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# SuperH™ Family E10A-USB Emulator

Additional Document for User's Manual

SH E10A-USB for SH7727

HS7727KCU01HE

Renesas Microcomputer

Development Environment

System

SuperH™ Family / SH7700 Series

Supplementary Information on

Using the SH7727



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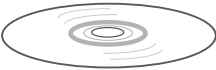


# Section 1 Connecting the Emulator with the User System

## 1.1 Components of the Emulator

The E10A-USB emulator supports the SH7727. Table 1.1 lists the components of the emulator.

**Table 1.1 Components of the Emulator**

Classification	Component	Appearance	Quantity	Remarks
Hardware	Emulator box		1	HS0005KCU01H: Depth: 65.0 mm, Width: 97.0 mm, Height: 20.0 mm, Mass: 72.9 g or HS0005KCU02H: Depth: 65.0 mm, Width: 97.0 mm, Height: 20.0 mm, Mass: 73.7 g
	User system interface cable		1	14-pin type: Length: 20 cm, Mass: 33.1 g
	User system interface cable		1	36-pin type: Length: 20 cm, Mass: 49.2 g (only for HS0005KCU02H)
	USB cable		1	Length: 150 cm, Mass: 50.6 g
Software	SH7727 E10A-USB emulator setup program, SuperH™ Family E10A-USB Emulator User's Manual, Supplementary Information on Using the SH7727*, and Test program manual for HS0005KCU01H and HS0005KCU02H		1	HS0005KCU01SR,  HS0005KCU01HJ, HS0005KCU01HE,  HS7727KCU01HJ, HS7727KCU01HE,  HS0005TM01HJ, and HS0005TM01HE (provided on a CD-R)

Note: Additional document for the MPUs supported by the emulator is included. Check the target MPU and refer to its additional document.

## 1.2 Connecting the E10A-USB Emulator with the User System

To connect the E10A-USB emulator (hereinafter referred to as the emulator), the H-UDI port connector must be installed on the user system to connect the user system interface cable. When designing the user system, refer to the recommended circuit between the H-UDI port connector and the MCU. In addition, read the E10A-USB emulator user's manual and hardware manual for the related device.

Table 1.2 shows the type number of the E10A-USB emulator, the corresponding connector type, and the use of AUD function.

**Table 1.2 Type Number, AUD Function, and Connector Type**

Type Number	Connector	AUD Function
HS0005KCU02H	36-pin connector	Available
HS0005KCU01H, HS0005KCU02H	14-pin connector	Not available

The H-UDI port connector has the 36-pin and 14-pin types as described below. Use them according to the purpose of the usage.

1. 36-pin type (with AUD function)

The AUD trace function is supported. A large amount of trace information can be acquired in realtime. The window trace function is also supported for acquiring memory access in the specified range (memory access address or memory access data) by tracing.

2. 14-pin type (without AUD function)

The AUD trace function cannot be used because only the H-UDI function is supported. For tracing, only the internal trace function is supported. Since the 14-pin type connector is smaller than the 36-pin type (1/2.5), the area where the connector is installed on the user system can be reduced.

## 1.3 Installing the H-UDI Port Connector on the User System

Table 1.3 shows the recommended H-UDI port connectors for the emulator.

**Table 1.3 Recommended H-UDI Port Connectors**

Connector	Type Number	Manufacturer	Specifications
36-pin connector	DX10M-36S	Hirose Electric Co., Ltd.	Screw type
	DX10M-36SE, DX10G1M-36SE		Lock-pin type
14-pin connector	2514-6002	Minnesota Mining & Manufacturing Ltd.	14-pin straight type

Note: When designing the 36-pin connector layout on the user board, do not connect any components under the H-UDI connector. When designing the 14-pin connector layout on the user board, do not place any components within 3 mm of the H-UDI port connector.

## 1.4 Pin Assignments of the H-UDI Port Connector

Figures 1.1 and 1.2 show the pin assignments of the 36-pin and 14-pin H-UDI port connectors, respectively.

Note: Note that the pin number assignments of the H-UDI port connector shown on the following pages differ from those of the connector manufacturer.

Pin No.	Signal	Input/Output*1	SH7727 Pin No.		Note	Pin No.	Signal	Input/Output*1	SH7727 Pin No.		Note
			FP-240	BP-240					FP-240	BP-240	
1	NC	—				19	TMS	Input	162	U7	
2	GND	—				20	GND	—			
3	AUDATA0	I/O	158	U8		21 <sup>2</sup>	/TRST	Input	160	W8	
4	GND	—				22 <sup>5</sup>	(GND)	—			
5	AUDATA1	I/O	156	W9		23	TDI	Input	163	H17	
6	GND	—				24	GND	—			
7	AUDATA2	I/O	154	T9		25	TDO	Output	143	V7	
8	GND	—				26	GND	—			
9	AUDATA3	I/O	153	U9		27 <sup>2</sup>	/ASEBRKAK	Output	151	U10	
10	GND	—				28	GND	—			
11 <sup>2</sup>	/AUDSYNC	Output	104	N19		29 <sup>4</sup>	UVCC	Output			
12	GND	—				30	GND	—			
13	NC	—				31 <sup>2</sup>	/RESETP	Output	220	H1	User reset
14	GND	—				32	GND	—			
15	NC	—				33 <sup>3</sup>	GND	Output			
16	GND	—				34	GND	—			
17	TCK	Input	164	W7		35	AUDCK	Input	176	W3	
18	GND	—				36	GND	—			

