
User's Guide

HP Debug User Interface for M16C/60/61 Groups

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Edition 1 B3753-97000, September 1996

Edition 2 B3753-97001, February 1997

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Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

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The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific **WARNINGS** elsewhere in this manual may impair the protection provided by the equipment. In addition it violates safety standards of design, manufacture, and intended use of the instrument.

The Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

Note

HP E3470A/B comply with INSTALLATION CATEGORY I and POLLUTION DEGREE 2 in IEC1010-1. HP E3470A/B are INDOOR USE product.

Note

LEDs in HP E3470A/B are Class 1 in accordance to IEC 825-1.

CLASS 1 LED PRODUCT

Do Not Operate in an Explosive Atmosphere

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

Do Not Service or Adjust Alone

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

Do Not Substitute Parts or Modify Instrument

Because of the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

Dangerous Procedure Warnings

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

Warning

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting this instrument.

Safety Symbols

General definitions of safety symbols used on equipment or in manuals are listed below.



Instruction manual symbol: The product is marked with this symbol when it is necessary for the user to refer to the instruction manual.



Alternating current.



Direct current.



On (Supply).



Off (Supply).



Frame (or chassis) terminal. A connection to the frame (chassis) of the equipment which normally include all exposed metal structures.

Warning

This Warning sign denotes a hazard. It calls your attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

Caution

This Caution sign denotes a hazard. It calls your attention to a procedure, practice, condition, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

Note

Note denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

In This Book

HP E3470A and HP E3470B are HP 64700 Series emulators supporting Mitsubishi M16C/60 group and M16C/61 group, respectively.

The HP B3753A Debug User Interface, which is used with the HP E3470A/B Emulator, is a high-level language debugger.

This book illustrates installation of the HP E3470A/B, describes processor-specific functions and usage of the HP B3753A Debug User Interface.

For installation of the HP 64700 series, refer to the *HP 64700 Card Cage Installation/Service Guide*.

For common functions and usage of the HP Debug User Interface, refer to the *HP Debug User Interface User's Guide*.

For installation of the HP Debug User Interface, refer to the *HP Debug User Interface Installation Guide*.

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Installing the Emulator



Installing the Emulator

This chapter covers the features and installation of the emulator, followed by the description on plugging the emulation probe into the target system and the instruction for cleaning.

Features

This sections shows you the features of the HP E3470A/B emulator.

Supported Processors

HP E3470A supports the Mitsubishi M16C/60 group and HP E3470B supports the Mitsubishi M16C/61 group.

Operating Frequency

The operating frequency of the emulator varies depending the type of the HP 64700 card cage you use, operating voltage, and the wait for memory access. Refer to the tables below.

Table 1-1. Operating Frequencies (HP E3470A)

Card Cage	Operating Voltage	Wait	System Clock ϕ
HP 64700A	4.0 to 5.25 V	None	1 MHz to 10 MHz
	2.7 to 5.25 V	None	1 MHz to 3 MHz
		1	1 MHz to 7 MHz
HP 64700B	4.0 to 5.25 V	None	32 kHz to 10 MHz
	2.7 to 5.25 V	None	32 kHz to 3 MHz
		1	32 kHz to 7 MHz



Table 1-2. Operating Frequencies (HP E3470B)

Card Cage	Operating Voltage	Wait	System Clock ϕ
HP 64700A	4.0 to 5.25 V	None	1 MHz to 10 MHz
		1	1 MHz to 16 MHz *
	2.7 to 5.25 V	None	1 MHz to 3 MHz
		1	1 MHz to 7 MHz
HP 64700B	4.0 to 5.25 V	None	32 kHz to 10 MHz
		1	32 kHz to 16 MHz *
	2.7 to 5.25 V	None	32 kHz to 3 MHz
		1	32 kHz to 7 MHz

* Expected values when 16 MHz will be supported in the future.

Emulation Memory

The emulator employs the 1 Mbyte dual port emulation memory which covers all of the memory space of M16C. Accessing memory from the emulator will be achieved by the cycle steal, having no affection of the execution of the user program.

You can define up to 16 different map terms. The minimum size of each map term is 256 bytes. Each map term can be defined as emulation RAM/ROM, target RAM/ROM, and guarded memory.

Tracing function

The emulator traces the bus cycle and instruction execution of M16C with the analyzer boards shown below:

- HP 64794A/C/D Analyzer Board (Deep memory)
- HP 64704A 80 Channel Analyzer Board (1k memory)

Hardware dequeuing enables you to set the trigger on the point where an instruction is actually executed as well as the bus cycle.

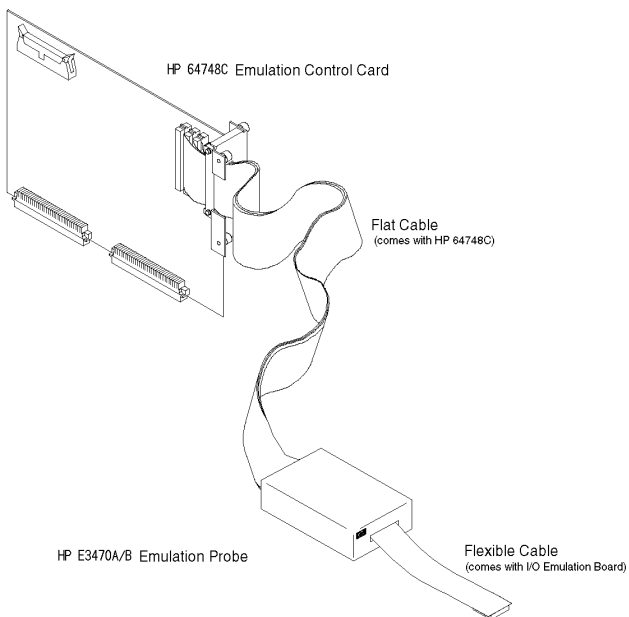
Also possible is tracing the bus cycle to the on-chip ROM/RAM via the internal bus of the M16C.

