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H8S/2148, H8S/2138, H8S/2128 Series, H8S/2149, H8S/2169, H8/3577, H8/3567 Series E6000 Emulator HS2148EPI61H

Supplementary Information

Renesas Microcomputer Development Environment System

RENESAS

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- Emulator station
- User system interface cables
- PC interface board
- Optional SIMM memory module
- E6000 expansion I/O board

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

Purpose of the Emulator Product:

This emulator product is a software and hardware development tool for systems employing the Hitachi microcomputer H8S/2148, H8S/2138, H8S/2128 series, H8S/2149, H8S/2169, H8/3577, H8/3567 series (hereafter referred to as the MCU).   The emulator product can be used for systems using other microcomputers by exchanging the evaluation chip.   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.**

• <u>**KEEP the user's manual handy for future reference.**</u>

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.

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⚠ 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.

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Preface

Thank you for purchasing the H8S/2148, H8S/2138, H8S/2128 series, H8S/2149, H8S/2169, H8/3577, H8/3567 series E6000 emulator.

The H8S/2148, H8S/2138, H8S/2128 series, H8S/2149, H8S/2169, H8/3577, H8/3567 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 HD6432148, HD6432138, HD6432128 series, HD64F2149, HD64F2169, HD6433577, HD6433567 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, the 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. The Supplementary Information describes the functions specialized for each microcomputer supported by the H8S/2148, H8S/2138, H8S/2128 series, H8S/2149, H8S/2169 and H8/3577, H8/3567 series E6000 emulator.   Please read this manual before using the E6000.

To connect the E6000 to the user system, the 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 (HS2148ECH61HE, 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)
  LAN Adapter (HS6000ELN01H)
- Optional 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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Section 1   Overview

The H8S/2148, H8S/2138, H8S/2128 series H8S/2149, H8S/2169 and H8/3577, H8/3567 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/2148, H8S/2138, H8S/2128 series and H8/3577, H8/3567 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

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1.2　Supported MCUs and User System Interface Cables

Tables 1.2 to 1.8 show the correspondence between the MCUs and the user system interface cables supported by the E6000.

H8S/2148 Series:

Table 1.2　H8S/2148 Series MCUs and User System Interface Cable

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6432148	100-pin QFP (FP-100B),	HS2148ECH61H
	HD64F2148	100-pin TQFP (TFP-100B)	
	HD6432147		
	HD6432144		
	HD64F2144		
	HD6432143		
	HD6432142		
	HD64F2142R		

H8S/2138 Series:

Table 1.3　H8S/2138 Series MCUs and User System Interface Cables

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6432138	80-pin QFP (FP-80A)	HS2138ECH61H
	HD64F2138		
	HD6432137		
2	HD6432134	80-pin TQFP (TFP-80C)	HS2138ECN61H
	HD64F2134		
	HD6432133		
	HD6432132		
	HD64F2132R		
	HD6432130		

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H8S/2128 Series:

Table 1.4   H8S/2128 Series MCUs and User System Interface Cables

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6432128 HD64F2128 HD6432127R	64-pin SDIP (DP-64S)	HS2128ECS61H
2	HD6432126R HD6432124 HD6432123	64-pin QFP (FP-64A)	HS2128ECH61H
3	HD6432122 HD6432120	80-pin TQFP (TFP-80C)	HS2128ECN61H

H8S/2149:

Table 1.5   H8S/2149 MCUs and User System Interface Cables

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD64F2149	100-pin QFP (FP-100B), 100-pin TQFP (TFP-100B)	HS2148ECH61H

Note: When emulating the H8S/2149, the H8S/2149 E6000 expansion I/O board (HS2149EIO61H) and the E6000 are required.

H8S/2169:

Table 1.6   H8S/2169 MCUs and User System Interface Cables

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD64F2169	144-pin TQFP (TFP-144)	HS2169ECN61H

Note: When emulating the H8S/2169, the H8S/2169 E6000 expansion I/O board (HS2169EIO61H) and the E6000 are required.

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H8/3577 Series:

Table 1.7   H8/3577 Series MCUs and User System Interface Cables

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6433577 HD6473577	64-pin SDIP (DP-64S)	HS2128ECS61H
2	HD6433574	64-pin QFP (FP-64A)	HS2128ECH61H

H8/3567 Series:

Table 1.8   H8/3567 Series MCUs and User System Interface Cables

No.	MCU Type Number	Package	E6000 User System Interface Cables
1	HD6433567 HD6473567 HD6433564	42-pin SDIP (DP-42S)	HS3567ECS61H
2	HD6433567U HD6473567U HD6433564U	64-pin SDIP (DP-64S)	HS3567UECS61H (Cable with USB function)
3		64-pin QFP (FP-64A)	HS3567UECH61H (Cable with USB function)

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1.3　Operating Voltage and Frequency Specifications

Table 1.9 shows the MCU operating voltage and frequency specifications supported by the E6000. Note that some MCUs do not operate at neither a low voltage nor a high frequency.

