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Renesas Electronics Corporation

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April 1, 2003

Supplementary Information

H8S/2655, H8S/2245, H8S/2357, H8S/2355, H8S/2350, H8S/2345 Series E6000 Emulator HS2655EPI61H Supplementary Information

Hitachi Microcomputer Development Environment System

Renesas Electronics
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Rev. 1.0 2000.11

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Emulator Product:

Throughout this document, the term "emulator product" shall be defined as the following products produced only by Hitachi, Ltd. excluding all subsidiary products.

- Emulator station
- User system interface cables
- PC interface board
- Optional SIMM memory module

The user system or a host computer is not included in this definition.

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This emulator product is a software and hardware development tool for systems employing the Hitachi microcomputer H8S/2655, H8S/2245, H8S/2357, H8S/2355, H8S/2350, H8S/2345 series (hereafter referred to as the MCU). This emulator product must only be used for the above purpose.

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SAFETY PAGE

READ FIRST

• READ this user's manual before using this emulator product.

• KEEP the user's manual handy for future reference.

Do not attempt to use the emulator product until you fully understand its mechanism.

DEFINITION OF SIGNAL WORDS

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER **DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION **CAUTION** used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTE emphasizes essential information.

⚠ WARNING

Observe the precautions listed below. Failure to do so will result in a FIRE HAZARD and will damage the user system and the emulator product or will result in PERSONAL INJURY. The USER PROGRAM will be LOST.

1. **Do not repair or remodel the emulator product by yourself for electric shock prevention and quality assurance.**
2. **Always switch OFF the E6000 emulator and user system before connecting or disconnecting any CABLES or PARTS.**
3. **Always before connecting any CABLES, make sure that pin 1 on both sides are correctly aligned.**
4. **Supply power according to the power specifications and do not apply an incorrect power voltage. Use only the provided power cable.**

CAUTION

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Preface

Thank you for purchasing the H8S/2655, H8S/2245, H8S/2357, H8S/2355, H8S/2350, H8S/2345 series E6000 emulator.

The H8S/2655, H8S/2245, H8S/2357, H8S/2355, H8S/2350, H8S/2345 series E6000 emulator (hereafter referred to as the E6000) was designed as a software and hardware development tool for systems based on Hitachi's original microcomputers HD6432655, HD6432245, HD6432357, HD6432355, HD6432351, HD6432345 series.

The E6000 provides a CD-R that contains the Hitachi Debugging Interface (HDI) system program, test program, and the user's manual.

There are three manuals for the E6000: the H8S series E6000 Emulator User's Manual, this Supplementary Information, and the Hitachi Debugging Interface User's Manual. The E6000 Emulator User's Manual describes E6000 functions common to all H8S series microcomputers. This Supplementary Information describes the functions specialized for each microcomputer supported by the H8S/2655, H8S/2245, H8S/2357, H8S/2355, H8S/2350, H8S/2345 series E6000 emulator. Please read this manual before using the E6000.

To connect the E6000 to the user system, a user system interface cable for each package type is available. For details on the user system interface cable, refer to the User System Interface Cable User's Manual.

The following shows the related manuals:

- H8S Series E6000 Emulator User's Manual (HS2000EPI61HE)
- Hitachi Debugging Interface User's Manual (HS6400DIIW5SE)
- User System Interface Cable User's Manual (HS2655ECH61HE, etc)
- The PC interface board user's manual which will be the following manuals:
  ISA Bus Interface Board User's Manual (HS6000EII01HE)
  PCI Bus Interface Board User's Manual (HS6000EIC01HE, HS6000EIC02HE)
  PCMCIA Interface Card User's Manual (HS6000EIP01HE)
- Option Memory Board User's Manual
  1M SIMM Memory Board User's Manual (HS6000EMS11HE)
  4M SIMM Memory Board User's Manual (HS6000EMS12HE)

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Contents

Figures

Tables

Section 1 Overview

The H8S/2655, H8S/2245, H8S/2357, H8S/2355, H8S/2350, H8S/2345 series E6000 emulator (hereafter referred to as the E6000) is an efficient software and hardware development support tool for application systems using Hitachi's original microcomputers H8S/2655, H8S/2245, H8S/2357, H8S/2355, H8S/2350, H8S/2345 series.