Installation of the emulator

Before installing HP E3470A/B emulator, be sure that the following hardwares are required:

- HP E3470A or HP E3470B Emulation Probe
- HP 64748C Emulation Control Card
- HP 64794A/C/D Analyzer Board (Deep Memory) or HP 64704A 80 Channel Analyzer Board (1k Memory)
- HP 64700A or HP 64700B Card Cage
- HP 64701A LAN Interface Card (for HP 64700A only)
- Mitsubishi M16C I/O Emulation Board

The I/O Emulation board is available from Mitsubishi Corp.



Follow the steps below to install the HP E3470A/B emulator.

1 Install the emulation control card and the analyzer board into the card cage.

Skip this step if your emulator is the HP E3470A/B bundle product.
See "*HP 64700 Card Cage Installation/Service Guide*" for details.

2 Install the emulation probe.

See the description that follows in this chapter.

3 Connect the card cage to the host computer.

This step contains connecting LAN cable and setting LAN parameters including IP address.

See "*HP Debug User Interface Installation Guide*" for details.

4 Update the firmware of the emulator.

Skip this step if your emulator is the HP E3470A/B bundle product.
See "*HP Debug User Interface Installation Guide*" for details.

Caution

The PC board has many electric parts which may be damaged by static electricity. To prevent the parts from being damaged, be sure to follow the cautions below when handling them.

- **Store and use the emulator in a place resistant to static electricity.**
 - **Always handle the board by edge, not the parts nor the patterns.**
 - **Use wrist strap which is grounded to the frame of HP 64700.**
-

Installing the Emulation Probe

Follow the steps below to install the emulation probe.

- 1 Check that the emulator is OFF.
- 2 Remove the screws that secure the cover of the emulation probe and detach the cover.

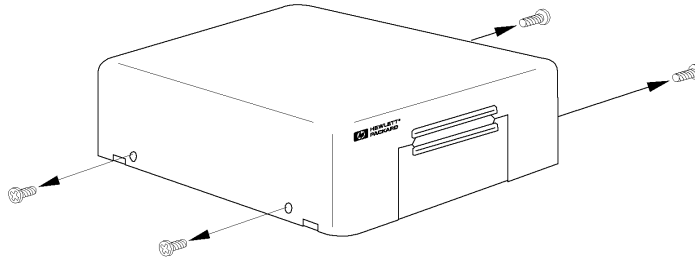


Figure 1-1. Removing the Screws

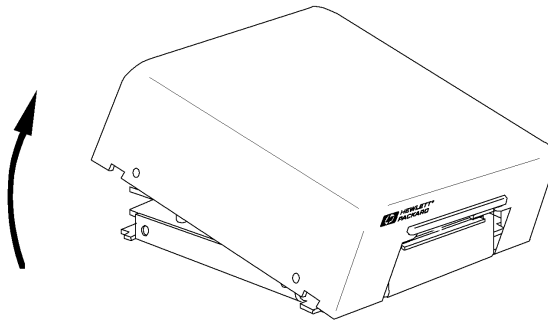


Figure 1-2. Detaching the Cover

- 3 Remove the test board from the emulation probe.

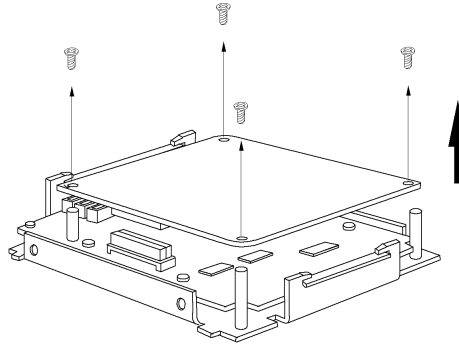


Figure 1-3. Removing the Test Board

Caution

The test board is required for the PV Test (Performance Verification Test), which runs a diagnostic check of the emulator. Once removed the board, store it in an appropriate way.
For details on the PV Test, see the *HP 64700B Card Cage Installation/Service Guide*.

- 4 Install the Mitsubishi I/O emulation board.

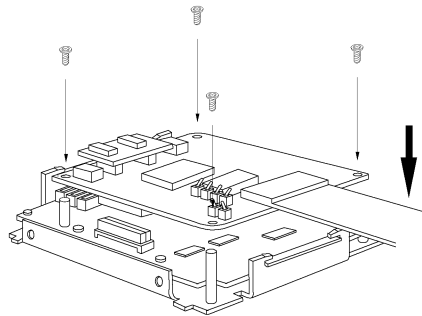


Figure 1-4. Installing the I/O Emulation Board

- 5 Connect three flat cables of the emulators side to the socket on the emulation probe.

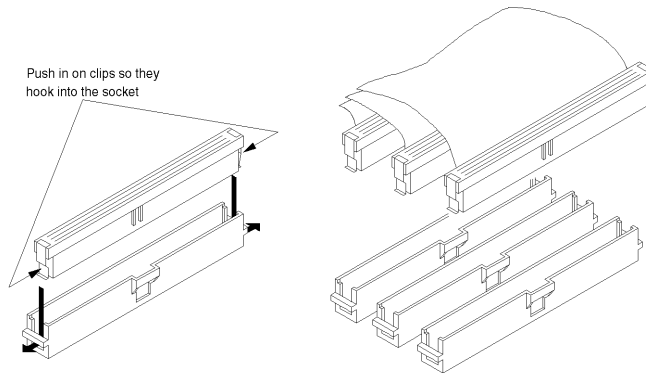


Figure 1-5. Connecting Flat Cables

- 6 Attach the cover to the emulation probe.

