Following list shows the register names and class that may be used with the "display registers" commands.

Register Name	Description
PC	Program Counter
PG	Program Bank Register
DT	Data Bank Register
SP	Stack Pointer
PS	Processor Status Register
A	Accumulator A
B	Accumulator B
X	Index Register X
Y	Index Register Y
DPR	Direct Page Register

When you enter the "step" command with registers displayed, the register display is updated every time you enter the "step" command.

```
step <RETURN>, <RETURN>, <RETURN>
```

```
Registers

Next_PC 00C01D
 PC C01D  PG 00    DT 00    SP 0221   PS 0031  <..mx...c>
 A  0075  B  0000  X  0200  Y  0120  DPR 0000


Step_PC 00C01D  INX
Next_PC 00C01E
 PC C01E  PG 00    DT 00    SP 0221   PS 0031  <..mx...c>
 A  0075  B  0000  X  0201  Y  0120  DPR 0000


Step_PC 00C01E  DEY
Next_PC 00C01F
 PC C01F  PG 00    DT 00    SP 0221   PS 0031  <..mx...c>
 A  0075  B  0000  X  0201  Y  011F  DPR 0000


STATUS:   M37700--Stepping complete_____________________________________........
 step


  run     trace     step   display           modify   break    end    ---ETC--
```

Enter the following command to cause sample program execution to continue from the current program counter.

```
run <RETURN>
```

Using the Analyzer

HP 64700 emulators contain an emulation analyzer. The emulation analyzer monitors the internal emulation lines (address, data, and status). Optionally, you may have an additional 16 trace signals which monitor external input lines. The analyzer collects data at each pulse of a clock signal, and saves the data (a trace state) if it meets a "storage qualification" condition.

Specifying a Simple Trigger

Suppose you want to trace program execution after the point at which the sample program execute the **Cmd_A** routine. To do this The following command makes this trace specification.

```
trace after cmd_rds.a77:Cmd_A status
exec<RETURN>
```

The message "Emulation trace started" will appear on the status line. Now, modify the command input byte to "A" with the following command.

```
modify memory Cmd_Input bytes to 41h <RETURN>
```

The status line now shows "Emulation trace complete".

Displaying the Trace

The trace listings which follow are of program execution on the 7700 Series emulator. To display the trace, enter:

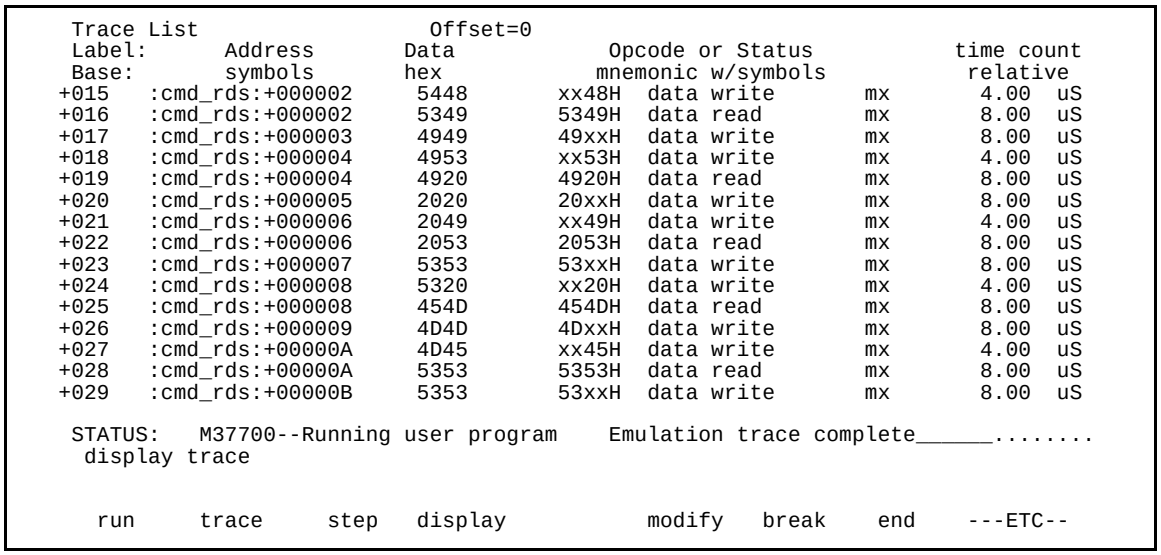
```
display trace <RETURN>
```

```
 Trace List                 Offset=0
 Label:      Address       Data           Opcode or Status          time count
 Base:       symbols       hex           mnemonic w/symbols          relative
after  cmd_rds.a7:Cmd_A     A9FF  INSTRUCTION--opcode unavailable   ------------
+001   :cmd_rds:+00002E     A211       A211H  opcode fetch     mx       6.00  uS
+002   :cmd_rds:+00002F     A211  LDX #C100H                             2.0   uS
+003   :cmd_rds:+000030     C100       C100H  opcode fetch              6.00  uS
+004   :cmd_rds:+000032     0C80       0C80H  opcode fetch              8.00  uS
+005   :cmd_rds:+000032     0C80  BRA cmd_rds.a:Output                   2.0   uS
+006   cmd_rds.a7:Cmd_B     11A9       11A9H  opcode fetch              6.00  uS
+007   cmd_rds.a:Output     01A0       01A0H  opcode fetch              8.00  uS
+008   cmd_rds.a:Output     01A0  LDY #0101H                             2.0   uS
+009   :cmd_rds:+000042     5401       5401H  opcode fetch              6.00  uS
+010   :cmd_rds:+000043     5401  MVN 00H,00H                            2.0   uS
+011   :cmd_rds:+000044     0000       0000H  opcode fetch     mx       6.00  uS
+012   :cmd_rds:+000046     BD80       BD80H  opcode fetch     mx       8.00  uS
+013        :Msgs           4854       4854H  data read        mx      10.0   uS
+014      :Msg_Dest         5454       54xxH  data write       mx       8.00  uS

 STATUS:   M37700--Running user program    Emulation trace complete______...R....
  display trace


   run     trace     step   display           modify   break    end    ---ETC--
```

Line 0 (labeled "after") in the trace list above shows the state which triggered the analyzer. The trigger state is always on line 0. To list the next lines of the trace, press the <PGDN> or <NEXT> key.



```
 Trace List                  Offset=0
 Label:      Address       Data            Opcode or Status          time count
 Base:       symbols       hex           mnemonic w/symbols           relative
+015   :cmd_rds:+000002     5448       xx48H  data write       mx       4.00  uS
+016   :cmd_rds:+000002     5349       5349H  data read        mx       8.00  uS
+017   :cmd_rds:+000003     4949       49xxH  data write       mx       8.00  uS
+018   :cmd_rds:+000004     4953       xx53H  data write       mx       4.00  uS
+019   :cmd_rds:+000004     4920       4920H  data read        mx       8.00  uS
+020   :cmd_rds:+000005     2020       20xxH  data write       mx       8.00  uS
+021   :cmd_rds:+000006     2049       xx49H  data write       mx       4.00  uS
+022   :cmd_rds:+000006     2053       2053H  data read        mx       8.00  uS
+023   :cmd_rds:+000007     5353       53xxH  data write       mx       8.00  uS
+024   :cmd_rds:+000008     5320       xx20H  data write       mx       4.00  uS
+025   :cmd_rds:+000008     454D       454DH  data read        mx       8.00  uS
+026   :cmd_rds:+000009     4D4D       4DxxH  data write       mx       8.00  uS
+027   :cmd_rds:+00000A     4D45       xx45H  data write       mx       4.00  uS
+028   :cmd_rds:+00000A     5353       5353H  data read        mx       8.00  uS
+029   :cmd_rds:+00000B     5353       53xxH  data write       mx       8.00  uS

 STATUS:   M37700--Running user program    Emulation trace complete______........
  display trace


   run     trace     step   display           modify   break    end    ---ETC--
```

The resulting display shows MVN instruction moves the "THIS IS MESSAGE A" message to the destination locations.