1.1 Environment Conditions

Table 1.1 Environment Conditions

Item	Specifications
Temperature	Operating: +10 to +35°C
	Storage: –10 to +50°C
Humidity	Operating: 35 to 80% RH; no condensation
	Storage: 35 to 80% RH; no condensation
Ambient gases	No corrosive gases
AC Power supply voltage	100 V to 240 V AC ±5% 50/60 Hz 0.6 A max.
User system voltage (UVcc)	Depends on the target MCU within the range 2.7 V to 5.5 V

1.2 Supported MCUs and User System Interface Cables

Tables 1.2 to 1.7 show the correspondence between the MCUs and the user system interface cables supported by the E6000.

H8S/2655 Series:

Table 1.2 H8S/2655 Series MCUs and User System Interface Cable

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6472655	128-pin QFP (FP-128)	HS2655ECH61H
	HD6432655	120-pin TQFP	HS2655ECN61H
	HD6432653	(TFP-120)	

H8S/2245 Series:

Table 1.3 H8S/2245 Series MCUs and User System Interface Cables

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6432246	100-pin QFP/TQFP	HS2245ECH61H
	HD6472246	FP/TFP-100B	
	HD6432245		
	HD6432244		
	HD6432243		
	HD6432242		
	HD6432241R		
	HD6412240		

H8S/2350 Series:

Table 1.4 H8S/2350 Series MCUs and User System Interface Cable

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6432351	128-pin QFP (FP-128)	HS2655ECH61H
	HD6412350	120-pin TQFP (TFP-120)	HS2655ECN61H

H8S/2345 Series:

Table 1.5 H8S/2345 Series MCUs and User System Interface Cable

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6432345	100-pin QFP (FP-100A)	HS2345ECF61H
	HD64F2345	100-pin QFP/TQFP	HS2345ECH61H
	HD6472345	(FP/TFP-100B)	
	HD6432344		
	HD6432343		
	HD6432341		
	HD6412340		

H8S/2357 Series:

Table 1.6 H8S/2357 Series MCUs and User System Interface Cable

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6432357	128-pin QFP (FP-128)	HS2655ECH61H
	HD64F2357	120-pin TQFP	HS2655ECN61H
	HD6472357	(TFP-120)	
	HD6412352		

H8S/2355 Series:

Table 1.7 H8S/2355 Series MCUs and User System Interface Cable

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6432355	128-pin QFP (FP-128)	HS2655ECH61H
	HD6472355	120-pin TQFP	HS2655ECN61H
	HD6432353	(TFP-120)	

1.3 Operating Voltage and Frequency Specifications

Table 1.8 shows examples of the MCU operating voltage and frequency specifications supported by the E6000. If the E6000 is used in an environment that exceeds the operating voltage range and operating frequency range guaranteed for the MCU operation, normal emulator operation is not guaranteed.

Table 1.8 Operating Voltage and Frequency Specifications

No.	MCU Types		Operating Voltage (V)	Operating Frequency (ϕ) (MHz)
1	H8S/2655 series		2.7-5.5	2-10
			4.5-5.5	2-20
2	H8S/2245 series		2.7-5.5	2-10
			4.5-5.5	2-20
3	H8S/2350 series		2.7-5.5	2-10
			4.5-5.5	2-20
4	H8S/2345 series		4.5-5.5	2-20
5	H8S/2357 series	3V	2.7-5.5	2-10
		3.3V	3.0-5.5	2-13
		5V	4.5-5.5	2-20
6	H8S/2355 series		2.7-5.5	2-10
			4.5-5.5	2-20

NOTE

For details on the operating voltage and frequency specifications, refer to the MCU hardware manual.