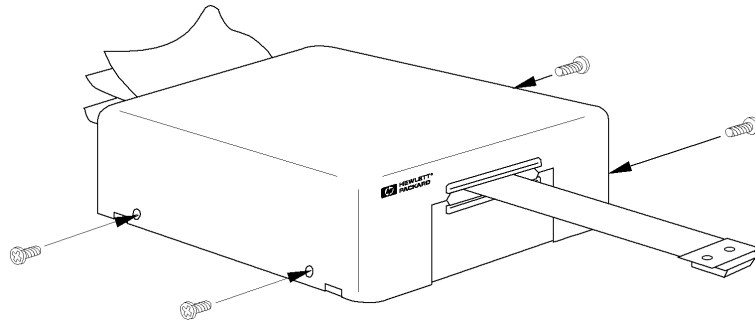


Figure 1-6. Attaching the Cover

Chapter 1: Installing the Emulator
Installation of the emulator



Attaching the sky hook will enable you to use the emulation probe in a hanged position

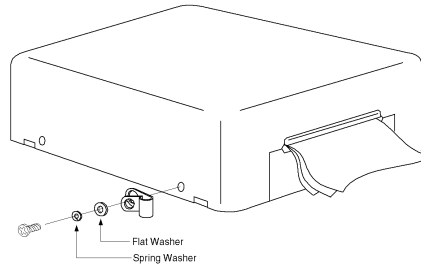


Figure 1-7. Attaching the Sky Hook

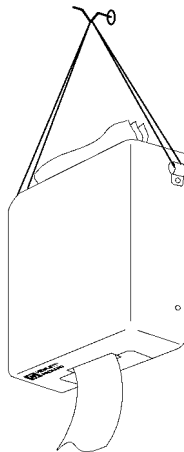


Figure 1-8. Hanging the Emulation Probe

Plugging the emulation probe into the target system.

The emulator can be connected to the target system with the flexible cable that comes with the I/O emulation board.

See the instructions with the I/O emulation board for details.

Caution

To prevent the emulator and the target system from being damaged, be sure to follow the cautions below when handling them.

- **To prevent the emulator from being damaged by static electricity, store and use the emulator in a place resistant to static electricity.**
 - **Be sure to turn off the emulator and the target system before connecting the emulation probe and target system.**
 - **Check that the orientation of the socket on the target system and the emulation probe pins is correct.**
 - **Check that the ground line of the emulator and that of the target system are properly connected.**
 - **When turning the system on, switch on the target system first and then the emulator.**
 - **When turning the system off, switch off the emulator first and then the target system.**
-

Chapter 1: Installing the Emulator
Plugging the emulation probe into the target system.

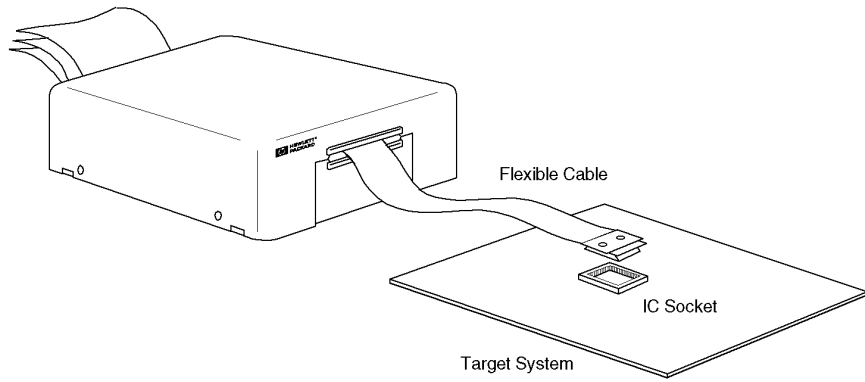
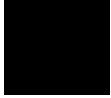


Figure 1-9. Plugging the Emulator into the Target System

Instruction for Cleaning

To prevent electrical shock, disconnect the HP E3470A/B power cable from the receptacle before cleaning. Use a dry cloth or a cloth slightly dipped in water to clean the casing. Do not attempt to clean the HP E3470A/B internally.





Note



Configuring the Emulator

Configuring the Emulator

This chapter shows you how to set the following items to configure the emulator.

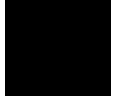
- Hardware Options
- Memory Map

Hardware Options

The emulator can be configured to suit developments of various target systems and user programs by setting the hardware options.

The HP E3470A/B emulator has the following hardware options.

- **Main Clock Source**
- **Sub Clock Source**
- **Clock is Faster than 10 MHz (for HP E3470B only)**
- **Restrict to Real Time**
- **Break on Write to ROM**
- **Respond to Target System NMI**
- **Respond to Target System HOLD**
- **Multiplexed Bus Space Type**
- **Language Tool Type**
- **Processor Operation Mode**
- **ISP Reset Value**



Setting the Hardware Options

To set the hardware options,

- 1 Choose **Settings**→**Configuration**→**Hardware...** (Alt, S, C, H) from the control menu of the Debug window.
- 2 Set the hardware options using the Emulator Configuration dialog box.
- 3 Click the OK button.

Note In the Emulator Configuration dialog box, the option button checked means **Yes**, the option button not checked means **No**.

Note Setting the hardware options will drive the emulator into a reset state.

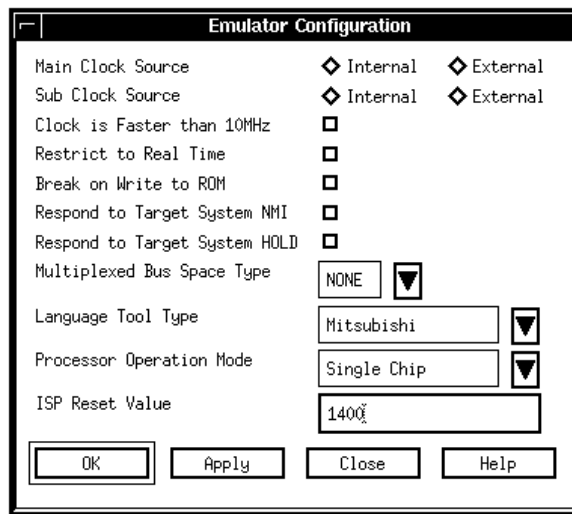


Figure 2-1. Emulator Configuration dialog box

Main Clock Source

This option allows you to select whether the processor's main clock X_{IN} is sourced by the I/O emulation board's internal clock or by the target system.

Internal The processor's main clock is sourced by the I/O emulation board's internal clock.