To list the previous lines of the trace, press the <PGUP> or <PREV> key.

Displaying Trace with Time Count Absolute

Enter the following command to display count information relative to the trigger state.

```
display trace count absolute <RETURN>
```

```
 Trace List                  Offset=0
 Label:      Address       Data            Opcode or Status           time count
 Base:       symbols       hex           mnemonic w/symbols            absolute
+015   :cmd_rds:+000002     5448       xx48H  data write       mx   +  84.0   uS
+016   :cmd_rds:+000002     5349       5349H  data read        mx   +  92.0   uS
+017   :cmd_rds:+000003     4949       49xxH  data write       mx   + 100.    uS
+018   :cmd_rds:+000004     4953       xx53H  data write       mx   + 104.    uS
+019   :cmd_rds:+000004     4920       4920H  data read        mx   + 112.    uS
+020   :cmd_rds:+000005     2020       20xxH  data write       mx   + 120.    uS
+021   :cmd_rds:+000006     2049       xx49H  data write       mx   + 124.    uS
+022   :cmd_rds:+000006     2053       2053H  data read        mx   + 132.    uS
+023   :cmd_rds:+000007     5353       53xxH  data write       mx   + 140.    uS
+024   :cmd_rds:+000008     5320       xx20H  data write       mx   + 144.    uS
+025   :cmd_rds:+000008     454D       454DH  data read        mx   + 152.    uS
+026   :cmd_rds:+000009     4D4D       4DxxH  data write       mx   + 160.    uS
+027   :cmd_rds:+00000A     4D45       xx45H  data write       mx   + 164.    uS
+028   :cmd_rds:+00000A     5353       5353H  data read        mx   + 172.    uS
+029   :cmd_rds:+00000B     5353       53xxH  data write       mx   + 180.    uS

 STATUS:   M37700--Running user program    Emulation trace complete_____...R....
  display trace count absolute


   run     trace     step   display          modify   break    end    ---ETC--
```

Changing the Trace Depth

The default states displayed in the trace list is 256 states. To change the number of states, use the "display trace depth" command.

```
display trace depth 512 <RETURN>
```

You can see the states more than 256 states by using the above command.

Using the Storage Qualifier

You can use storage qualifier to trace only states with specific conditions. Suppose that you would like to trace only states which write the messages to the **Msg_Dest** area. To accomplish this, you can use the "trace only" command like following.

```
trace after Msg_Dest status write only range
Msg_Dest thru +20h status write <RETURN>
```

Only accesses to address **Msg_Dest** through **Msg_Dest+20h** will be stored in the trace buffer.

Modify the command input byte with the following command, and display trace display with time count relative.

```
modify memory Cmd_Input bytes to 41h <RETURN>
display trace count relative <RETURN>
```

```
 Trace List                 Offset=0
 Label:      Address       Data            Opcode or Status          time count
 Base:       symbols       hex           mnemonic w/symbols           relative
after     :Msg_Dest         0088       00xxH  data write       mx   ------------
+001   :cmd_rds:+000002     D000       xx00H  data write       mx      56.00  uS
+002   :cmd_rds:+000003     0088       00xxH  data write       mx      56.00  uS
+003   :cmd_rds:+000004     D000       xx00H  data write       mx      56.00  uS
+004   :cmd_rds:+000005     0088       00xxH  data write       mx      56.00  uS
+005   :cmd_rds:+000006     D000       xx00H  data write       mx      56.00  uS
+006   :cmd_rds:+000007     0088       00xxH  data write       mx      56.00  uS
+007   :cmd_rds:+000008     D000       xx00H  data write       mx      56.00  uS
+008   :cmd_rds:+000009     0088       00xxH  data write       mx      56.00  uS
+009   :cmd_rds:+00000A     D000       xx00H  data write       mx      56.00  uS
+010   :cmd_rds:+00000B     0088       00xxH  data write       mx      56.00  uS
+011   :cmd_rds:+00000C     D000       xx00H  data write       mx      56.00  uS
+012   :cmd_rds:+00000D     0088       00xxH  data write       mx      56.00  uS
+013   :cmd_rds:+00000E     D000       xx00H  data write       mx      56.00  uS
+014   :cmd_rds:+00000F     0088       00xxH  data write       mx      56.00  uS

 STATUS:   M37700--Running user program    Emulation trace started_______........
  display trace count relative
```

7700 Series Analysis Status Qualifiers

The status qualifier "write" was used in the example trace command used above. The following analysis status qualifiers may also be used with the 7700 Series emulator.

Qualifier	Status bits (40..47)	Description
backgrnd	x1xx xxxx	Background cycle
byte	xx1x 1x1x	Byte access
cpu	xx11 xxxx	CPU cycle
data	xx1x 10xx	Data access
dma	xx10 xxxx	DMA cycle
exec	xx11 01xx	Execution Cycle
fetch	xx11 11x1	Fetch cycle
foregrnd	x0xx xxxx	Foreground cycle
hold	xx01 xxxx	HOLD cycle
mx	1xxx xxxx	Value of MX signal
read	xx1x 1xx1	Read cycle
ref	xx00 xxxx	Refresh cycle

Restriction of the Analyzer

The following section describes restrictions of the analyzer of the 7700 Series emulator.

Trace of Internal RAM

The HP 64146A/B emulator **cannot** trace data which is read from internal RAM or SFR. Such data always appears FF hex in the trace listing. This is because the emulator uses the internal RAM and SFR of the emulation processor to perform emulation. Data read from internal RAM or SFR does not appear on the data bus.

As an example, trace the accesses to the **Cmd_Input**.

```
trace after cmd_rds.a77:Scan status exec
<RETURN>
```

```
 Trace List                 Offset=0
 Label:      Address       Data            Opcode or Status          time count
 Base:       symbols       hex           mnemonic w/symbols           relative
after  cmd_rds.a77:Scan     00AD  INSTRUCTION--opcode unavailable   ------------
+001   :cmd_rds:+00000E     C901       C901H  opcode fetch     mx       6.00  uS
+002      :Cmd_Input        FFFF       xxFFH  data read        mx       4.00  uS
+003   :cmd_rds:+00000F     FFFF  CMP A,#00H                             2.0   uS
+004   :cmd_rds:+000010     F000       F000H  opcode fetch     mx       6.00  uS
+005   :cmd_rds:+000011     F000  BEQ cmd_rds.a77:Scan                   2.0   uS
+006   :cmd_rds:+000012     E2F9       E2F9H  opcode fetch             6.00  uS
+007   :cmd_rds:+000014     A210       A210H  opcode fetch             8.00  uS
+008   cmd_rds.a77:Scan     00AD       00ADH  opcode fetch             8.00  uS
+009   cmd_rds.a77:Scan     00AD  LDA A,DT::Cmd_Input                   2.0   uS
+010   :cmd_rds:+00000E     C901       C901H  opcode fetch     mx       6.00  uS
+011      :Cmd_Input        FFFF       xxFFH  data read        mx       4.00  uS
+012   :cmd_rds:+00000F     FFFF  CMP A,#00H                             2.0   uS
+013   :cmd_rds:+000010     F000       F000H  opcode fetch     mx       6.00  uS
+014   :cmd_rds:+000011     F000  BEQ cmd_rds.a77:Scan                   2.0   uS

 STATUS:   M37700--Running user program    Emulation trace complete_____...R....
  trace after cmd_rds.a77:Scan


   run     trace     step   display          modify   break    end    ---ETC--
```

As you can see in line 11 of the trace listing, data read from internal RAM (which should be 00 hex) appears FF hex.