- Notes: 1. Input to or output from the user system.  
2. The slash (/) means that the signal is active-low.  
3. The emulator monitors the GND signal of the user system and detects whether or not the user system is connected.  
4. If the VccQ pin is not connected to the UVCC, the I/O voltage of the user system interface will be fixed to 3.3 V.  
5. The /ASEMD0 pin must be 0 when the emulator is connected and 1 when the emulator is not connected, respectively.  
(1) When the emulator is used: /ASEMD0 = 0 (ASE mode)  
(2) When the emulator is not used: /ASEMD0 = 1 (normal mode)  
To allow the /ASEMD0 pin to be GND by connecting the user system interface cable, connect pin 22 directly to the /ASEMD0 pin. Do not ground the pin.

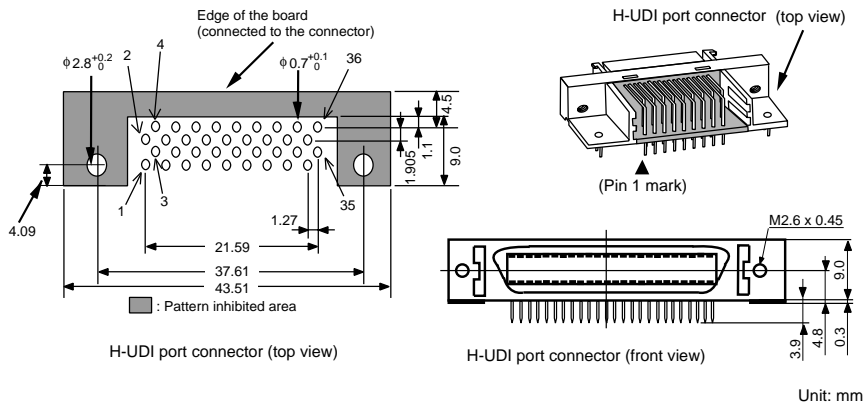


Figure 1.1 Pin Assignments of the H-UDI Port Connector (36 Pins)

Pin No.	Signal	Input/ Output*1	SH7727 Pin No.		Note
			FP-240	BP-240	
1	TCK	Input	164	W7	
2*2	/TRST	Input	160	W8	
3	TDO	Output	143	U12	
4*2	/ASEBRKAK	Output	151	U10	
5	TMS	Input	162	U7	
6	TDI	Input	163	V7	
7*2	/RESETP	Output	220	H1	User reset
8	N.C.	—	—	—	
9*5	(GND)				
11*4	UVCC	Output	—	—	
10, 12, and 13	GND	—	—	—	
14*3	GND	Output	—	—	

Notes: 1. Input to or output from the user system.

2. The slash (/) means that the signal is active-low.

3. The emulator monitors the GND signal of the user system and detects whether or not the user system is connected.

4. If the VccQ pin is not connected to the UVCC, the I/O voltage of the user system interface will be fixed to 3.3 V.

5. The /ASEMD0 pin must be 0 when the emulator is connected and 1 when the emulator is not connected, respectively.

(1) When the emulator is used: /ASEMD0 = 0 (ASE mode)

(2) When the emulator is not used: /ASEMD0 = 1 (normal mode)

To allow the /ASEMD0 pin to be GND by connecting the user system interface cable, connect pin 9 directly to the /ASEMD0 pin. Do not ground the pin.

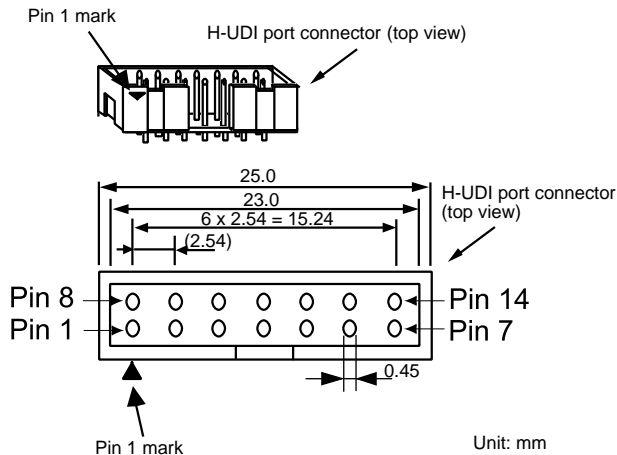


Figure 1.2 Pin Assignments of the H-UDI Port Connector (14 Pins)