External The processor's main clock is sourced by the target system.

Sub Clock Source

This option allows you to select whether the processor's sub clock X_{CIN} is sourced by the I/O emulation board's internal clock or by the target system.

Internal The processor's sub clock is sourced by the I/O emulation board's internal clock.

External The processor's sub clock is sourced by the target system.

Clock Faster than 10 MHz

This hardware option is dedicated for the HP E3470B M16C/61 emulator and allows you to select whether the processor's system clock ϕ is faster than 10 MHz.

Yes Select this option if the system clock is faster than 10 MHz. In this setting, accessing memory in 1 clock cycle is not possible. Put 1 wait or more in all of the memory accesses. Only when the emulator breaks to the monitor from the Emulation reset status, the wait bit in the processor mode register (PM1) is automatically set to 1.

No Select this option if the system clock is not faster than 10 MHz. In this setting, accessing memory in 1 clock cycle is possible.



Restrict to Real Time

The emulator has to break to the monitor to access processor registers and target memory. While running the user program, this break is done implicitly and called "temporary break".

With temporary breaks, the user program cannot be executed in real time. This may cause unexpected result if your target system circuitry is dependent on constant execution time of the program code.

This option allows you to select whether the emulator is restricted to real-time runs.

Yes The emulator is restricted to real-time runs. While running the user program, all commands that cause a temporary break are refused. The user program is guaranteed to be executed in real time. Commands to display/modify registers and target memory are not allowed when the emulator is running the user program. However, you can still execute the run control commands such as reset, break, run, step. Select this option if the target system should be tested with the user program running in real time.

No The emulator is not restricted to real-time runs. All commands, regardless of whether or not they require a break to the monitor, are accepted by the emulator.

Break on Write to ROM

This option allows you to select whether the emulator breaks to the monitor when the user program writes to a memory area mapped as ROM.

Yes The emulator breaks to the monitor when the user program writes to a memory area mapped as ROM.

No The emulator does not break to the monitor upon a write to ROM.

Note

When the user program writes to memory mapped as emulation ROM, the memory is not protected; data will be written in the same manner as the user program writes to memory mapped as emulation RAM.

Respond to Target System NMI

This option allows you to select whether the emulator responds to the $\overline{\text{NMI}}$ signal from the target system.

- Yes** The emulator responds to the $\overline{\text{NMI}}$ signal from the target system.
- While running the user program, the emulator starts an NMI exception process if the NMI signal is asserted. While running the monitor, the emulator ignores an NMI request.
- No** The emulator always ignores the $\overline{\text{NMI}}$ signal from the target system.

Note While running the monitor, the emulator ignores any interrupts except address match and watchdog timer, as well as NMI.

 The emulator suspends maskable interrupt requests while running the monitor; the requests will be serviced upon return to the user program.

Note While running the monitor, the emulator responds to address match and monitoring timer interrupts. This may destroy the monitor program.

 The address match interrupt is effective on an execution of an instruction when the monitor is running. Do not specify 1000H to 1FFFH for addresses of address match interrupt. The monitoring timer must not be operated.

Respond to Target System $\overline{\text{HOLD}}$

This option allows you to select whether the emulator responds to the $\overline{\text{HOLD}}$ signal from the target system.

Yes The emulator responds to the $\overline{\text{HOLD}}$ signal from the target system.

While running the user program, the emulator enters a reset state if the $\overline{\text{HOLD}}$ signal is asserted. While running the monitor, the $\overline{\text{HOLD}}$ signal is ignored.

No The emulator always ignores the $\overline{\text{HOLD}}$ signal. When the $\overline{\text{HOLD}}$ lead is used for other function such as a port, this setting has no affection to the function.

Note

Regardless of this option setting, while running the monitor, the $\overline{\text{HOLD}}$ signal is ignored.

Multiplexed Bus Space Type

This option lets you specify address area on your target system used as multiplexed bus space.

NONE Select this option if your target system does not use multiplexed bus space.

CS1 Select this option if your target system uses the CS1 area as multiplexed bus space.

CS2 Select this option if your target system uses the CS2 area as multiplexed bus space.

ALL Select this option if your target system uses whole area as multiplexed bus space.

Do not select this option when the microprocessor mode is selected for the processor operation mode.

Only when the emulator breaks to the monitor from the Emulation reset status, the multiplexed bus space selection bit in the processor mode register (PM0) is automatically set depending on this configuration.

Language Tool Type

This option allows you to specify language tools which is used to create the user program.

Mitsubishi The user program created with the Mitsubishi language tools can be debugged.

IAR The user program created with the IAR language tools can be debugged.

Note When debugging a program created with the Mitsubishi language tool, note that the Backtrace window displays only function names; parameters for the functions are not shown.

Note When debugging a program created with the IAR language tool, note that the Backtrace window does not display the first parameter of the function; the displaying starts at the second parameter.

Processor Operation Mode

This option allows you to select the processor operation mode.

Single Chip The emulator operates in the single-chip mode.

Memory Expanded The emulator operates in the memory expanded mode.

Microprocessor The emulator operates in the microprocessor mode.

Only when the emulator breaks to the monitor from the Emulation reset status, the processor mode selection bit in the processor mode register (PM0) is automatically set depending on this configuration.

ISP Reset Value

This option allows you to specify a initial value to which the ISP (interrupt stack pointer) will be set on transition from emulation reset status into the monitor.

The value must be specified as a 16-bit address in RAM area. Normally, specify the default value of the user program.

Note

The emulator uses 4 bytes of the user interrupt stack when executing run or break commands. The ISP must be specified in on-chip RAM area, or external RAM area which can be accessed with 16-bit address.

Memory Map

The HP E3470A/B memory mapper allows you to define up to 16 different map terms. The minimum size of each map term is 256 bytes. You can specify one of the following memory types to each map term.