For a Complete Description

For a complete description of using the HP 64700 Series analyzer with the Softkey Interface, refer to the *Analyzer Softkey Interface User's Guide*.

Exiting the Softkey Interface

There are several options available when exiting the Softkey Interface: exiting and releasing the emulation system, exiting with the intent of reentering (continuing), exiting locked from multiple emulation windows, and exiting (locked) and selecting the measurement system display or another module.

End Release System

To exit the Softkey Interface, releasing the emulator so that other users may use the emulator, enter the following command.

```
end release_system <RETURN>
```

Ending to Continue Later

You may also exit the Softkey Interface without specifying any options; this causes the emulator to be locked. When the emulator is locked, other users are prevented from using it and the emulator configuration is saved so that it can be restored the next time you enter (continue) the Softkey Interface.

```
end <RETURN>
```

Ending Locked from All Windows

When using the Softkey Interface from within window systems, the "end" command with no options causes an exit only in that window. To end locked from all windows, enter the following command.

```
end locked <RETURN>
```

This option only appears when you enter the Softkey Interface via the **emul700** command. When you enter the Softkey Interface via **pmon** and **MEAS_SYS**, only one window is permitted.

Refer to the *Softkey Interface Reference* manual for more information on using the Softkey Interface with window systems.

Selecting the Measurement System Display or Another Module

When you enter the Softkey Interface via **pmon** and **MEAS_SYS**, you have the option to select the measurement system display or another module in the measurement system when exiting the Softkey Interface. This type of exit is also "locked"; that is, you can continue the emulation session later. For example, to exit and select the measurement system display, enter the following command.

```
end select measurement_system <RETURN>
```

This option is not available if you have entered the Softkey Interface via the **emul700** command.

3

"In-Circuit" Emulation

Introduction

The emulator is *in-circuit* when it is plugged into the target system. This chapter covers topics which relate to in-circuit emulation.

This chapter will:

- Describe the issues concerning the installation of the emulator probe into target systems.
- Show you how to install the emulator probe.
- Show you how to use features related to in-circuit emulation.

Prerequisites

Before performing the tasks described in this chapter, you should be familiar with how the emulator operates in general. Refer to the *HP 64700 Emulators: System Overview* manual and the "Getting Started" chapter of this manual.

Installing the Target System Probe

Caution

POSSIBLE DAMAGE TO THE EMULATOR PROBE. The emulation probe contains devices that are susceptible to damage by static discharge. Therefore, precautionary measures should be taken before handling the microprocessor connector attached to the end of the probe cable to avoid damaging the internal components of the probe by static electricity.

Caution

POSSIBLE DAMAGE TO THE EMULATOR. Make sure target system power is OFF before installing the emulator probe into the target system. Do not install the emulator probe into the processor socket with power applied to the target system.

Caution

DAMAGE TO THE EMULATOR WILL RESULT IF THE PROBE IS NOT INSTALLED CORRECTLY. Make sure pin 1 of probe connector is aligned with pin 1 of the socket. When installing the emulation probe, be sure that the probe is installed into the processor socket so that pin 1 of the connector aligns with pin 1 of the socket.

Note

When you use the emulator in-circuit, turn ON the target system first, then turn ON the emulator. Likewise, turn OFF your target system first, then turn OFF the emulator.

In-Circuit Configuration Options

The 7700 Series emulator provides configuration options for the following in-circuit emulation issues.
Refer to the "Configuring the Emulator" for more information on these configuration options.

Using the Target System Clock Source

You can configure the emulator to use the external target system clock source.

Note

Your target system **must** have a clock generation circuit. The emulation pod cannot generate clock signal using a ceramic (or quartz crystal) resonator.

Target Memory Access Size

You can configure the emulator to access target system memory by byte access or word access to perform emulation commands.

Respond to Target System Interrupts

You can configure the emulator whether or not the emulator responds to interrupt signals from the target system during foreground operation.

Note

You may need to set up switches inside the emulation pod to accept target system interrupt signals. Refer to the manual provided with your emulation pod.

Notes

4

Configuring the Emulator

Introduction

Your 7700 Series emulator can be used in all stages of target system development. For instance, you can run the emulator out-of-circuit when developing your target system software, or you can use the emulator in-circuit when integrating software with target system hardware. You can use the emulator's internal clock or the target system clock. Emulation memory can be used in place of, or along with, target system memory. You can execute target programs in real-time or allow emulator execution to be diverted into the monitor when commands request access of target system resources (target system memory, register contents, etc).

The emulator is a flexible instrument and may be configured to suit your needs at any stage of the development process. This chapter describes the options available when configuring the HP 64146A/B emulator.

The configuration options are accessed with the following command.

```
modify configuration <RETURN>
```

After entering the command above, you will be asked questions regarding the emulator configuration. The configuration questions are listed below and grouped into the following classes.

General Emulator Configuration:

- Specifying the emulator clock source (internal/external).
- Selecting monitor entry after configuration.
- Restricting to real-time execution.

Emulator Reconfiguration:

- Selecting microprocessor to be emulated.
- Selecting CPU operation mode.
- Defining the reset value of the stack pointer.

Memory Configuration:

- Enabling the high speed access mode
- Selecting the background or foreground emulation monitor.
- Mapping memory.

Emulator Pod Configuration:

- Selecting target memory access data size.
- Enabling interrupts from the target system.
- Enabling watch dog timer.

Debug/Trace Configuration:

- Enabling breaks on writes to ROM.
- Enabling tracing refresh cycles.
- Enabling tracing DMA cycles.
- Enabling tracing HOLD/HLDA cycles.
- Enabling 16bit symbol display.
- Defining the DT register value for symbol display.

Simulated I/O Configuration: Simulated I/O is described in the *Simulated I/O* reference manual.

Interactive Measurement Configuration: See the chapter on coordinated measurements in the *Softkey Interface Reference* manual.

External Analyzer Configuration: See the *Analyzer Softkey Interface User's Guide.*

General Emulator Configuration

The configuration questions described in this section involve general emulator operation.

Micro-processor clock source?