In the E6000, the clock can be selected by using the Configuration window or the Clock command.

Table 1.9 Clock Selections

Clock Command Parameter	Configuration Window Setting	Notes
8	8 MHz internal clock	
10	10 MHz internal clock	Default
12	12.5 MHz internal clock	
16	16 MHz internal clock	
20	20 MHz internal clock	
t	Target	
t2	Target/2	Not supported by the actual MCU. Use this clock only when the required clock duty cannot be obtained.

NOTE

The system clock (ϕ) frequency is the same clock frequency input to the XTAL and EXTAL when external clock t is specified. For example, when a 20-MHz crystal oscillator is connected to the XTAL and EXTAL of the user system, the system clock (ϕ) frequency is 20 MHz. When external clock t2 is specified, the system clock (ϕ) frequency is 1/2 of the clock frequency input to the XTAL and EXTAL.

The frequency of the E6000 internal clock specified with the HDI CLOCK command is applied to the system clock (ϕ).

Section 2 User System Interface

All user system interface signals are directly connected to the MCU in the E6000 with no buffering except for those listed below which are connected to the MCU through control circuits:

- NMI
- RESET
- MD2, MD1, MD0
- XTAL
- EXTAL
- WAIT

2.1 Signal Protection

All user system interface signals are protected from over- or under-voltage by use of diode arrays except for the AVcc and Vref.

Pull-up resistors are connected to the port signals except for the analog port signals.

The Vcc pins (except for the AVcc pin) at the head of the user system interface cable are connected together. The E6000 monitors the voltage level of the Vcc pins and displays the power-supply status in the Status Window.

2.2 User System Interface Circuits

The interface circuit between the MCU in the E6000 emulator and the user system has a signal delay of about 8 ns due to the user system interface cable and it includes pull-up resistors. Therefore, high-impedance signals will be pulled up to the high level. When connecting the E6000 emulator to a user system, adjust the user system hardware to compensate for propagation delays.

The following diagrams show the interface signal circuits.

Default:

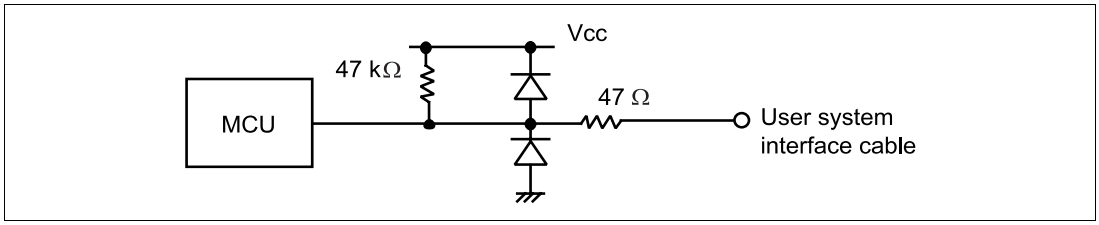

Figure 2.1 Default User System Interface Circuit

Mode Pins (MD2, MD1 and MD0) and NMI: The Mode Pins and the NMI signal are input to the MCU through the emulator control circuit. The rising/falling time of the signal must be 8 ns/V or less. The mode pins are only monitored. The CPU mode depends on the HDI Configuration settings.