- eram** Emulation RAM. This area operates as read/write emulation memory.
- erom** Emulation ROM. This area operates as read only emulation memory. You can configure the emulator to break to the monitor at an attempted write to this area.
- tram** Target RAM. This area operates as read/write target memory.
- trom** Target ROM. This area operates as read only target memory. You can configure the emulator to break to the monitor when the user program writes to this area.
- grd** Guarded memory. This area operates as an access-prohibited area. When the user program attempts to access to this area, the emulator breaks to the monitor. Access with emulator commands are also prohibited.

The memory type of other area (area of no map terms defined) can be defaulted to **tram** or **trom**.

Note When the user program writes to memory mapped as emulation ROM, the memory is not protected; data will be written in the same manner as the user program writes to memory mapped as emulation RAM.

Note The target system cannot perform direct memory access to the emulation memory.

Setting the Memory Map

To set the memory map,

- 1 Choose **Settings**→**Configuration**→**Memory Map...** (Alt, S, C, M) from the control menu of the Debug window.
- 2 Set the memory map using the Memory Map dialog box.
 - **Setting a map term**
 1. Specify an area to the Address Range text box.

Format: <start address>..<end address>
 2. Select a memory type in the Attribute option box.
 3. Click the Apply button.
 - **Deleting a map term**
 1. Select a map term in the Map Term list box.
 2. Click the Delete button.
 - **Deleting all map terms**
 1. Click the Del.All button.
 - **Setting a memory type of other area**
 1. Select a memory type in the Other option box.
- 3 Click the Close button.

Note

Setting the memory map will drive the emulator into a reset state.

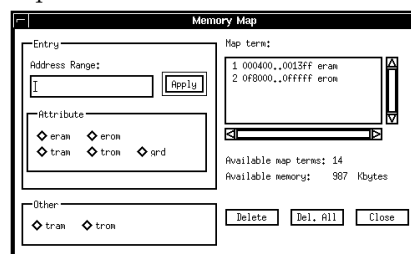


Figure 2-2. Memory Map Dialog Box

On-Chip ROM

When using the on-chip ROM, map the on-chip ROM area as emulation ROM.

On-Chip RAM

The on-chip RAM is mapped automatically as emulation RAM regardless of the memory map settings. You don't have to map this area. However, this mapping is not displayed as a map term.

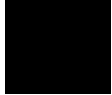
If you define a map term of this area, the map term is handled as that for external address space overlapped with the on-chip RAM.

On-Chip Peripheral Module Control Registers

The on-chip peripheral module control registers (SFR) work as the on-chip peripheral module registers regardless of the memory map settings. Mapping the SFR area will cause an error.

Note

You should understand some restrictions before accessing to the interrupt control register in SFR. See Chapter 7 for details.



Configuration Commands

You can also configure the emulator by configuration files or command files. The HP B3753A Debug User Interface has the following configuration commands. Case is not significant in both commands and parameters.

Note

The hardware option commands and the memory map commands must be placed between its own start and end commands.

Table 2-1. Configuration Commands

Command	Parameter 1	Parameter 2	Operation
config	start		Start of Hardware Option Commands
config	clk1	internal external	Main Clock Source
config	clk2	internal external	Sub Clock Source
config	bclk	10 16	Clock is Faster than 10 MHz (for HP E3470B only)
config	rrt	enable disable	Restrict to Real Time
config	rombreak	enable disable	Break on Write to ROM
config	nmi	enable disable	Respond to Target System $\overline{\text{NMI}}$
config	thold	enable disable	Respond to Target System HOLD
config	ampx	<mpx space>	Multiplexed Bus Space Type
config	language	Mitsubishi IAR	Language Tool Type
config	mode	<proc mode>	Processor Operation Mode
config	risp	<isp value>	ISP Reset Value
config	end		End of Hardware Option Commands
map	start		Start of Memory Map Commands
map	<map range>	<memory type>	Setting Map Term
map	other	<memory type>	Setting Memory Type of Other Area
map	end		End of Memory Map Commands

“10” | “16” Specify 16 when the system clock ϕ is faster than 10 MHz,
10 when slower than 10 MHz.

“enable” | “disable”

Specify “enable” when **Yes**, “disable” when **No**.

<mpx space> Specify one of the following multiplexed bus space.

- none
- cs1
- cs2
- all

<proc mode> Specify one of the following processor operation mode.

- single (single-chip mode)
- ext (memory expanded mode)
- proc (microprocessor mode)

<isp value> Specify a 16-bit address in RAM area. Normally, specify the
default value of the user program.

<map range> Specify an area to be mapped.

Format: <start address>..<end address>

<memory type> Specify one of the following memory types.

- eram
- erom
- tram
- trom
- grd

For a memory type of other area, eram, erom and grd cannot be specified.

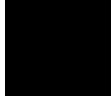




Figure 2-3. Configuration File Example

3



Language Tools

Language Tools

This chapter describes language tools which can be used with the HP B3753A Debug User Interface.



Mitsubishi Language Tools

The HP B3753A Debug User Interface can debug user programs created with the following Mitsubishi language tools.

Table 3-1. Mitsubishi Language Tools

Tool	Command	Description
C Compiler	nc30	M16C Family C Compiler
Assembler	as30	M16C Family Assembler
Linker	ln30	M16C Family Linkage Editor

For version numbers of language tools supported by the HP B3753A Debug User Interface, contact your nearest HP support office.

Note

When debugging a program created with the Mitsubishi language tool, note that the Backtrace window displays only function names; parameters for the functions are not shown.

Command Options

This section describes important command options when using the Mitsubishi language tools.

C Compiler

- g Generates debug information.
You must always specify this option. Modules without debug information cannot be debugged.

- genter Generates a stack frame whenever a function is called.
A function which does not generate a stack frame will result in improper display of backtrace.

- greg Generates debug information for register variables.
Always specify this option as well as the option -g.

Assembler

-S Generates local symbol information.
Specify this option whenever you debug with local symbol information.

Linker

-G Generates debug information.
You must always specify this option. Programs without debug information cannot be debugged.

-E *address* Specifies the starting absolute address.
If the address is not specified, the "Start Address" is 0 in run and step command.

IAR Language Tools

The HP B3753A Debug User Interface can debug user programs created with the following IAR language tools.