This configuration question allows you to select whether the emulator will be clocked by the internal clock source or by a target system clock source.

internal — Selects the internal clock oscillator as the emulator clock source. The internal clock is provided from the emulation pod. In the case of HP 64146-61001 or HP 64146-61602 emulation pod, the clock speed is 1 MHz. When you use an emulation pod with clock faster than 16 MHz, you need to select the high speed access mode to run the emulator with no wait state. If the high speed access mode is not selected, one wait state is inserted by the emulator.

external — Selects the clock input to the emulator probe from the target system. You must use a clock input conforming to the specifications for the 7700 Series microprocessor. The HP 64146A/B emulator runs with no wait state with target system clock up to 16 MHz. When clock is faster than 16 MHz, you need to select the high speed access mode to run the emulator with no wait state. If the high speed access mode is not selected, one wait state is inserted by the emulator.

Note

Your target system **must** have a clock generation circuit. The emulation pod cannot generate clock signal using a ceramic (or quartz crystal) resonator.

Note

Changing the clock source drives the emulator into the reset state. The emulator may later break into the monitor depending on how the following "Enter monitor after configuration?" question is answered.

Enter monitor after configuration?

This question allows you to select whether the emulator will be running in the monitor or held in the reset state upon completion of the emulator configuration.

How you answer this configuration question is important in some situations. For example, when the external clock has been selected and the target system is turned off, reset to monitor should not be selected; otherwise, configuration will fail.

When an external clock source is specified, this question becomes "Enter monitor after configuration (using external clock)?" and the default answer becomes "no".

yes	When reset to monitor is selected, the emulator will be running in the monitor after configuration is complete. If the reset to monitor fails, the previous configuration will be restored.
no	After the configuration is complete, the emulator will be held in the reset state.

Restrict to real-time runs?

The "restrict to real-time" question lets you configure the emulator so that commands which cause the emulator to break to monitor and return to the user program are refused.

no — All commands, regardless of whether or not they require a break to the emulation monitor, are accepted by the emulator.

yes — When runs are restricted to real-time and the emulator is running the user program, all commands that cause a break (except "reset", "break", "run", and "step") are refused. For example, the following commands are not allowed when runs are restricted to real-time:

- Display/modify registers.
- Display/modify internal RAM or SFR.
- Display/modify target system memory.
- Load/store target system memory

Caution

If your target system circuitry is dependent on constant execution of program code, you should restrict the emulator to real-time runs. This will help insure that target system damage does not occur. However, remember that you can still execute the "reset", "break", and "step" commands; you should use caution in executing these commands.

Emulator Reconfiguration

The emulator reconfiguration questions allows you to reconfigure the emulator for your system. Type of the processor, processor operation mode and reset value for the stack pointer will be configured here. To access the emulator reconfiguration questions, you must answer "yes" to the following question.

Reconfigure emulator?

Micro-processor group?

This configuration item allows you to select the processor you are going to emulate.

7700	When you are going to emulate M37700xx or M37701xx, select this item.
7702	When you are going to emulate M37702xx or M37703xx, select this item.
7704	When you are going to emulate M37704xx or M37705xx, select this item.
7720	When you are going to emulate M37720xx or M37710xx,select this item.
7730	When you are going to emulate M37730xx or M37732xx, select this item.
7790	When you are going to emulate M37795xx, M37796xx, M37780xx or M37781xx, select this item.

When you select one of these groups, you will see the following question.

Micro-processor type (xxxx group)?

Select the chip you are going to emulate.

Note

If your processor is not included in the above groups, select "**othe**r" in this question and answer to the following questions.

Usually, the previous question set up internal memory addresses automatically. However, when your processor is not supported by the previous question, you must configure the following questions by yourself.

<chip_name>	Processor
7700M2	M37700M2-xxxFP M2AxxxFP M37701M2-xxxSP M2AxxxSP
7700M4	M37700M4-xxxFP M4AxxxFP M37701M4-xxxSP M4AxxxSP
7700S	M37700SFP SAFP M37701SSP SASP
7700S4	M37700S4FP S4AFP M37701S4SP S4ASP
7702M2	M37702M2-xxxFP M2AxxxFP M2BxxxFP M37703M2-xxxSP M2AxxxSP M2BxxxSP
7702M4	M37702M4-xxxFP M4AxxxFP M4BxxxFP M37703M4-xxxSP M4AxxxSP M4BxxxSP
7702M6	M37702M6BxxxFP M6LxxxFP
7702S1	M37702S1FP S1AFP S1BFP M37703S1SP S1ASP S1BSP
7702S4	M37702S4FP S4AFP S4BFP M37703S4SP S4ASP S4BSP

<chip_name>	Processor
7704M2	M37704M2-xxxFP M2AxxxFP M37705M2-xxxSP M2AxxxSP
7704M3	M37704M3BxxxFP
7704M4	M37704M4BxxxFP
7704S1	M37704S1FP S1AFP M37705S1SP S1ASP
7710M4	M37710M4BxxxFP
7710S4	M37710S4BFP
7720S1	M37720S1FP S1AFP
7730S2	M37730S2FP S2AFP S2SP S2ASP
7732S4	M37732S4FP S4AFP
7780S	M37780STJ STFP
7781M4	M37781M4TxxxJ M4TxxxFP
7781E4	M37781E4TxxxJ E4TxxxFP
7795S	M37795SJ STJ
7796E4	M37796E4-xxxJ E4TxxxJ E4TxxxFP

Figure 4-1. Chip Group and Type for Configuration

SFR area start address?
SFR area end address?
Second SFR area start address?
Second SFR area end address?

Specify the start address and end address of internal SFR of your processor. These addresses can be defined on 16 byte boundaries.

If your processor has only one SFR area, specify the same value as the first one for the "Second SFR ..." questions.

Internal RAM area start address?
Internal RAM area end address?
Second internal RAM area start address?
Second internal RAM area end address?

Specify the start address and end address of internal RAM of your processor. These addresses can be specified on 16 byte boundaries. If your processor has no internal RAM, enter 0 as start address and end address of internal RAM area. If your processor has only one SFR area, specify the same value as the first one for the "Second internal RAM ..." questions.

Internal ROM area start address?
Internal ROM area end address?

Specify the start address and end address of internal ROM of your processor. These addresses can be defined on 16 byte boundaries. If your processor has no internal ROM, enter 0 as start address and end address of internal ROM area.

Processor mode register address?

Specify the address of processor mode register. This is needed to manage processor operation modes.

Processor mode?

This configuration defines operation mode of the processor.

single	The emulator will operate in single-chip mode.
expand8	The emulator will operate in memory expansion mode with 8 bit data width.
expand16	The emulator will operate in memory expansion mode with 16 bit data width.
proc8	The emulator will operate in microprocessor mode with 8 bit data width.
proc16	The emulator will operate in microprocessor mode with 16 bit data width.

Note

You may need to set up a switch inside the emulation pod in addition to this configuration. Refer to the manual provided with your emulation pod.

Modify value for Stack Pointer (SP)?

Reset value for the stack pointer is automatically set up to the end of internal RAM area. When the processor you select has no internal RAM, it is set up to FFF hex. If you would like to change the value, answer "yes" to this question.

Reset value for Stack Pointer (SP)?

This question allows you to specify the value to which the stack pointer (SP) will be set on entrance to the emulation monitor initiated RESET state. The address specified in response to this question must be a 16-bit hexadecimal address.

This address should be defined in RAM area (internal RAM, target RAM or emulation RAM) which is not used by user program. When the emulator breaks to the background monitor, the background monitor uses 5 bytes of stack area.

Caution

Without a stack pointer, the emulator is unable to make the transition to the run state, step or perform many other emulation functions.