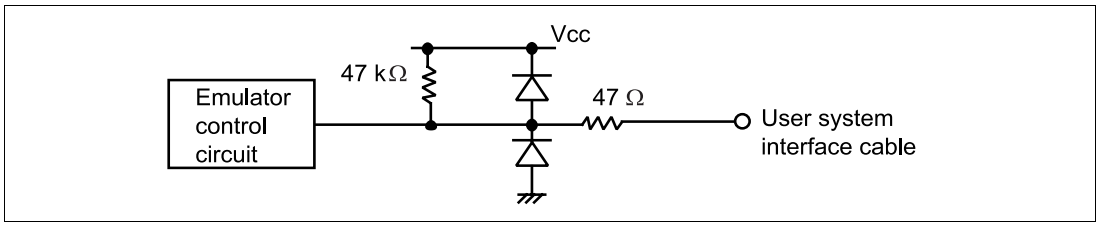

Figure 2.2 User System Interface Circuit for MD2, MD1, MD0 and NMI

RESET:

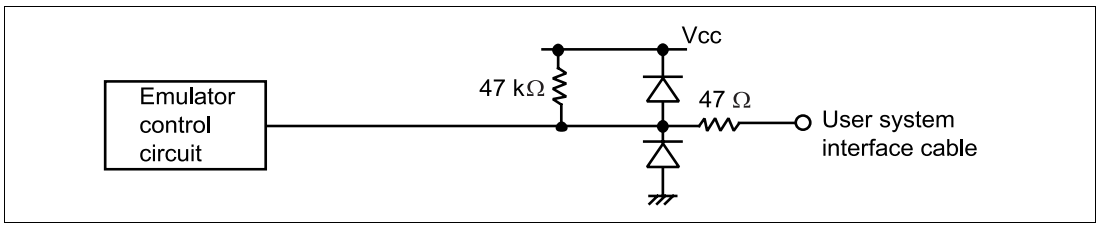

Figure 2.3 User System Interface Circuit for RESET

P40 to P47 (pins used for AN0 to AN7 and DA0 to DA1), AVcc, AVss and Vref:

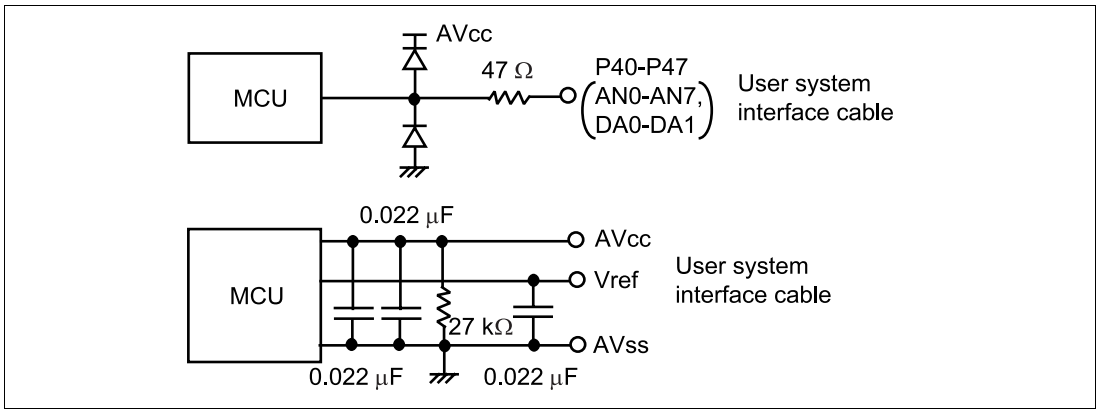

Figure 2.4 User System Interface Circuit for P40 to P47, AVcc, AVss and Vref Signals

IRQ0–IRQ7 and WAIT: The IRQ0 to IRQ7 and WAIT signals are input to the MCU and also to the trace acquiring circuit. Therefore, the rising and falling time of these signals must be within 8 ns/v or shorter.