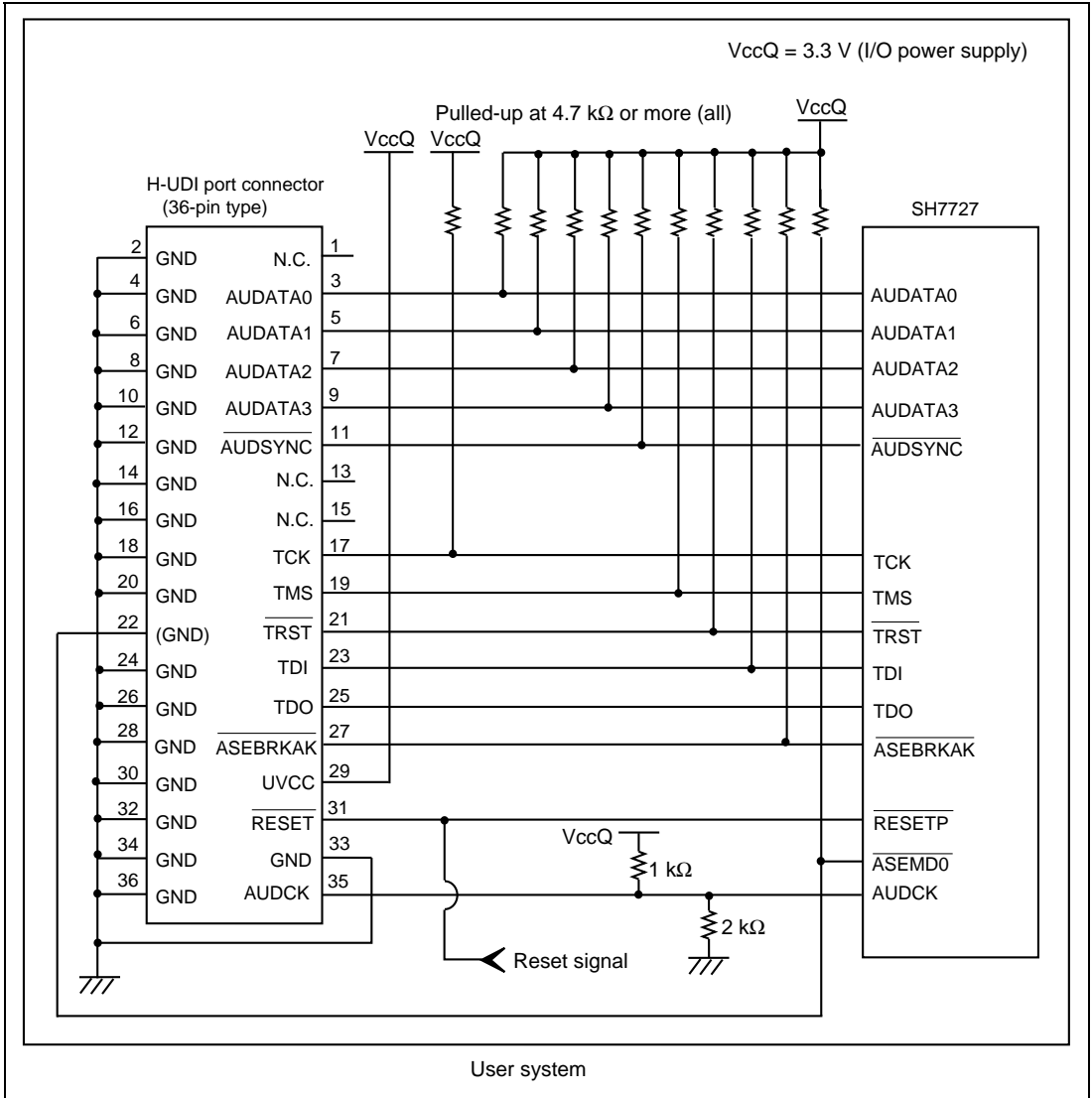
## 1.5 Recommended Circuit between the H-UDI Port Connector and the MPU

### 1.5.1 Recommended Circuit (36-Pin Type)

Figure 1.3 shows a recommended circuit for connection between the H-UDI and AUD port connectors (36 pins) and the MPU when the emulator is in use. Figure 1.4 shows a circuit for connection when UVCC is not connected.