Memory Configuration

The memory configuration questions allows you to select the monitor type and to map memory. To access the memory configuration questions, you must answer "yes" to the following question.

Modify memory configuration?

Is speed of input clock faster than 16 MHz?

This question allows you to configure the emulator for clock (internal/external) faster than 16 MHz.

no	When the clock speed is equal or slower than 16 MHz, select this answer. The emulator runs with no wait state.
yes	When the clock speed is faster than 16 MHz, select this answer. You will be asked the following question.

Enable high speed access mode for emulation memory?

When clock speed is faster than 16 MHz, the emulator can run with no wait state by selecting the "**high speed access mode**." If you don't select the high speed access mode, the emulator inserts one wait state.

yes — Enables the high speed access mode of the emulator. In the high speed access mode:

- The emulator can run with no wait state up to 25 MHz.
- you can map the emulation memory only to the following address ranges.

Memory	**Monitor**	**Available location**
128K	Background	000000H-01F7FFH
128K	Foreground	000000H-01FFFFH
512K	Background	000000H-07F7FFH
512K	Foreground	000000H-07FFFFH
1M	Background	000000H-0FF7FFH
1M	Foreground	000000H-0FFFFFH
2M	Background	000000H-1FF7FFH
2M	Foreground	000000H-1FFFFFH

no — Select the normal mode. In the normal mode:

- You can define up to 16 different map terms which can be placed wherever you like. (Refer to "Mapping memory" section in this chapter.)
- The emulator generates the /RDY signal, and inserts one wait state for all memory access.

Note

Changing this configuration will reset the memory map,

Monitor type?

The monitor type configuration question allows you to choose between a foreground monitor (which is supplied with the emulation software but must be assembled, linked, converted, and loaded into emulation memory) or the background monitor (which resides in the emulator).

The *emulation monitor* is a program that is executed by the emulation processor. It allows the emulation system controller to access target

system resources. For example, when you enter a command that requires access to target system resources, say a command to display target system memory, the system controller writes a command code to the monitor communications area and breaks execution of the emulation processor from the user program into the monitor program. The monitor program then reads the command from the communications area and executes the 7700 Series instructions which read the contents of the target system memory locations. After the monitor has completed its task, execution returns to the user program.

The *background monitor*, resident in the emulator, offers the greatest degree of transparency to your target system (that is, your target system should generally be unaffected by monitor execution). However, in some cases you may require an emulation monitor tailored to the requirements of your system. In this case, you will need to use a foreground monitor linked into your program modules. See the "Using the Foreground Monitor" appendix for more information on foreground monitors.

background — Selects the use of the background monitor. When you select the background monitor and the current monitor type is "foreground", you are asked the following question.

Reset map (change of monitor type requires map reset)?

This question must be answered "yes" to change the monitor type.

foreground — Specifies that a foreground monitor will be used. Foreground monitor programs are shipped with the Softkey Interface. When you select a foreground monitor, you will be asked additional questions.

Reset map (change of monitor type requires map reset)?

This question must be answered "yes" or else the foreground monitor will not be selected.

Monitor address?

The default configuration specifies a monitor address of 0b800 hex. The monitor base address must be located on a 2K byte boundary other than internal RAM and Special Function Register area; otherwise, configuration will fail.

Monitor filename?

This question allows you to specify the name of the foreground monitor program absolute file. Remember that the foreground monitor must already be assembled and linked starting at the 2K byte boundary specified for the previous "Monitor address?" question.

The monitor program will be loaded after you have answered all the configuration questions; therefore, you should not link the foreground monitor to the user program. If it is important that the symbol database contain both monitor and user program symbols, you can create a different absolute file in which the monitor and user program are linked. Then, you can load this file after configuration.

Mapping memory

The emulation memory consists of 128K/512K/1M/2M bytes, mappable in 256 byte blocks. You can define up to 16 different map terms.

The memory mapper allows you to characterize memory locations. It allows you specify whether a certain range of memory is present in the target system or whether you will be using the emulation memory for that address range. You can also specify whether the target system memory is ROM or RAM, and you can specify that emulation memory be treated as ROM or RAM.

Note

You cannot map Internal RAM and SFR as guarded.

Note

Target system accesses to emulation memory are not allowed. Target system devices that take control of the bus (for example, external DMA controller) cannot access emulation memory.

Caution

The default emulator configuration maps location C000 hex through FFFF hex as emulation ROM. This must be needed when you use the 7700 Series internal ROM. You don't have to map internal RAM area since the emulator uses internal RAM of the emulation processor. When you answered "yes" to the "Reset map (change of monitor type requires map reset)?" question , you must map again for memory space where internal ROM is located as emulation ROM.

Blocks of memory can also be characterized as guarded memory.

Guarded memory accesses will generate "break to monitor" requests. Writes to ROM will generate "break to monitor" requests if the "Enable breaks on writes to ROM?" configuration item is enabled (see the "Debug/Trace Configuration" section which follows).

To map memory for the sample program, enter the following mapper commands:

```
delete all <RETURN>
0c000h thru 0ffffh emulation rom <RETURN>
end <RETURN>
```

When mapping memory for your target system programs, you may wish to characterize emulation memory locations containing programs and constants (locations which should not be written to) as ROM. This will prevent programs and constants from being written over accidentally, and will cause breaks when instructions attempt to do so.

Note

You should map all memory ranges used by your programs **before** loading programs into memory. This helps safeguard against loads which accidentally overwrite earlier loads if you follow a **map/load** procedure for each memory range.

Internal RAM and SFR

The emulator uses internal RAM of emulation processor to emulate user program. When you direct the emulator to display the contents of internal RAM or SFR area, the emulator breaks to the monitor and the monitor program reads the contents of memory. Therefore, execution of user program is suspended to perform your direction. However, you can configure the emulator so that write cycles are performed to both internal RAM (or SFR) and emulation memory. In this case, you can display the data written to emulation memory without suspending program execution.

To use this feature, you need to map these area to emulation RAM (eram). When you do this, you can display the contents of emulation memory with "display memory" command without suspending user program execution. You still can display the contents of internal RAM by specifying "fcode i" syntax in "display memory" command.

For example, to see the contents of address 100 hex in internal RAM, you can do both of the following:

```
display memory fcode none 100h
(This command accesses emulation memory)
display memory fcode i 100h
(This command accesses internal RAM of
emulation processor.)
```

Note

When you specify "fcode", the "fcode" becomes the new default to display memory. That is, once you specify "fcode i", you need to specify "fcode none" to display emulation memory.

When you don't map the internal RAM and SFR area to emulation RAM (when you don't copy the contents to emulation memory), you can access the internal RAM and SFR without specifying "fcode" syntax.

Note

The contents of emulation memory is updated only when user program writes data to internal RAM (or SFR). Therefore, the contents of emulation memory may be different from the actual value of internal RAM. Especially, you should pay a close attention when seeing flags of SFR.

Note

When you modify memory, the emulator breaks to the monitor, and writes data to internal RAM or SFR. Therefore, user program is suspended when modifying internal RAM or SFR.

Emulator Pod Configuration

To access the emulator pod configuration questions, you must answer "yes" to the following question.

Modify emulator pod configuration?

Target memory access size?

This question allows you to specify the types of cycles that the emulation monitor use when accessing target system memory. When an emulation command requests the monitor to read or write target

system memory locations, the monitor will either use byte or word instructions to accomplish the read/write.

byte	Specifies that the emulator will access target system memory by byte accesses.
word	Specifies that the emulator will access target system memory by word accesses.