Table 3-2. IAR Language Tools

Tool	Command	Description
C Compiler	iccm16c	IAR M16C C-Compiler
Assembler	am16c	IAR M16C Assembler
Linker	xlink	IAR Universal Linker
Converter	iar2ieee	UBROF to IEEE-695 Converter

The converter is not required when using the linker which can generate the IEEE-695 format.

For version numbers of language tools supported by the HP B3753A Debug User Interface, contact your nearest HP support office.

Note

When debugging a program created with the IAR language tool, note that the Backtrace window does not display the first parameter of the function; display starts at the second parameter.

Command Options

This section describes important command options when using the IAR language tools.

C Compiler

- h Generates a stack frame whenever a function is called. A function which does not generate a stack frame will result in improper display of backtrace.
- r Generates debug information. You must always specify this option. Modules without debug information cannot be debugged.

-s<level> Specifies a speed optimization level in “0” to “9”.
Modules which are optimized at level “7” or higher cannot be debugged.

-z<level> Specifies a size optimization level in “0” to “9”.
Modules which are optimized at level “7” or higher cannot be debugged.

Assembler

-r<level> Generates debug information.
You must always specify this option. Modules without debug information cannot be debugged.

Linker

-F<format> Specifies an output file format. When “debug” is specified, it generates the UBROF format. When “ieee695” is specified, it generates the IEEE-695 format.
When the linker cannot generate the IEEE-695 format, you must convert the output file from the UBROF format to the IEEE-695 format by the converter.

Converter

No command options are required.

4



Emulation Status

Emulation Status

This chapter describes the emulation status messages which are displayed in the Debug window.



An emulation status message is displayed in the Debug window.

The HP B3753A Debug User Interface has the following emulation status messages.

- **Emulation reset**

The emulator is resetting the processor.

- **Running in monitor**

The emulator is executing the monitor.

- **Running user program**

The emulator is executing the user program.

- **Awaiting target reset**

The emulator is awaiting a reset signal from the target system.

When a "run from reset" command is executed, the emulator enters this state. During this state, the emulator cannot break to the monitor.

- **Target reset**

The target system is resetting the processor.

When the emulator accepts the $\overline{\text{RESET}}$ signal from the target system while running the user program, the emulator enters this state. During this state, the emulator cannot break to the monitor.

- **Wait mode**

Waiting mode.

Note

In the wait mode, the function that stops clock to on-chip peripheral modules is not supported.

Do not set the on-chip peripheral clock stop on WAIT bit to 1 in the system clock control register 0 (CM0).

- **Bus grant**

A holding state.

When the emulator accepts the $\overline{\text{HOLD}}$ signal from the target system, the emulator enters this state.

- **Waiting for ready**

Waiting mode for ready from the target system.

The emulator enters this mode when the $\overline{\text{RDY}}$ signal from the target system is left asserted.

- **Slow clock**

The processor's clock is abnormally slow or stopped.

When setting a hardware option to use the processor's clock sourced by the target system, turning off the target system or a broken-down clock on the target system may cause this state.

The HP E3470B M16C/61 emulator also enters this state during the stop mode.

Note

The HP E3470A M16C/61 emulator does not support the stop mode. Do not set the all clock stop bit to 1 in the system clock control register 1 (CM1).

- **No bus cycles**

A state with no bus cycles.

- **Unknown state**

An abnormal state.

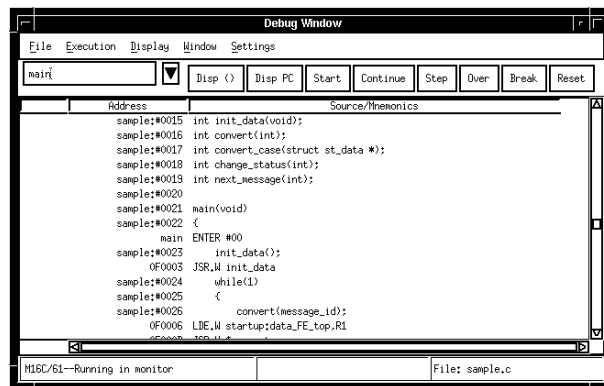


Figure 4-1. Debug Window

5



Trace

Trace

This chapter describes trace functions specific to the HP B3753A Debug User Interface.

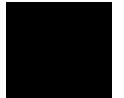


Trace Clock Speed

When using the analyzer boards **HP 64703/04A**, you can set the trace clock speed.

For the HP B3753A Debug User Interface, setting the trace clock speed is not required. Do not change it from the default value "**Slow**".

The analyzer boards **HP 64794A/C/D** have no trace clock speed setting.



Address, Data and Status Conditions

This section describes the address, data and status conditions in the following dialog boxes of the HP B3753A Debug User Interface.

- Trace Trigger Store Condition dialog box
- Trace Pattern dialog box of sequential trace

Address Condition

The M16C processor has an on-clip instruction queue of several byte which makes it unpredictable that an instruction is actually executed when it is fetched.

The HP E3470A/B emulator employs hardware dequeuing which enables you to set the trigger on the point where an instruction is actually executed as well as the bus cycle.

For this purpose, there are two address buses from the emulator to the analyzer

- Address bus for instruction execution
- Address bus for bus cycle

When specifying an address condition, a status condition is also required to specify which address bus the condition is applied to. Specify exec for the status condition when the address condition is applied to instruction execution, specify bus when the condition is applied to bus cycle.

Data Condition

The data condition can be applied to bus cycle only. Always specify the status condition bus when you set the data condition.

The data bus to the emulation analyzer is 16-bit width. Bus width of memory area and access size influence whether upper or lower byte data is valid.

- When accessing in word to a 16-bit data bus area, both upper and lower byte data are valid if the address is even. For odd address, access completes byte-wise in twice; only lower byte data is valid at the first access and only upper byte data at the second access.
- When accessing in byte to an 16-bit data bus area, only upper byte data is valid at an even address. Only lower byte data is valid at an odd address.