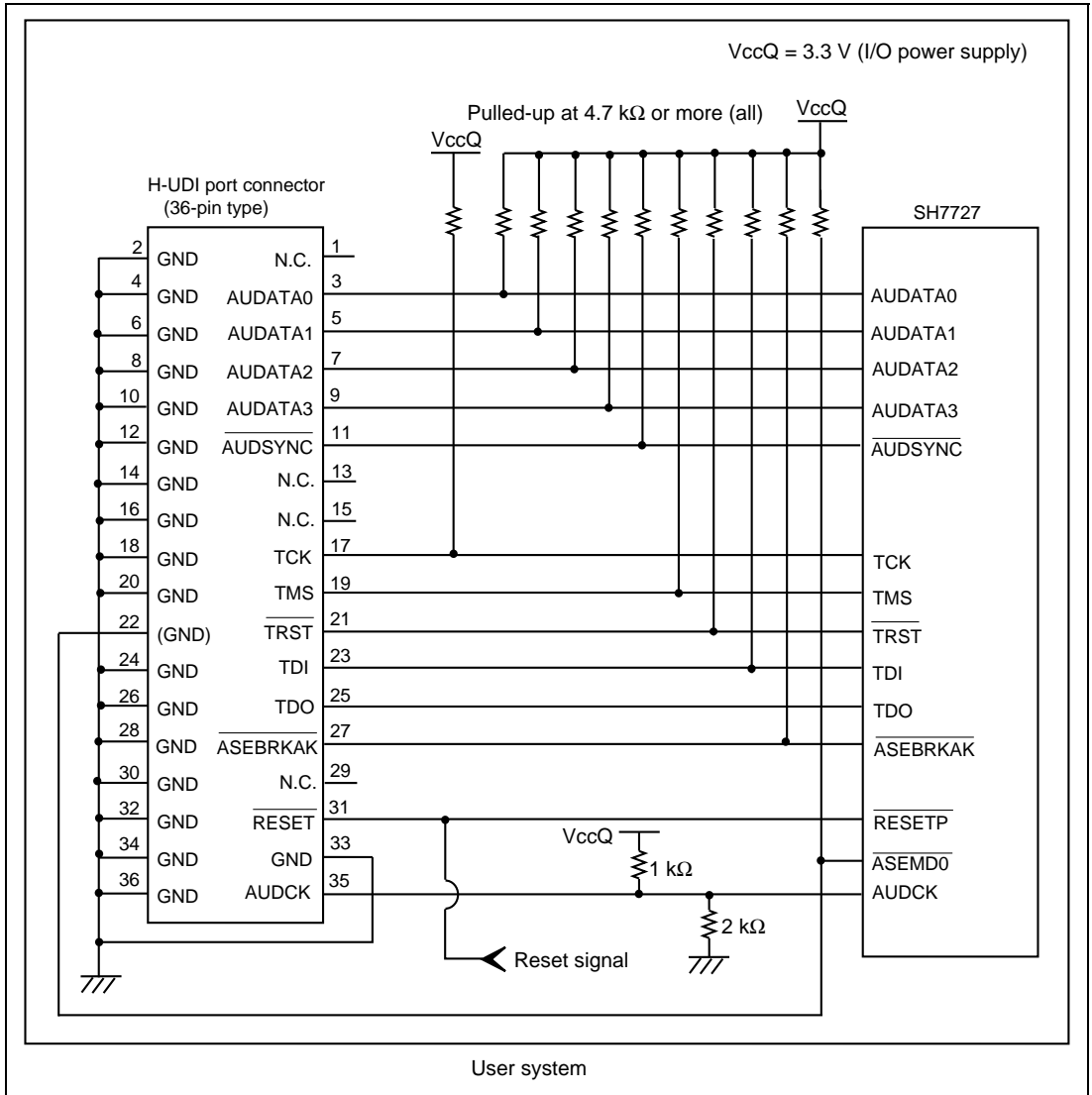
- Notes:
1. Do not connect anything to the N.C. pins of the H-UDI port connector.
  2. The /ASEMD0 pin must be 0 when the emulator is connected and 1 when the emulator is not connected, respectively.
    - (1) When the emulator is used: /ASEMD0 = 0 (ASE mode)
    - (2) When the emulator is not used: /ASEMD0 = 1 (normal mode)Figures 1.3 and 1.4 show examples of circuits that allow the /ASEMD0 pin to be GND (0) whenever the emulator is connected by using the user system interface cable. When the /ASEMD0 pin is changed by switches, etc., ground pin 22. Do not connect this pin to the /ASEMD0 pin.
  3. When a network resistance is used for pull-up, it may be affected by a noise. Separate TCK from other resistances.
  4. The pattern between the H-UDI port connector and the MPU must be as short as possible. Do not connect the signal lines to other components on the board.
  5. When the power supply of the user system is turned off, supplying VccQ of the user system to the UVCC pin reduces the leakage current from the emulator to the user system. A level shifter that is activated by the internal power supply or user power supply (changed by the switch) is installed in the interface circuit of the emulator. If the user power is supplied to the UVCC pin, the level shifter is not activated as long as no user power is supplied. When the power supply of the user system is turned off, no current flows from the user interface. The I/O voltage level of the user system interface can be the same as that of the VccQ. To operate the emulator with low voltage (lower than 3.3 V), the VccQ must be supplied to the UVCC pin. Make the emulator's switch settings so that the VccQ will be supplied (SW2 = 1 and SW3 = 1) (as shown in figure 1.3).
  6. The resistance values shown in figures 1.3 and 1.4 are recommended.
  7. For the pin processing in cases where the emulator is not used, refer to the hardware manual of the related MPU.