Table 1.9　Operating Voltage and Frequency Specifications

No.	MCU Types	Operating Voltage (V)	Operating Frequency Range (ϕ) (MHz)
1	H8S/2148 series H8S/2138 series H8S/2128 series	2.7-4.0	2-10
		4.0-4.5	2-16
		4.5-5.5	2-20
2	H8S/2149 H8S/2169	2.7-3.6	2-10
3	H8/3577 series H8/3567 series (except for the MCUs listed below)	4.5-5.5	2-20
4	HD6433564-10	4.5-5.5	2-10

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 dialog box or the Clock command.

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Table 1.10   Clock Selections

Clock Command Parameter	Configuration Dialog Box 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).

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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
- 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 signals (except for AVcc signals) at the head of the user system interface cable are connected together, which is monitored by the E6000 to detect whether the user system hardware is connected.

2.2   User System Interface Circuits

The interface circuit between the MCU in the E6000 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 to a user system, adjust the user system hardware to compensate for propagation delays.

The following diagrams show the equivalent circuit examples of the interface signals.

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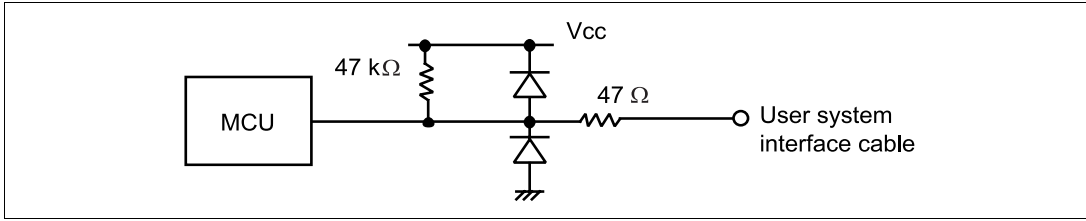
Default:

Figure 2.1   Default User System Interface Circuit

Mode Pins (MD1 and MD0) and NMI: The NMI signal is input to the MCU through the emulator control circuit. The rising/falling time of these signals must be 8 ns/V or less. The mode pins are only monitored. The CPU mode depends on the HDI settings.
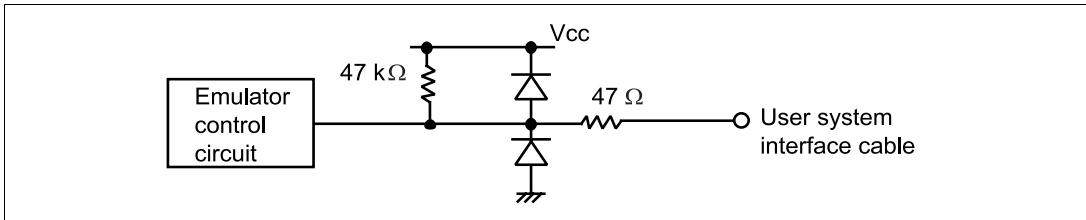
Figure 2.2   User System Interface Circuit for MD1, MD0, and NMI

RESET:
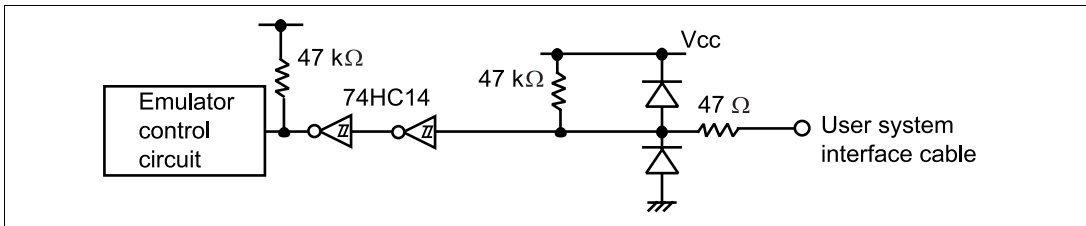
Figure 2.3   User System Interface Circuit for RESET