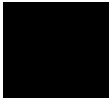
- When accessing in byte to an 8-bit data bus area, only lower byte data is valid.

Note Data cannot be traced in the read cycle of on-chip peripheral module control register (SFR) which resides in the address range 0 to 3FH. Traced value is unpredictable.

Use "x" for invalid byte data to set the data condition as examples shown in the following table.

Table 5-1. Data Condition Settings

Area	Bus Width	Access Size	Address	Upper Byte	Lower Byte	Example
On-Chip ROM On-Chip RAM On-Chip Peripheral External Memory	16-Bit	Byte	Even	-	Valid	0xxa1
			Odd	Valid	-	0a1xx
		Word	Even	Valid	Valid	0b2a1
			Odd (1st)	Valid	-	0a1xx
			Even (2nd)	-	Valid	0xxb2
External Memory	8-Bit	Byte	-	-	Valid	0xxa1
		Word	(1st)	-	Valid	0xxa1
			(2nd)	-	Valid	0xxb2



Status Condition

You can specify the following items as the status condition.

exec Instruction execution.

bus Bus cycle.

You can also specify the following items as the status condition when bus is specified.

fetch Instruction fetch cycle.

data Data access cycle.

read Read cycle.

write Write cycle.

byte Byte access cycle.

word Word access cycle.

sfr On-chip peripheral module control register (SFR) access cycle.

dma DMA controller (DMAC) cycle.

intack Interrupt acknowledge cycle.

wrrom Write cycle to an area mapped as ROM.

grd Access cycle to an area mapped as guarded memory.

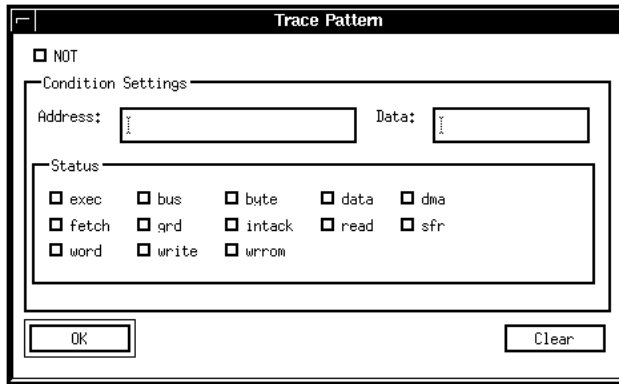


Figure 5-1. Trace Pattern Dialog Box



Note



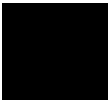
6



Windows

Windows

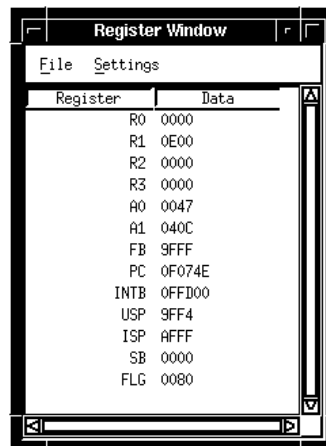
This chapter describes windows specific to the HP B3753A Debug User Interface.



Register Window

In the Register window of the HP B3753A Debug User Interface, the internal registers of the CPU can be displayed and modified.

- Data Registers (R0 to R3)
- Address Registers (A0, A1)
- Frame Base Register (FB)
- Program Counter (PC)
- Interrupt Table Register (INTB)
- User Stack Pointer (USP)
- Interrupt Stack Pointer (ISP)
- Static Base Register (SB)
- Flag Register (FLG)



The screenshot shows a window titled "Register Window" with a menu bar containing "File" and "Settings". Below the menu bar is a table with two columns: "Register" and "Data". The table lists the following registers and their values:

Register	Data
R0	0000
R1	0E00
R2	0000
R3	0000
A0	0047
A1	040C
FB	9FFF
PC	0F074E
INTB	0FFD00
USP	9FF4
ISP	AFFF
SB	0000
FLG	0080

Figure 6-1. Register Window

Peripheral Window

In the Peripheral window of the HP B3753A Debug User Interface, all registers of the following on-chip peripheral module control registers (SFR) can be displayed and modified.

- Register Bank
- System Control Registers
- Interrupt Control Registers
- Address Match Interrupt
- Watchdog Timer
- DMA Controller (DMAC)
- 16-bit Timer
- Serial I/O
- CRC Controller
- A/D Converter
- D/A Converter
- Programmable I/O Port

Note

You should understand some restrictions before accessing to the interrupt control register in SFR. See Chapter 7 for details.

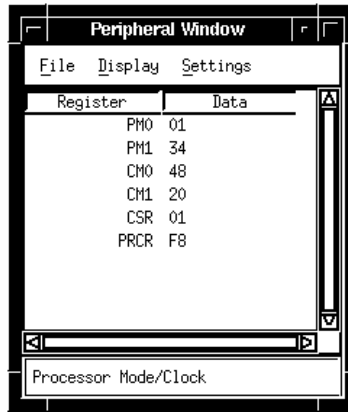
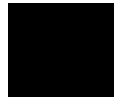


Figure 6-2. Peripheral Window



Note





Restrictions and Limitations

Restrictions and Limitations

This chapter describes restrictions and limitations.



The HP B3753A Debug User Interface and the HP E3470A/B emulator have the following restrictions and limitations.

- **Mitsubishi Language Tools**

When debugging a program created with the Mitsubishi language tool, note that the Backtrace window displays only function names; parameters for the functions are not shown.

- **IAR Language Tools**

When debugging a program created with the IAR language tool, note that the Backtrace window does not display the first parameter of the function; display starts at the second parameter.

- **Emulation Memory**

When the user program writes to memory mapped as emulation ROM, the memory is not protected; data will be written in the same manner as the user program writes to memory mapped as emulation RAM.

- **Direct Memory Access**

The target system cannot perform direct memory access to the emulation memory.

- **Reset and HOLD**

While running the monitor, the $\overline{\text{RESET}}$ and $\overline{\text{HOLD}}$ signals from the target system are ignored.