When the circuit is connected as shown in figure 1.3, the switches of the emulator are set as SW2 = 1 and SW3 = 1. For details, refer to section 3.8, Setting the DIP Switches, in the Debugger Part of the SuperH™ Family E10A-USB Emulator User's Manual.



**Figure 1.3 Recommended Circuit for Connection between the H-UDI Port Connector and MPU when the Emulator is in Use (36-Pin Type UVCC Connected)**

When the circuit is connected as shown in figure 1.4, the switches of the emulator are set as SW2 = 0 and SW3 = 1. For details, refer to section 3.8, Setting the DIP Switches, in the Debugger Part of the SuperH™ Family E10A-USB Emulator User's Manual.



**Figure 1.4 Circuit for Connection between the H-UDI Port Connector and MPU when the Emulator is in Use (36-Pin Type UVCC Not Connected\*)**

Note: When UVCC is not connected and the user system is turned off, note that the leakage current flows from the emulator to the user system.

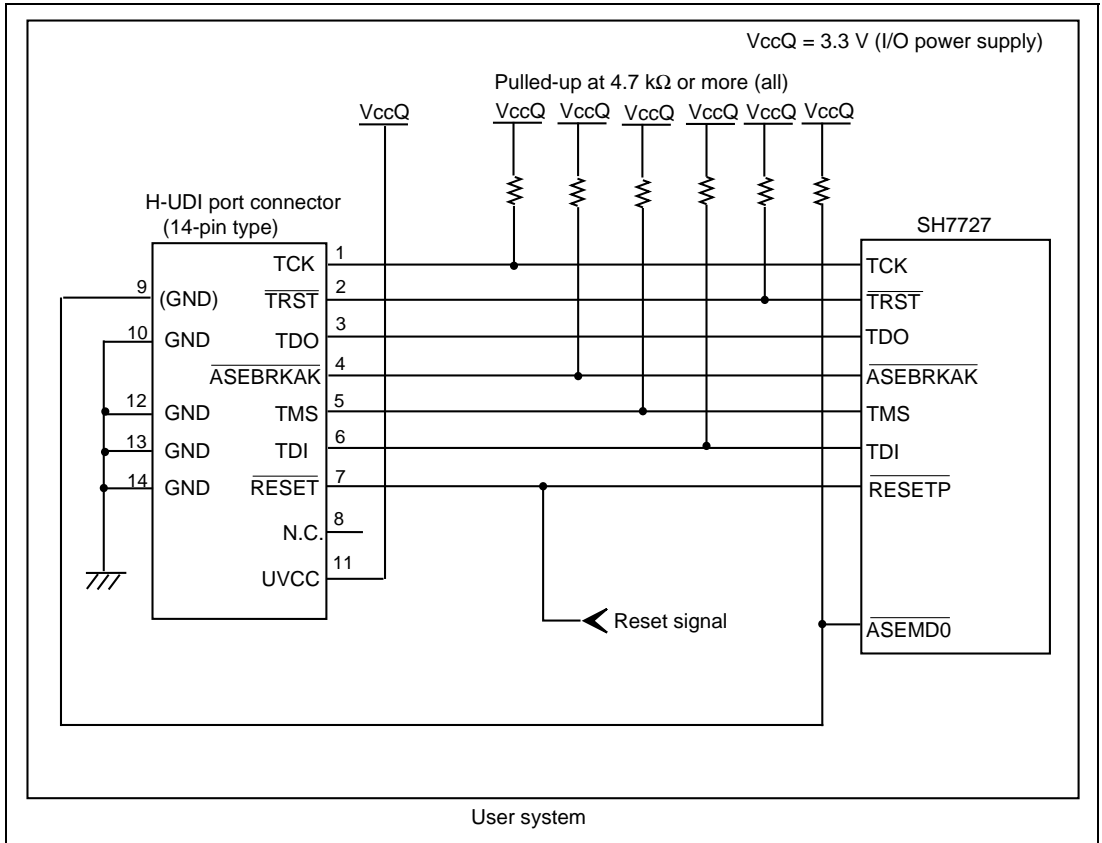


## 1.5.2 Recommended Circuit (14-Pin Type)

Figure 1.5 shows a recommended circuit for connection between the H-UDI and AUD port connectors (14 pins) and the MPU when the emulator is in use. Figure 1.6 shows a circuit for connection when UVCC is not connected.