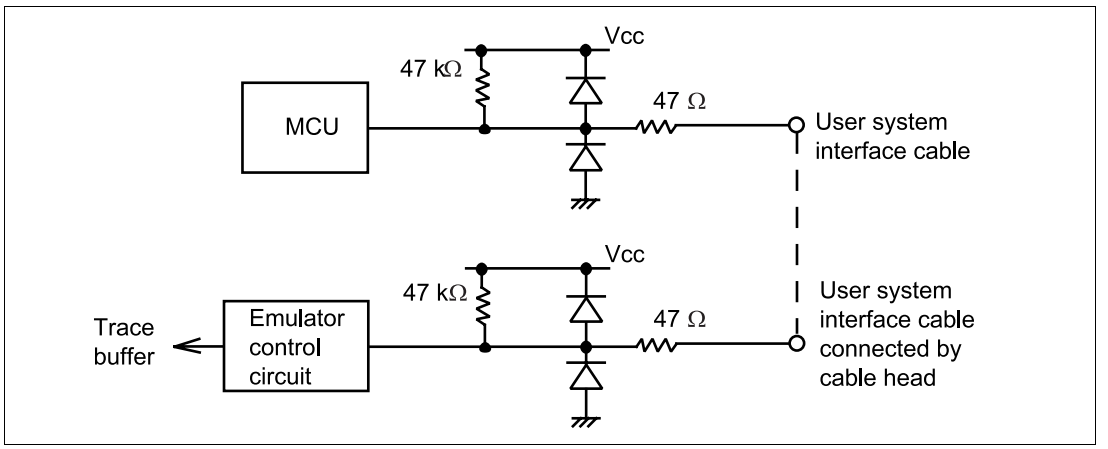

Figure 2.5 IRQ0–IRQ7 and WAIT User System Interface Circuit

Section 3 Notes on Use

3.1 I/O Register Differences between Actual MCU and E6000

In the E6000, one evaluation chip emulates several types of MCU. Therefore, there are some differences in I/O registers between an actual MCU and the E6000. Note these differences when accessing the I/O registers.

I/O port is in the input state at default. The I/O register contents indicate the emulator port status. When the user system interface cable is not connected, the read value is 1 due to the emulator's pull-up resistors.

In E6000, accesses to the following registers for controlling the flash memory are invalid.

- RAM emulation register (RAMER: H'FEDB)
- System control register 2 (SYSCR2: H'FF42)
- Flash memory control register 1 (FLMCR1: H'FFC8)
- Flash memory control register 2 (FLMCR2: H'FFC9)
- Erase block register 1 (EBR1: H'FFCA)
- Erase block register 2 (EBR2: H'FFCB)

3.2 Access to the Reserved Area

When accessing the reserved area, note the following:

1. Part of the reserved area (specified in each MCU’s memory map) can be used as an external address area when the EAE bit of the BCRL is set to "1". User (user memory) or Emulator (optional memory) can be specified for this area with the Memory Mapping settings.
2. If the reserved area other than that described in item 1 above is used, the operation in the actual MCU cannot be guaranteed. If the user program extends to the reserved area during debugging, select the MCU having the largest ROM capacity (for example, debug the program for H8S/2653 with the H8S/2655 memory mapping).

3.3 Use of an Internal RAM Area as External Memory

An internal RAM area can be used as an external address when the RAME bit of the SYSCR is cleared to "0". An emulator (optional memory) cannot be specified for the internal RAM area. Only user memory can be accessed as an external address. Option memory cannot be accessed as an external address. In this case, Memory Mapping setting is the same as the Internal RAM setting.

3.4 Support of Flash Memory

The E6000 does not emulate the flash memory control operation in the MCU.

3.5 Hardware Standby

When the User Standby enable check box is selected in the Configuration window, the STBY signal of the user system is directly input to the E6000.

When the STBY signal is enabled, the E6000 hardware is initialized and the E6000 stops the emulation. In such a case, terminate the HDI and restart the E6000. Therefore, the User Standby enable check box should be cleared (not selected) for general emulation.

Section 4 HDI Parameters

4.1 Address Areas

Table 4.1 lists the parameters for address areas (Area) that can be specified with HDI command line interface or displayed as trace results.