Respond to target system interrupts?

This configuration allows you to specify whether or not the emulator responds to interrupt signals from the target system during foreground operation.

yes	The emulator will respond to interrupt signals from the target system.
no	The emulator will not respond to interrupt signals from the target system.

Note

You may need to set up switches inside the emulation pod to accept interrupts from the target system. Refer to the manual provided with your emulation pod.

Enable watchdog timer?

This question allows you to enable/disable the watchdog timer interrupt.

no	Disables the watchdog timer interrupt. This may useful in early stage of your program development.
yes	Enables the watchdog timer interrupt.

Debug/Trace Configuration

The debug/trace configuration questions allows you to specify breaks on writes to ROM, and specify that the analyzer trace foreground/background execution, and bus release cycles. To access the trace/debug configuration questions, you must answer "yes" to the following question.

Modify debug/trace options?

Break processor on write to ROM?

This question allows you to specify that the emulator break to the monitor upon attempts to write to memory space mapped as ROM. The emulator will prevent the processor from actually writing to memory mapped as emulation ROM; however, they cannot prevent writes to target system RAM locations which are mapped as ROM, even though the write to ROM break is enabled.

yes	Causes the emulator to break into the emulation monitor whenever the user program attempts to write to a memory region mapped as ROM.
no	The emulator will not break to the monitor upon a write to ROM. The emulator will not modify the memory location if it is in emulation ROM.

Trace background or foreground operation?

This question allows you to specify whether the analyzer trace only foreground emulation processor cycles, only background cycles, or both foreground or background cycles.

foreground	Specifies that the analyzer trace only foreground cycles. This option is specified by the default emulator configuration.
background	Specifies that the analyzer trace only background cycles. (This is rarely a useful setting.)
both	Specifies that the analyzer trace both foreground and background cycles. You may wish to specify

this option so that all emulation processor cycles may be viewed in the trace display.

Trace refresh cycles by emulation analyzer?

This question is asked only when the 7720 processor is selected in "Micro-processor group?" configuration question.

You can direct the emulator to send refresh cycle data to emulation analyzer or not to send it.

yes	Enables the emulator to trace refresh cycles.
no	Refresh cycles will not appear on analysis trace list.

Trace DMA cycles by emulation analyzer?

This question is asked only when the 7720 processor is selected in "Micro-processor group?" configuration question.

You can direct the emulator to send DMA cycle data to emulation analyzer or not to send it.

yes	When you enable tracing DMA cycles, DMA cycles will appear as one analysis trace line.
no	DMA cycles will not appear on analysis trace list.

Trace HOLD/HLDA cycles by emulation analyzer?

You can direct the emulator to send HOLD/HLDA cycle data to emulation analyzer or not to send it.

yes	When you enable tracing HOLD/HLDA cycles, these cycles will appear as one analysis trace line.
no	HOLD/HLDA cycles will not appear on analysis trace list.

Replace 16-bit addresses with symbolic references?

You can direct the emulator whether or not to display symbols in 16bit addresses in mnemonic field of memory and trace display.

no	Symbols are displayed only in 24bit addresses of mnemonic field.
yes	Symbols are displayed both in 16 and 24bit addresses of mnemonic field. When you select this answer, you are asked the following question.

Data bank register value for symbolic references?

Since symbols have 24bit value, you need to specify the value of the upper 8bit which will be used to display symbols in 16bit addresses. The value specified in this question will be combined with the 16bit value in mnemonic field, and symbols are displayed using the value.

Simulated I/O Configuration

The simulated I/O feature and configuration options are described in the *Simulated I/O reference* manual.

Interactive Measurement Configuration

The interactive measurement configuration questions are described in the chapter on coordinated measurements in the *Softkey Interface Reference* manual. Examples of coordinated measurements that can be performed between the emulator and the emulation analyzer are found in the
"Using the Emulator" chapter.

External Analyzer Configuration

The external analyzer configuration options are described in the *Analyzer Softkey Interface User's Guide*.

Saving a Configuration

The last configuration question allows you to save the previous configuration specifications in a file which can be loaded back into the emulator at a later time.

Configuration file name? <FILE>

The name of the last configuration file is shown, or no filename is shown if you are modifying the default emulator configuration.

If you press <RETURN> without specifying a filename, the configuration is saved to a temporary file. This file is deleted when you exit the Softkey Interface with the "end release_system" command.

When you specify a filename, the configuration will be saved to two files; the filename specified with extensions of ".EA" and ".EB". The file with the ".EA" extension is the "source" copy of the file, and the file with the ".EB" extension is the "binary" or loadable copy of the file.

Ending out of emulation (with the "end" command) saves the current configuration, including the name of the most recently loaded configuration file, into a "continue" file. The continue file is not normally accessed.

Loading a Configuration

Configuration files which have been previously saved may be loaded with the following Softkey Interface command.

```
load configuration <FILE> <RETURN>
```

This feature is especially useful after you have exited the Softkey Interface with the "end release_system" command; it saves you from having to modify the default configuration and answer all the questions again. To reload the current configuration, you can enter the following command.

```
load configuration <RETURN>
```

5

Using the Emulator

Introduction

In the "Getting Started" chapter, you learned how to load code into the emulator, how to modify memory and view a register, and how to perform a simple analyzer measurement. In this chapter, we will discuss in more detail other features of the emulator.

This chapter discusses:

- Internal RAM and SFR of 7700 Series.
- Features available via "pod_command".
- Debugging C Programs
- Limitations and restrictions of the emulator.

This chapter shows you how to:

- Use sequential trigger feature of the analyzer.
- Store the contents of memory into absolute files.
- Make coordinated measurements.
- Use a command file.

Sample Program

In the "Getting Started" chapter, we looked at a sample program which functioned as a primitive command interpreter. In this section, we will use the same program.

Internal RAM and SFR

As described in chapter 2 and chapter 4, the emulator breaks into the monitor when displaying internal RAM or SFR. However, you can configure the emulator so that write cycles are performed to both internal RAM (or SFR) and emulation memory. In this case, you can display the data written to emulation memory without suspending user program execution. To perform this, you need to map the internal RAM area and SFR area to emulation memory. Enter memory mapping screen with "modify configuration" command, and map 100H through 27FH to emulation RAM.

```
100h thru 27fh emulation ram <RETURN>
end <RETURN>
```

Loading the Sample Program

The sample program is loaded with the following command.

```
load cmd_rds <RETURN>
```

Running the Example

Enter the following command to cause the emulator to run the sample program.

```
run from Init <RETURN>
```

Modify the command input byte to "A" to let the program write the message to the Destination area.

```
modify memory fcode i Cmd_Input byte to 41h
<RETURN>
```

Notice that you need to specify "fcode i" syntax to access internal RAM. If you specify "fcode none" syntax, the data you entered is written to emulation memory. In this case, the program will never write the message, since user program reads data only from internal RAM.

Now, let's display the message written to the destination area.

```
display memory fcode i Msg_Dest blocked byte
<RETURN>
```

The above command displays the contents of internal RAM. Sample program is suspended, and the monitor reads the internal RAM.

To display the data copied to emulation memory, enter the following command.

```
display memory fcode none Msg_Dest <RETURN>
```

The above command displays the contents of emulation memory. When user program writes data to internal RAM or SFR, it is written to emulation memory simultaneously. You can display this data in emulation memory without suspending user program execution.