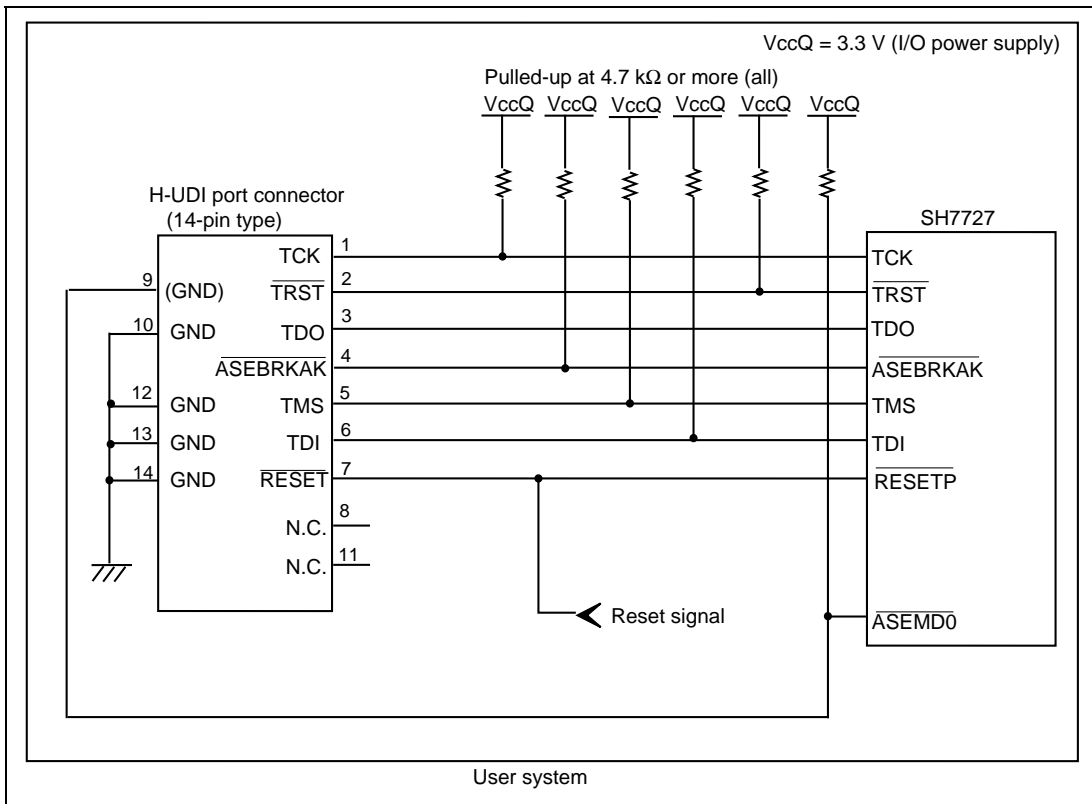
- Notes:
1. Do not connect anything to the N.C. pins of the H-UDI port connector.
  2. The  $\text{/ASEMD0}$  pin must be 0 when the emulator is connected and 1 when the emulator is not connected, respectively.
    - (1) When the emulator is used:  $\text{/ASEMD0} = 0$  (ASE mode)
    - (2) When the emulator is not used:  $\text{/ASEMD0} = 1$  (normal mode)Figures 1.5 and 1.6 show examples of circuits that allow the  $\text{/ASEMD0}$  pin to be GND (0) whenever the emulator is connected by using the user system interface cable. When the  $\text{/ASEMD0}$  pin is changed by switches, etc., ground pin 9. Do not connect this pin to the  $\text{/ASEMD0}$  pin.
  3. When a network resistance is used for pull-up, it may be affected by a noise. Separate TCK from other resistances.
  4. The pattern between the H-UDI port connector and the MPU must be as short as possible. Do not connect the signal lines to other components on the board.
  5. When the power supply of the user system is turned off, supplying VccQ of the user system to the UVCC pin reduces the leakage current from the emulator to the user system. A level shifter that is activated by the internal power supply or user power supply (changed by the switch) is installed in the interface circuit of the emulator. If the user power is supplied to the UVCC pin, the level shifter is not activated as long as no user power is supplied. When the power supply of the user system is turned off, no current flows from the user interface. The I/O voltage level of the user system interface can be the same as that of the VccQ. To operate the emulator with low voltage (lower than 3.3 V), the VccQ must be supplied to the UVCC pin. Make the emulator's switch settings so that the VccQ will be supplied (SW2 = 1 and SW3 = 1) (as shown in figure 1.5).
  6. The resistance values shown in figures 1.5 and 1.6 are recommended.
  7. For the pin processing in cases where the emulator is not used, refer to the hardware manual of the related MPU.

When the circuit is connected as shown in figure 1.5, the switches of the emulator are set as SW2 = 1 and SW3 = 1. For details, refer to section 3.8, Setting the DIP Switches, in the Debugger Part of the SuperH™ Family E10A-USB Emulator User's Manual.



**Figure 1.5 Recommended Circuit for Connection between the H-UDI Port Connector and MPU when the Emulator is in Use (14-Pin Type UVCC Connected)**

When the circuit is connected as shown in figure 1.6, the switches of the emulator are set as SW2 = 0 and SW3 = 1. For details, refer to section 3.8, Setting the DIP Switches, in the Debugger Part of the SuperH™ Family E10A-USB Emulator User’s Manual.



**Figure 1.6 Circuit for Connection between the H-UDI Port Connector and MPU when the Emulator is in Use (14-Pin Type UVCC Not Connected\*)**

Note: When UVCC is not connected and the user system is turned off, note that the leakage current flows from the emulator to the user system.