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AN0 to AN7, DA0, DA1, AVcc, AVss, and Vref:
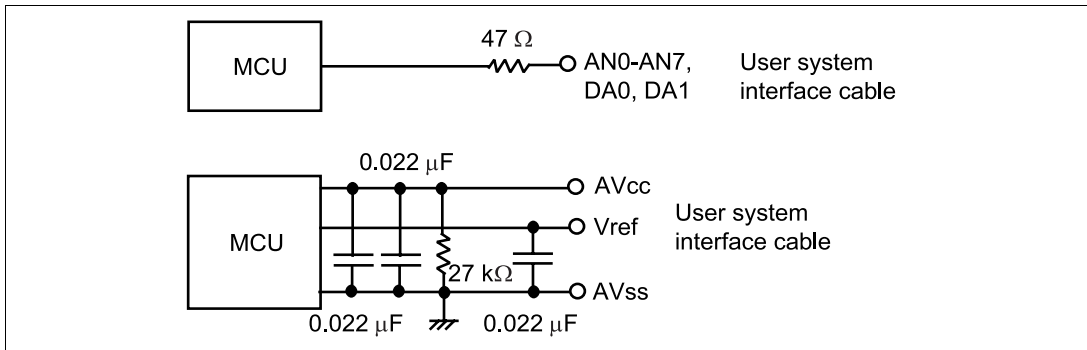
Figure 2.4   User System Interface Circuit for AN0 to AN7, DA0, DA1, AVcc, AVss, and Vref Signals

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.
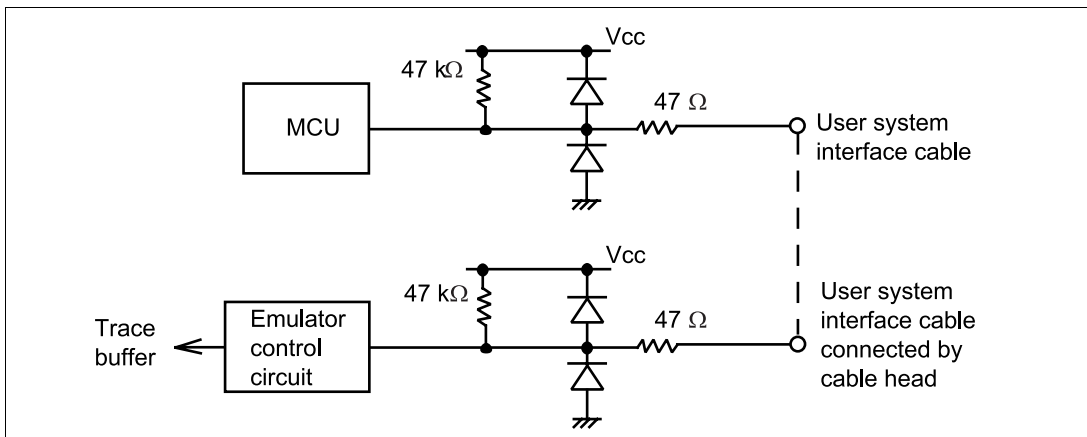
Figure 2.5   IRQ0–IRQ7 and WAIT User System Interface Circuit

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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 pull-up resistors.

In the E6000, accesses to the following registers for controlling the flash memory in the H8S/2148, H8S/2138, H8S/2128 series, H8S/2149, H8S/2169 are invalid.

- Flash memory control register 1 (FLMCR1: FF80)
- Flash memory control register 2 (FLMCR2: FF81)
- Erase block register 1 (EBR1: FF82)
- Erase block register 2 (EBR2: FF83)
- Serial timer control register (STCR: H'FFC3)
  (Accesses to the FLSHE bit are invalid)

3.2   Access to the Reserved Area and Internal RAM

When accessing the reserved area and internal RAM, 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 RAME bit of the SYSCR is cleared to 0.   Target (user memory) or Emulator (optional memory) can be specified for this area with the Configuration 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 H8S/2144 program in the H8S/2148 mode).
3. Internal RAM (specified in each MCU's memory map) can be used as an external address area when the RAME bit of the SYSCR is cleared to 0.   Target (user memory) can be specified for this area with the Configuration settings.

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3.3   Support of Flash Memory

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

3.4   Hardware Standby

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

When the STBY signal is input, the E6000 hardware is initialized and the E6000 stops emulation.
In such a case, terminate the HDI and restart the E6000.   Therefore, we recommend to clear the
User Standby enable check box (not selected) for general emulation.

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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 (Breakpoint command etc.) or displayed as trace results.

Table 4.1   Address Area Parameters

HDI Parameter (Trace Display)	Address Area	Description
rom (ROM)	On-chip ROM	MCU's on-chip ROM, which can be read but cannot be written to.
ram (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.

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4.2 Access Status

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

Table 4.2   Access Status Parameters

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

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4.3　　　I/O Module Selection

Table 4.3 lists the I/O modules that can be selected as Custom settings in the HDI command line interface (Modules command).