Note

The contents of emulation memory is updated only when user program writes data to internal RAM (or SFR). Therefore, the contents of emulation memory may be different from the actual value in internal RAM (or SFR). Especially, you should pay a close attention when seeing flags of SFR,

---

Note

Notice that user program is still suspended, when you modify internal RAM or SFR.

Note

Once you specify "fcode", it becomes the new default to access memory.

Features Available via Pod Commands

Several emulation features available in the Terminal Interface but not in the Softkey Interface may be accessed via the following emulation commands.

```
display pod_command <RETURN>
pod_command '<Terminal Interface command>'
<RETURN>
```

Some of the most notable Terminal Interface features not available in the softkey Interface are:

- Copying memory.
- Searching memory for strings or numeric expressions.
- Performing coverage analysis.

Refer to your Terminal Interface documentation for information on how to perform these tasks.

Note

Be careful when using the "pod_command". The Softkey Interface, and the configuration files in particular, assume that the configuration of the HP 64700 pod is NOT changed except by the Softkey Interface. Be aware that what you see in "modify configuration" will NOT reflect the HP 64700 pod's configuration if you change the pod's configuration with this command. Also, commands which affect the communications channel should NOT be used at all. Other commands may confuse the protocol depending upon how they are used. The following commands are not recommended for use with "pod_command":

stty, po, xp - Do not use, will change channel operation and hang.
echo, mac -Usage may confuse the protocol in use on the channel.
wait -Do not use, will tie up the pod, blocking access.
init, pv -Will reset pod and force end release_system.
t - Do not use, will confuse trace status polling and unload.

Debugging C Programs

Softkey Interface has following functions to debug C programs.

- Including C source lines in memory mnemonic display
- Including C source lines in trace listing
- Stepping C sources
- Display memory in various data type

The following section describes such features.

Displaying Memory with C Sources

You can display memory in mnemonic format with C source lines. For example, to display memory in mnemonic format from address **_main** with source lines, enter the following commands.

```
display memory _main mnemonic <RETURN>
set source on <RETURN>
```

You can display source lines highlighted with the following command.

```
set source on inverse_video on <RETURN>
```

To display only source lines, use the following command.

```
set source only <RETURN>
```

Specifying Address with Line Numbers

You can specify addresses with line numbers of C source program. For example, to set a breakpoint to line 20 of "main.c" program, enter the following command.

```
modify software_breakpoints set main.c: line
20 <RETURN>
```

Displaying Trace with C Sources

You can include C source information in trace listing. You can use the same command as the case of memory display. For example, to display trace listing with source lines highlighted, enter the following command.

```
display trace <RETURN>
set source on inverse_video on <RETURN>
```

Stepping C Sources

You can direct the emulator to execute a line or a number of lines at a time. For example, to step one line from the beginning of function **main**, enter the following command.

```
step source from _main <RETURN>
```

To step 1 line from the current line, enter the following command.

```
step source <RETURN>
```

You can specify the number of lines to be executed. To step 5 lines from the current line, enter the following command.

```
step 5 source <RETURN>
```

Displaying Memory in Various Data Type

You can display the contents of memory in various data types. For example, to display character type data "strings[0]" through "strings[20], enter the following command.

```
display data _strings thru +20 char <RETURN>
```

To display 16 bit integer data "int_data", enter the following command.

```
display data _int_data int_16 <RETURN>
```

Using a Command File

You can use a command file to perform many functions for you, without having to manually type each function. For example, you might want to create a command file that loads configuration, loads program into memory and displays memory.

To create such a command file, type "**log**" and press TAB key. You will see a command line "**log_commands**" appears in the command field. Next, select "**to**" in the softkey label, and enter the command file name "sample.cmd". This set up a file to record all commands you execute. The commands will be logged to the file sample.cmd in the current directory. You can use this file as a command file to execute these commands automatically.

Suppose that your configuration file and program are named "cmd_rds". To load configuration:

```
load configuration cmd_rds <RETURN>
```

To load the program into memory:

```
load cmd_rds <RETURN>
```

To display memory C000 hex through C020 hex in mnemonic format:

```
display memory 0c000h thru 0c020h mnemonic
```

Now, to disable logging, type "**log**" and press TAB key, select "**off**", and press **Enter**. The command file you created looks like this:

```
load configuration cmd_rds
load cmd_rds
display memory 0c000h thru 0c020h mnemonic
```

If you would like to modify the command file, you can use any text editor on your host computer. To execute this command file, type "sample.cmd", and press **Enter**.

Storing Memory Contents to an Absolute File

The "Getting Started" chapter shows you how to load absolute files into emulation or target system memory. You can also store emulation or target system memory to an absolute file with the following command.

```
store memory 0c000h thru 0c047h to absfile
<RETURN>
```

The command above causes the contents of memory locations C000 hex through C047 hex to be stored in the absolute file "absfile.X". Notice that the ".X" extension is appended to the specified filename.

Coordinated Measurements

For information on coordinated measurements and how to use them, refer to the "Coordinated Measurements" chapter in the *Softkey Interface Reference* manual.

Limitations, Restrictions

Access to Internal RAM

Modifying internal RAM or SFR suspends user program execution.

Trace Internal RAM

Read data from the internal RAM or SFR is not traced correctly by the emulation analyzer.

Note

Write data is also not traced correctly in the following case:

- The emulator is used with the M37795 emulation pod.

And:

- The processor is operating in the memory expansion or microprocessor mode with 8 bit external bus.

DMA Support

Direct memory access to emulation memory is not allowed.

Watch Dog Timer in Background

Watch dog timer suspends count up while the emulator is running in background monitor.

Step Command with Foreground Monitor

Step command is not available when the emulator is used with foreground monitor.

Step Command and Interrupts

When an interrupt occurs while the emulator is ruuning in monitor, the emulator fails to do the first step operation. The emulator will display the mnemonic of the instruction which should be stepped, but the instruction is not actually executed. The second step operation will step the first instruction of the interrupt routine.

Emulation Commands in Stop/Wait Mode

When the 7700 microprocessor is in the stop or wait mode, emulation commands which access memory or registers will fail. You need to break the emulator into the monitor to use these commands. Once you break the emulator into the monitor, the stop or wait mode will be released.

Stack Address

In some versions of 7700 microprocessor, the stack can be located in Bank FF. However, the HP 64146A/B emulator doesn't support the feature. The stack must be located in Bank 0.

Notes

A

Using the Foreground Monitor

Introduction

By using and modifying the optional foreground monitor, you can provide an emulation environment which is customized to the needs of a particular target system.

The foreground monitors are supplied with the emulation software and can be found in the following path:

/usr/hp64000/monitor/*

The monitor programs are named **fm7700b.a77**.

Comparison of Foreground and Background Monitors

An emulation monitor is required to service certain requests for information about the target system and the emulation processor. For example, when you request a register display, the emulation processor is forced into the monitor. The monitor code has the processor dump its registers into certain emulation memory locations, which can then be read by the emulator system controller without further interference.

Background Monitors

A *background* monitor is an emulation monitor which overlays the processor's memory space with a separate memory region. Entry into the monitor is normally accomplished by jamming the monitor addresses onto the processor's address bus.