Table 4.1 Address Area Parameters

HDI Parameter (Trace Display)	Address Area	Description
rom	On-chip ROM	MCU's on-chip ROM, which can be read but cannot be written to.
ram	On-chip RAM	MCU's on-chip RAM (except for DTC RAM), which can be read and written to.
IO16 (I/O-16)	Internal I/O registers (16-bit bus)	MCU's internal I/O registers for the 16-bit bus.
IO8 (I/O-8)	Internal I/O registers (8-bit bus)	MCU's internal I/O registers for the 8-bit bus.
ext16 (EXT-16)	External area (16-bit bus)	External area for the 16-bit bus, which can be allocated to the user system memory or the optional SIMM memory module in the E6000.
ext8 (EXT-8)	External area (8-bit bus)	External area for the 8-bit bus, which can be allocated to the user system memory or the optional SIMM memory module in the E6000.
Dtcram (RAM/DTC)	DTC RAM	MCU's on-chip RAM for DTC.

4.2 Access Status

Table 4.2 lists the parameters for access status (Status) that can be specified with HDI command line interface or displayed as trace results.

Table 4.2 Access Status Parameters

HDI Parameter (Trace Display)	Access Status	Description
dmac	On-chip DMAC	Access by the MCU's DMAC
dtc	On-chip DTC	Access by the MCU's DTC
refresh	Refresh	Refresh cycle by the MCU's refresh controller
prefetch (PROG)	CPU prefetch	Instruction prefetch cycle by the CPU
data (DATA)	CPU data access	Data access for instruction execution by the CPU

Section 5 Diagnostic Test Procedure

This section describes the diagnostic test procedure using the E6000 test program.

5.1 System Set-Up for Test Program Execution

To execute the test program, use the following hardware; do not connect the user system interface cable and user system.

- E6000 (HS2655EPI61H)
- Host computer
- The E6000 PC interface board which will be one of the following boards or card:
  Select one interface board from the following depending on the PC interface specifications.
  ISA bus interface board (HS6000EII01H)
  PCI bus interface board (HS6000EIC01H or HS6000EIC02H)
  PCMCIA interface card (HS6000EIP01H)

1. Install the E6000 PC interface board in the host computer and connect the supplied PC interface cable to the board.
2. Connect the PC interface cable to the E6000.
3. Connect the supplied AC adapter to the E6000.
4. Initiate the host computer to make it enter DOS prompt command input wait state.
5. Turn on the E6000 switch.

5.2 Diagnostic Test Procedure Using the Test Program

Insert the CD-R (HS2655EPI61SR supplied with the E6000) into the CD-ROM drive of the host computer by pressing the Shift key, move the current directory to <Drive>:\Diag with a command prompt, and enter one of the following commands according to the PC interface board used to initiate the test program:

1. ISA bus interface boad (HS6000EII01H)
   > TM2655 –ISA (RET)

2. PCI bus interface boad (HS6000EIC01H or HS6000EIC02H)
   > TM2655 –PCI (RET)

3. PCMCIA interface card (HS6000EIP01H)
   > TM2655 –PCCD (RET)

The HDI must be installed before the test program is executed.

Be sure to initiate the test program from <Drive>:\Diag. Do not initiate it from a directory other than <Drive>:\Diag, such as > <Drive>:\Diag\TM2655 –ISA (RET). If the test program is initiated when the current directory is not <Drive>:\Diag, the test program will not operate correctly.

When –S is added to the command line such as >TM2655 –ISA –S (RET), steps 1 to 18 will be repeatedly executed. To stop the execution, enter Q.

Notes: 1. When the CD-R is inserted into the CD-ROM drive without pressing the Shift key, the HDI installation wizard is automatically started.
In such a case, exit the HDI installation wizard.

2. <Drive> is a drive name for the CD-ROM drive.

3. Do not remove the CD-R from the CD-ROM drive during test program execution.

It will take about 11 minutes to execute the test program when the host computer using Windows®95 runs at 166 MHz and the PCMCIA interface card is used. The following messages are displayed during the test.