Table 4.3　　I/O Modules

HDI Parameter	I/O Module
DTC	Data transfer controller (DTC)
TIMER	Timer connection
D/A	D/A converter
HIF	HIF (host interface), KMIMR (keyboard matrix interrupt mask), KMIMRA (keyboard matrix interrupt mask A), and KMPCR (port 6 pull-up MOS control)
TMRY	Timer Y
TMRX	Timer X
A/D	A/D converter
IIC1	I^2C bus interface 1 (IIC1)
IIC0	I^2C bus interface 0 (IIC0)
PWM8	8-bit PWM timer (PWM)
PWM14	14-bit PWM timer (PWM X)
SCI2/IrDA	Serial communication interface 2 (SCI2/IrDA standard)
SCI1	Serial communication interface 1 (SCI1)
PS/2	Keyboard buffer controller (PS/2)

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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 (HS2148EPI61H)
- 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, 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.

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5.2 Diagnostic Test Procedure Using the Test Program

Insert the CD-R (HS2148EPI61SR supplied with the E6000) into 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)
   >TM2148 –ISA (RET)

2. PCI bus interface boad (HS6000EIC01H, HS6000EIC02H)
   >TM2148 –PCI (RET)

3. PCMCIA interface card (HS6000EIP01H)
   >TM2148 –PCCD (RET)

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¥TM2148 –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 >TM2148 –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.
   2.   <Drive> is a drive name for the CD-ROM drive.
   3.   Do not remove the CD-R from the CD-ROM drive during text program execution.

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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/2148 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`	Shows the ID number of the lower board of the E6000 (always 5).
`Emulation Board ID  H'e`	Shows the ID number of the upper board of the E6000 (always e).
`Revision           H'x`	Shows the revision number of the upper board of the E6000.

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   SIMM            No SIMM module inserted              Shows whether the SIMM
                                                        memory board is
                                                        installed.


 Downloading firmware .....                             Loading the test program.

 01) Testing Main Board Register :
    IDR0 Register.....................OK                Shows the check results
    PAGE Register.....................OK                for the registers in the
    TRACE G/A Register................OK                E6000 (normal
    PERFM G/A Register................OK                completion).
    CES GA register ..................OK
    IDR1 Register.....................OK

 02) Testing Dual-Port RAM :
    Decode Test ......................OK                Shows the results of
    Marching Test ....................OK                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).
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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
```
Shows the results of decoding test for the mapping RAM in the E6000 (normal completion).

```
Marching Test. page range H'200 - H'27f .........OK
```
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).

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10) Testing Emulation RAM Hardware Break :        Shows the check results
    Setting up, please wait..                     for the illegal access break
    GRD Break ..........................OK         controlling circuits in the E6000
    Setting up, please wait..                     (normal completion).
    WPT Break ..........................OK

11) Testing Internal ROM Write-Protect :          Shows the check results
    Setting up, please wait..                     for the internal ROM write-
    Write-Protect ......................OK         protection controlling
                                                   circuits in the E6000
                                                   (normal completion).


12) Testing Hardware Break :                      Shows the check results for
    Setting up, please wait..                     the hardware break control
    A)Break Point Intialised .............OK       circuits in the E6000
    B)Event Detectors CES channel 1-12 ...OK       (normal completion).
    C)Test Sequencing 1 ..................OK
    D)Check Range Break ..................OK
    E)Check Range Break for Data .........OK
    F)Check Compare Either ...............OK

13) Testing Emulation RAM Trace :                 Shows the check results for
    Setting up, please wait..                     the trace controlling circuits
    A)Free Trace Test ....................OK       in the E6000 (normal
    B)Range Trace Test ...................OK       completion).
    C)Point to Point Trace Test ..........OK
    D)Start and Stop Event Trace Test ....OK
    E)Trace memory Overflow 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

14) Testing Runtime counter :                     Shows the check results for
    Setting up, please wait..                     the run-time counter in the
    Testing Internal Clock = 16.0 MHz ....OK       E6000 (normal completion).
    Testing Internal Clock = 12.5 MHz ....OK

15) Testing Emulation Monitor :                   Shows the check results for
    Setting up, please wait..                     the emulation monitor
    A)EMA23-EMA0(MONIT00:D7-D0,MONIT10,E:D7-D0)TEST..OK   controlling circuits in the
    B)ACST2-ACST0(MONIT0E:D2-D0)TEST............OK        E6000 (normal completion).
    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
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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 Parallel Access :
    A)IN ROM Parallel Read Access(WORD) .........OK
    B)IN ROM Parallel Write Access(WORD) ........OK
    C)IN ROM Parallel Write Access(High Byte) ...OK
    D)IN ROM Parallel Write Access(Low Byte) ....OK
    E)IN RAM Parallel Read Access(WORD) .........OK
    F)IN RAM Parallel Write Access(WORD) ........OK
    G)IN RAM Parallel Write Access(High Byte) ...OK
    H)IN RAM Parallel Write Access(Low Byte) ....OK
    I)SIMM Parallel Read Access(WORD) ...........SKIP
    J)SIMM Parallel Write Access(WORD) ..........SKIP
    K)SIMM Parallel Write Access(High Byte) .....SKIP
    L)SIMM Parallel 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.

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