Usually, a background monitor will be easier to work with in starting a new design. The monitor is immediately available upon powerup, and you don't have to worry about linking in the monitor code or allocating space for the monitor to use the emulator. No assumptions are made about the target system environment; therefore, you can test and debug hardware before any target system code has been written. All of the processor's address space is available for target system use, since the monitor memory is overlaid on processor memory, rather than subtracted from processor memory. Processor resources such as interrupts are not taken by the background monitor.

However, all background monitors sacrifice some level of support for the target system. For example, when the emulation processor enters the monitor code to display registers, it will not respond to target system interrupt requests. This may pose serious problems for complex applications that rely on the microprocessor for real-time, non-intrusive support. Also, the background monitor code resides in emulator firmware and can't be modified to handle special conditions.

Foreground Monitors

A *foreground* monitor may be required for more complex debugging and integration applications. A foreground monitor is a block of code that runs in the same memory space as your program. Foreground monitors allow the emulator to service real-time events, such as interrupts or watchdog timers, while executing in the monitor. For most multitasking, interrupt intensive applications, you will need to use a foreground monitor.

You can tailor the foreground monitor to meet your needs, such as servicing target system interrupts. However, the foreground monitor does use part of the processor's address space, which may cause problems in some target systems. You must also properly configure the emulator to use a foreground monitor (see the "Configuring the Emulator" chapter and the examples in this appendix).

An Example Using the Foreground Monitor

In the following example, we will illustrate how to use a foreground monitor with the sample program from the "Getting Started" chapter. By using the emulation analyzer, we will also show how the emulator switches from state to state using a foreground monitor.

For this example, we will locate the monitor at b800 hex; the sample program will be located at c000 hex with the message table at c100 hex and the command input, message destination, and stack locations at 27f hex.

```
$ cp /usr/hp64000/monitor/fm7700b.a77 .
<RETURN>
```

Assemble and Link the Monitor

You can assemble, link and convert the foreground monitor program with the following commands.

```
$ rasm77 -s fm7700b.a77 <RETURN>
$ link77 fm7700b <RETURN>
```

Enter **-s** as command parameter.

```
$ m77cnvhp fm7700b <RETURN>
```

If you haven't already assembled ,linked, and converted the sample program, do that now. Refer to the "Getting Started" chapter for instructions on assembling, linking, and converting the sample program.

Modifying Location Declaration Statement

You may need to modify the foreground monitor program to adjust it to your needs.

Monitor Address

You can load the monitor "fm7700b.a77" at any base address on a 2K byte boundary except internal RAM and SFR area. To relocate the monitor, you must modify the "LOCATE_ADRS" label statement near the top of the monitor listing to point the base address where the monitor will be loaded. You will see the statement in the monitor listing as follows:

```
LOCATE_ADRS     .EQU      0B800H      ;start monitor on 2k boundary in bank 0
                                      ;rather than sfr/iram area
PROCMODEREG     .EQU      0005EH      ;processor mode register;s address
```

For example, if you want to locate the monitor at a000 hex, you may change the address "0B800H" to "0A000H".

Processor Mode Register Address

You may need to modify the .EQU statement at the PROCMODEREG label. This value defines the location of processor mode register. If your processor has processor mode register at address other than 5e hex, modify this value to appropriate value. The following list shows the address of processor mode register.

Processor	Processor Mode Register Address	Processor	Processor Mode Register Address
7700M2	5e	7704M2	5e
7700S	5e	7704S1	5e
7700M4	5e	7720S1	5e
7700S4	5e	7730S2	5e
7702M2	5e	7732S4	d8
7702S	5e	7795S	d8
7702M4	5e	7796E4	d8
7702S4	5e		

Modifying the Emulator Configuration

The following assumes you are modifying the default emulator configuration (that is, the configuration present after initial entry into the emulator or entry after a previous exit using "end release_system"). Enter all the default answers except those shown below.

Modify memory configuration? yes

You must modify the memory configuration so that you can select the foreground monitor and map memory.

Monitor type? foreground

Specifies that you will be using a foreground monitor program.

Reset map (change of monitor type requires map reset)? yes

You must answer this question as shown to change the monitor type to foreground.

Monitor address? 0b800h

Specifies that the monitor will reside in the 2K byte block from b800 hex through bfff hex.

Monitor file name? fm7700b

Enter the name of the foreground monitor absolute file. This file will be loaded at the end of configuration.

Mapping Memory for the Example

When you specify a foreground monitor and enter the monitor address, all existing memory mapper terms are deleted and a term for the monitor block will be added. Add the additional term to map memory for the sample program and, map other area as target RAM.

```
0c00h0 thru 0dfffh emulation rom <RETURN>
default target ram <RETURN>
end <RETURN>
```

If your processor has no internal RAM, map 0 hex through 2ff hex as emulation RAM.

See the "Mapping Memory" section of the "Configuring the Emulator" chapter for more information.

Modify emulation pod configuration ? yes

You need to modify the emulation pod configuration to select your processor.

Select chip (group)? <chip group>
Select chip ? <chip type>

Select the processor you are going to emulate.

Configuration file name? fmconfig

If you wish to save the configuration specified above, answer this question as shown.

Load the Program Code

Now it's time to load the sample program. You can load the sample program with the following command:

```
load cmd_rds <RETURN>
```

Running User Program

Before running the user program, you should initialize the stack pointer by breaking the emulator out of reset.

```
break <RETURN>
```

To run the sample program from address **Init**, enter the following command:

```
run from Init <RETURN>
```

Now you can use the emulator with the foreground monitor.

Limitations of Foreground Monitors

Listed below are limitations or restrictions present when using a foreground monitor.

Step Command

Step command is not available when you are using the emulator with a foreground monitor.

Synchronized Measurement

You cannot perform synchronized measurements over the CMB when using a foreground monitor. If you need to make such measurements, select the background monitor type when configuring the emulator.

Notes

Using the Format Converter

How to Use the Converter

The format converter is a program that generates HP format files from MELPS 7700 Hex format file and its symbol file. This means you can use available language tools to create MELPS 7700 Hex format file, then load the file into the emulator using the format converter.

To execute the converter program, use the following command:

```
$ m77cnvhp [-q] <file_name> <RETURN>
```

<file_name> is the name of MELPS 7700 Hex format file without suffix. The converter program will read the MELPS 7700 Hex format file (with .hex suffix) and the symbol file (with .sym suffix). It will generate the following HP format files:

- HP Absolute file (with .X suffix)
- HP Linker symbol file (with .L suffix)
- HP Assembler symbol files (with .A suffix)

When the **-q** option is specified, warning messages are suppressed.

Suppose that you have the following two files:

sample.hex (MELPS 7700 Hex format file)
sample.sym (Symbol file)

You can generate HP format files from these two files with the following command:

```
$ m77cnvhp sample <RETURN>
```

Note

The converter uses both .hex file and .sym file. You need to direct your assembler and linker to generate .sym file.

Specifications

The following are specifications of the format converter.

- Label names and Symbol names must be 15 and less characters in length.
- File name must be 14 and less characters in length.
- Up to 10000 sections can be handled.
- Up to 1000 functions can be handled.
- If a label name or symbol name contains "?", it will be replaced with "_".

Note

When you convert files which contain no local symbols, the assembler symbol files (.A file) won't be generated. In this case, you will see an error message when you load the program into the emulator. However, this error will cause no damage on your operation.

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