Message	Description
`E6000 H8S/2655 EMULATION BOARD Tests Vx.x` `Hitachi Ltd (1999)`	Test program start message. Vx.x shows the version number.
`SIMM module fitted? (1.None 2.1MB 3. 4MB) 1`	Enter 1 because the SIMM memory module is not installed in this example.
`Searching for interface card ........OK, card at H'd0000`	Shows that the PC interface board is correctly installed in the host computer, and displays the address when the ISA bus interface is installed. The displayed address depends on the settings. When the PCI interface board or PCMCIA interface card is installed, the address is not displayed.
`Checking emulator is connected ......OK`	Shows that the E6000 is correctly connected to the host computer.

```
 Emulator Board Information:
    Main Board ID      H'5

    Emulation Board ID H'e

Revision        H'x

SIMM            No SIMM module inserted

Downloading firmware .....

01) Testing Main Board Register :
  IDR0 Register.....................OK
  PAGE Register.....................OK
  TRACE G/A Register................OK
  PERFM G/A Register................OK
  CES GA register ..................OK
  IDR1 Register.....................OK

02) Testing Dual-Port RAM :
  Decode Test ......................OK
  Marching Test ....................OK
```

Shows the ID number of the lower board of the E6000 (always 5).

Shows the ID number of the upper board of the E6000 (always e).

Shows the revision number of the upper board of the E6000.

Shows whether the SIMM memory board is installed.

Loading the test program.

Shows the check results for the registers in the E6000 (normal completion).

Shows the results of decoding test and step test for the dual-port RAM in the E6000 (normal completion).

```
  03) Testing Firmware RAM :
```

```
    Decode Test. page range H'700 - H'71f .....OK
```

Shows the results of decoding test for the firmware RAM in the E6000 (normal completion).

```
   Marching Test. page range H'700 - H'71f .....OK
```

Shows the results of step for the firmware RAM in the E6000 (normal completion).

```
Downloading firmware .....
```

Loading the test program.

```
  04) Testing Trace RAM :
```

```
    Decode Test. page range H'000 - H'04f .....OK
```

Shows the results of decoding test for the trace RAM (first half) in the E6000 (normal completion).

```
   Marching Test. page range H'000 - H'04f .....OK
```

Shows the results of step test for the trace RAM (first half) in the E6000 (normal completion).

```
   Decode Test. page range H'000 - H'04f .....OK
```

Shows the results of decoding test for the trace RAM (last half) in the E6000 (normal completion).

```
   Marching Test. page range H'000 - H'04f .....OK
```

Shows the results of step test for the trace RAM (last half) in the E6000 (normal completion).

```
05) Testing Mapping RAM :
  Decode Test.   page range H'200 - H'27f ........OK
 Marching Test. page range H'200 - H'27f .........OK
```

Shows the results of decoding test for the mapping RAM in the E6000 (normal completion).

Shows the results of step test for the mapping RAM in the E6000 (normal completion).

```
06) Testing Internal ROM and RAM :
    Setting up, please wait..
    Decode Test .........................OK
    Marching Test .......................OK
```

Shows the results of decoding test and step test for internal ROM and RAM in the E6000 (normal completion).

```
07) Testing Option RAM :
    Setting up, please wait..
    No SIMM fitted - test skipped
```

Shows the check results for the optional SIMM memory module in the E6000 (not installed).

```
08) Testing STEP Operation :
    Setting up, please wait..
    Step Operation ......................OK
```

Shows the check results for the step execution controlling circuits in the E6000 (normal completion).

```
09) Testing Key Break :
    Setting up, please wait..
    Key Break ...........................OK
```

Shows the check results for the forced break controlling circuits in the E6000 (normal completion).

```
10) Testing Emulation RAM Hardware Break :
    Setting up, please wait..
    GRD Break ...........................OK
    Setting up, please wait..
    WPT Break ...........................OK
```