# Section 2 Specifications of the Software when Using the SH7727

## 2.1 Differences between the SH7727 and the Emulator

1. When the emulator system is initiated, it initializes the general registers and part of the control registers as shown in table 2.1. The initial values of the actual SH7727 registers are undefined.

**Table 2.1 Register Initial Values at Emulator Link Up**

<b>Register</b>	<b>Emulator at Link Up</b>
R0 to R14	H'00000000
R15 (SP)	H'A0000000
R0_BANK to R7_BANK	H'00000000
PC	H'A0000000
SR	H'700000F0
GBR	H'00000000
VBR	H'00000000
MACH	H'00000000
MACL	H'00000000
PR	H'00000000
SPC	H'00000000
SSR	H'000000F0
RS	H'00000000
RE	H'00000000
MOD	H'00000000
A0G, A1G	H'00
A0, A1	H'00000000
X0, X1	H'00000000
Y0, Y1	H'00000000
M0, M1	H'00000000
DSR	H'00

2. The emulator uses the H-UDI; do not access the H-UDI.

### 3. Ports E, F, G, and H

The AUD and H-UDI pins are multiplexed as shown in table 2.2.

**Table 2.2 Multiplexed Functions**

Port	Function 1	Function 2	Function 3
E	PTE0 input/output (port) <sup>1</sup>	TDO (H-UDI)	—
E	PTE7 input/output (port) <sup>2</sup>	/AUDSYNC output	—
F	PTF7 input (port) / PINT15 input (INTC) <sup>1</sup>	/TRST (AUD and H-UDI)	—
F	PTF6 input (port) / PINT14 input (INTC) <sup>1</sup>	TMS (H-UDI)	—
F	PTF5 input (port) / PINT13 input (INTC) <sup>1</sup>	TDI (H-UDI)	—
F	PTF4 input (port) / PINT12 input (INTC) <sup>1</sup>	TCK (H-UDI)	—
G	PTG6 input (port) <sup>1</sup>	/ASEMD0 (AUD and H-UDI)	—
G	PTG5 input (port) <sup>1</sup>	/ASEBRKAK (H-UDI)	—
G	PTG3 input (port) <sup>2</sup>	AUDATA3 (AUD)	PCC0BVD2 (PCC) <sup>3</sup>
G	PTG2 input (port) <sup>2</sup>	AUDATA2 (AUD)	PCC0BVD1 (PCC) <sup>3</sup>
G	PTG1 input (port) <sup>2</sup>	AUDATA1 (AUD)	/PCC0CD2 (PCC) <sup>3</sup>
G	PTG0 input (port) <sup>2</sup>	AUDATA0 (AUD)	/PCC0CD1 (PCC) <sup>3</sup>
H	PTH6 input (port) <sup>2</sup>	AUDCK (AUD)	—

- Notes:
1. Note that function 1 cannot be used when the emulator is used.
  2. Function 1 can be used when the AUD pins are not connected to the emulator. Note that the emulator setting should be made so that function 2 would be forcibly used during activation. If function 1 is to be used, the setting should be made by the pin function controller.
  3. Function 3 cannot be used when the /ASEMD0 pin state is low (when the emulator is in use) at the rising edge of /RESETP.

#### 4. Low-Power States (Sleep, Software Standby, and Module Standby)

For low-power consumption, the SH7727 has sleep, software standby, and module standby states.

The sleep, software standby, and module standby states are switched using the SLEEP instruction. When the emulator is used, only the sleep state can be cleared with either the normal clearing function or with the [STOP] button, and a break will occur. Note that if a command has been entered in standby mode or module standby mode, no commands can be used from the emulator. The states cannot be canceled by the [STOP] button.

- Notes:
1. The memory must not be accessed or modified in sleep mode.
  2. When the [STOP] button is clicked in sleep mode, a break does not occur immediately after executing the SLEEP instruction. The number of instructions to be proceeded differs according to the emulator environment or operating frequency of the chip. It is about 500 instructions when the Pentium® III 800-MHz PC is used and the operating frequency is 25 MHz.
  3. When the UBC is set to be used, do not set the UBC to the standby mode.
  4. When the SLEEP instruction is executed by STEP-type commands to switch the mode to sleep, the emulator does not enter sleep mode, and execution skips to the next instruction. Do not execute the SLEEP instruction to switch the mode to standby because a TIMEOUT error will occur.
5. Reset Signals (/RESETP and /RESETM)

The SH7727 reset signals (/RESETP and /RESETM) are only valid during emulation started with clicking the GO or STEP-type button. If these signals are enabled on the user system in command input wait state, they are not sent to the SH7727.

Note: Do not break the user program when the /RESETP, /RESETM, /BREQ, or /WAIT signal is being low. A TIMEOUT error will occur. If the /BREQ or /WAIT signal is fixed to low during break, a TIMEOUT error will occur at memory access.

6. Direct Memory Access Controller (DMAC)

The DMAC operates even when the emulator is used. When a data transfer request is generated, the DMAC executes DMA transfer.