- **Interrupts**

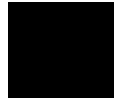
While running the monitor, the emulator responds to no interrupts except address match and watchdog timer interrupts.

The emulator suspends maskable interrupt requests in the monitor; the requests will be serviced upon return to the user program.

- **Address Match Interrupt**

Do not specify 1000H to 1fffH for an address match interrupt address.

Address match interrupts are enabled even for instructions issued during monitor program execution. Address match interrupts during monitor program execution may destroy the monitor program.



- **Watchdog Timer**

Do not use watchdog timer.

Watchdog timer interrupts are enabled even for instructions issued during monitor program execution. Monitoring timer interrupts during monitor program execution may destroy the monitor program.

- **On-chip Peripheral Module Control Registers**

Data cannot be traced in the read cycle of on-chip peripheral module control register (SFR) which resides in the address range 0 to 3FH. Traced value is unpredictable.

- **Interrupt Control Register**

When the user program or the emulator writes to the interrupt control registers with the main clock X_{IN} as the system clock ϕ , note the followings:

For HP E3470A M16C/60 emulator, write must be done with the main clock divided by two. In the mode without clock dividing, the emulator does not operate properly.

For HP E3470B M16C/61 emulator, write must be done with the main clock divided by two if one of the following condition meets. In the mode without clock dividing, the emulator does not operate properly.

- The processor operates with 5 V and the main clock is faster than 10 MHz.
- The processor operates with 3 V and the main clock is faster than 5 MHz.

- **Interrupt Stack Pointer**

The emulator uses 4 bytes of the user interrupt stack when executing run or break commands. The ISP must be specified in on-chip RAM area, or external RAM area which can be accessed with 16-bit address.

- **Single-step**

Do not set the debug flag (D flag) in the flag register (FLG) to 1 in the user program since single-step interrupts are used for stepping the user program.

- **Breakpoint**

The BRK instruction (00h) is used for software breakpoints. Do not use the BRK instruction in the user program.

When the emulator executes run or step command, it automatically sets the BRK instruction interrupt vector in the user program to its required value 040FFFE7H.

This setting cannot be done if the BRK instruction interrupt vector resides in the ROM on the target system. If this is the case, write your program to define the BRK instruction interrupt vector in the source code, as shown below. The same definition is also required if the user program has the check sum calculation including an interrupt vector.

```

; Fixed Vector Table
.ORG 0fffdch
...
; BRK Interrupt Vector (address: 0fffe4h)
.LWORD 040fffe7h
...
```

- **Breakpoint and NMI**

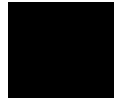
If an $\overline{\text{NMI}}$ interrupt occurs immediately after handling a BRK interrupt caused by an software breakpoint, the emulation probe cannot break normally.

In this case, an error message indicating that an $\overline{\text{NMI}}$ occurs during break process is displayed and values displayed for registers, memories, and so on may not be correct. Reset the emulator to recover from this error.

- **Undefined Instruction Interrupt**

If an undefined interrupt occurs when the undefined interrupt vector points a UND instruction, the emulation probe cannot continue executing the program normally, causing an another undefined interrupt occurs while processing interrupt.

In this case, the emulator cannot break to the monitor and reset the emulator to recover from this error.



- **Wait Mode**

In the wait mode, the function that stops clock to on-chip peripheral modules is not supported.

Do not set the on-chip peripheral clock stop on WAIT bit to 1 in the system clock control register 0 (CM0).

- **Driving Force of XOUT (HP E3470A only)**

The HP E3470A M16C/60 emulator does not operate properly when the driving force of XOUT lead is set to Low.

Do not specify 0 to the XIN-XOUT driving force selection bit in the system clock control registers 1 (CM1).

- **Stop Mode (HP E3470A only)**

The HP E3470A M16C/61 emulator does not support the stop mode.

Do not set the all clock stop bit to 1 in the system clock control register 1 (CM1).

- **JMP.S Instruction**

The emulator does not correctly execute a JMP.S instruction which jumps across a 64 K bytes boundary, resulting in a jump to a wrong address.

For example, when the user program issues a JMP.S instruction which resides in the address 0EFFFFDH and jumps to the address 0F0006H, the emulator does not operate properly.

In this case, use the JMP.B instruction instead.

- **JMP.A / JSR.A Instruction (HP E3470A only)**

The E3470A M16C/60 emulator has the following restriction with regard to the JMP.A / JSR.A instruction.

The emulator does not operate properly when the JMP.A or JSR.A instruction is executed immediately after executing a write instruction by word to an odd address in an area with software wait inserted or to an external area with software wait inserted while the external data bus width is equal to 8 bits. Data will be written to a wrong address.

When address 4001H is in an area with software wait inserted, executing the program shown below will result in an improper operation of the emulator.

```

...
; Write Word Data
MOV.W R0,4001h
; Jump Far Instruction
JMP.A FAR_ROUTINE
...
FAR_ROUTINE
...

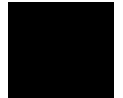
```

In this case, insert JMP.B instruction before the JMP.A or JSR.A instruction.

```

...
; Write Word Data
MOV.W R0,4001h
; Jump to Jump Far Instruction
JMP.B PATCH
PATCH:
; Jump Far Instruction
JMP.A FAR_ROUTINE
...
FAR_ROUTINE:
...

```



- **Shift Instruction (HP E3470A only)**

The HP E3470A M16C/60 emulator has the following restriction with regard to the shift instruction.

The emulator does not operate properly when the shift instructions with R1H which indicates the number of bits to shift and the R1H is "00h".

SHA.size	R1H,dest
SHL.size	R1H,dest
ROT.size	R1H,dest

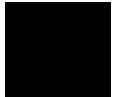
If this is the case for your program, modify the program so that the shift instruction would be skipped if R1H is "00h".

```
...  
; If R1H = 0, Skip Shift Instruction  
  CMP.B  #0,R1H  
  JZ     SKIP_SHIFT  
; Shift Instruction  
  SHL.B  R1H,-2[FB]  
SKIP_SHIFT:  
...
```



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