Shows the check results for the illegal access break controlling circuits in the E6000 (normal completion).

```
11) Testing Internal ROM Write-Protect :
    Setting up, please wait..
    Write-Protect .....................OK
```

Shows the check results for the internal ROM write-protection controlling circuits in the E6000 (normal completion).

```
12) Testing Hardware Break :
    Setting up, please wait..
    A)Break Point Intialised .............OK
    B)Event Detectors CES channel 1-12 ...OK
    C)Test Sequencing 1 ..................OK
    D)Check Range Break ..................OK
    E)Check Range Break for Data .........OK
    F)Check Compare Either ...............OK
```

Shows the check results for the hardware break control circuits in the E6000 (normal completion).

```
13) Testing Emulation RAM Trace :
    Setting up, please wait..
    A)Free Trace Test ....................OK
    B)Range Trace Test ...................OK
    C)Point to Point Trace Test ..........OK
    D)Start and Stop Event Trace Test ....OK
    F)Time STAMP Trace Test ..............OK
      Time STAMP Trace Test 1 ............OK
      Time STAMP Trace Test 2 ............OK
      Time STAMP Trace Test 3 ............OK
```

Shows the check results for the trace controlling circuits in the E6000 (normal completion).

```
14) Testing Runtime counter :
    Setting up, please wait..
    Testing Internal Clock = 16.0 MHz ....OK
    Testing Internal Clock = 12.5 MHz ....OK
```

Shows the check results for the run-time counter in the E6000 (normal completion).

```
15) Testing Emulation Monitor :
    Setting up, please wait..
    A)EMA23-EMA0(MONIT00:D7-D0,MONIT10,E:D7-D0)TEST..OK
    B)ACST2-ACST0(MONIT0E:D2-D0)TEST..................OK
    C)ST3-ST0(MONIT2E:D3-D0)TEST......................OK
    D)BRKACK(MONIT0E:D7)TEST..........................OK
    E)CNN(MONIT3E:D1)TEST.............................OK
    F)NOCLK(MONIT3E:D2)TEST...........................OK
```

Shows the check results for the emulation monitor controlling circuits in the E6000 (normal completion).

```
16) Testing PERM_GA :
    Setting up, please wait..
    A)Time Measure Test .........................OK
    B)PERM_POINT TO POINT Time Measure Test .....OK
    C)PERM_SUBROUTINE Time Measure Test .........OK
    D)PERM Time Out Bit Test
      Time Out Test 1............................OK
      Time Out Test 2............................OK
```

Shows the check results for the performance analysis controlling circuits in the E6000 (nomal completion).

```
17) Testing Bus Monitor :
    Setting up, please wait..
    A) Register test.............................OK
    B) Parallel RAM test.........................OK
    C) SPRSEL2 test..............................OK
    Setting up, please wait..
    D) RAM monitor test..........................OK
```

Shows the check results for the bus monitor controlling circuits in the E6000 (normal completion).

```
18) Testing Paralell Access :
    A)IN ROM Paralell Read Access(WORD) .........OK
    B)IN ROM Paralell Write Access(WORD) ........OK
    C)IN ROM Paralell Write Access(High Byte) ...OK
    D)IN ROM Paralell Write Access(Low Byte) ....OK
    E)IN RAM Paralell Read Access(WORD) .........OK
    F)IN RAM Paralell Write Access(WORD) ........OK
    G)IN RAM Paralell Write Access(High Byte) ...OK
    H)IN RAM Paralell Write Access(Low Byte) ....OK
     I)SIMM Paralell Read Access(WORD) ..........SKIP
     J)SIMM Paralell Write Access(WORD) .........SKIP
     K)SIMM Paralell Write Access(High Byte) ....SKIP
     L)SIMM Paralell Write Access(Low Byte) .....SKIP
```

Shows the check results for the parallel access controlling circuits in the E6000 (normal completion).

```
0 total errors
```

Total number of errors.

```
Tests passed, emulator functioning correctly
```

Shows that the E6000 is correctly operating.