7. Memory Access during User Program Execution

When a memory is accessed from the memory window, etc. during user program execution, the user program is resumed after it has stopped in the E10A-USB emulator to access the memory. Therefore, realtime emulation cannot be performed.

The stopping time of the user program is as follows:

Environment:

Host computer: 800 MHz (Pentium® III)

Operating system: Windows® 2000

SH7727: 50 MHz (CPU clock)

JTAG clock: 10 MHz

When a one-byte memory is read from the command-line window, the stopping time will be about 45 ms.

## 8. Memory Access during User Program Break

The emulator can download the program for the flash memory area (refer to section 6.22, Download Function to the Flash Memory Area, in the Debugger Part of the SuperH™ Family E10A-USB Emulator User's Manual). Other memory write operations are enabled for the RAM area. Therefore, an operation such as memory write or BREAKPOINT should be set only for the RAM area. When the memory area can be written by the MMU, do not perform memory write, BREAKPOINT, or downloading.

## 9. Cache Operation during User Program Break

When cache is enabled, the emulator accesses the memory by the following methods:

- At memory write: Writes through the cache, then writes to the memory.
- At memory read: Does not change the cache write mode that has been set.

Therefore, when memory read or write is performed during user program break, the cache state will be changed.

## 10. UBC

When [User] is specified in the [UBC mode] list box in the [Configuration] dialog box, the UBC can be used in the user program.

Do not use the UBC in the user program as it is used by the E10A-USB emulator when [EML] is specified in the [UBC mode] list box in the [Configuration] dialog box.

## 11. Loading Sessions

Information in [JTAG clock] of the [Configuration] dialog box cannot be recovered by loading sessions. Thus the TCK value will be 5 MHz.

## 12. [IO] window

- Display and modification

Do not change values of the User Break Controller because it is used by the emulator.

For each watchdog timer register, there are two registers to be separately used for write and read operations.

**Table 2.3 Watchdog Timer Register**

Register Name	Usage	Register
WTCSR(W)	Write	Watchdog timer control/status register
WTCNT(W)	Write	Watchdog timer counter
WTCSR(R)	Read	Watchdog timer control/status register
WTCNT(R)	Read	Watchdog timer counter

- The watchdog timer operates only when the user program is executed. Do not change the value of the frequency change register in the [IO] window or [Memory] window.



- The internal I/O registers can be accessed from the [IO] window. However, note the following when accessing the SDMR register of the bus-state controller. Before accessing the SDMR register, specify addresses to be accessed in the I/O-register definition file (SH7727.IO) and then activate the HEW. After the I/O-register definition file is created, the MPU's specification may be changed. If each I/O register in the I/O-register definition file differs from addresses described in the hardware manual, change the I/O-register definition file according to the description in the hardware manual. The I/O-register definition file can be customized depending on its format. Note that, however, the E10A-USB emulator does not support the bit-field function.
- Verify  
In the [IO] window, the verify function of the input value is disabled.

### 13. Illegal Instructions

If illegal instructions are executed by STEP-type commands, the emulator cannot go to the next program counter.

### 14. Interrupt

When the BLMSK bit in the ICR1 register is 1, the NMI interrupt is accepted during break and the program is executed from the NMI interrupt vector. If the program cannot return normally from the NMI interrupt routine or the value in the general-purpose register is not guaranteed, a communication timeout error will occur.

## 2.2 Specific Functions for the Emulator when Using the SH7727

The SH7727 does not support the following function:

- Profiler function

### 2.2.1 Break Condition Functions

In addition to BREAKPOINT functions, the emulator has Break Condition functions. Three types of conditions can be set under Break Condition 1, 2, 3. Table 2.4 lists these conditions of Break Condition.

**Table 2.4 Types of Break Conditions**

<b>Break Condition Type</b>	<b>Description</b>
Address bus condition (Address)	Breaks when the SH7727 address bus value or the program counter value matches the specified value.
Data bus condition (Data)	Breaks when the SH7727 data bus value matches the specified value. Byte, word, longword, X bus, or Y bus can be specified as the access data size.
X-bus or Y-bus condition (Address and data)	Breaks when the X-bus or Y-bus address bus or data bus matches the specified value.
ASID condition (ASID)	Breaks when the SH7727 ASID value matches the specified condition.
Bus state condition (Bus State)	There are two bus state condition settings: Read/Write condition: Breaks when the SH7727 RD or RDWR signal level matches the specified condition. Bus state condition: Breaks when the operating state in an SH7727 bus cycle matches the specified condition.
Internal I/O break condition	Breaks when the SH7727 accesses the internal I/O.
LDTLB instruction break condition	Breaks when the SH7727 executes the LDTLB instruction.
Count	Breaks when the conditions set are satisfied the specified number of times.

Table 2.5 lists the combinations of conditions that can be set under Break Condition 1, 2, 3.

**Table 2.5 Dialog Boxes for Setting Break Conditions**

Dialog Box	Type						
	Address Bus Condition (Address)	Data Bus Condition (Data)	ASID Condition (ASID)	Bus State Condition (Bus Status)	Count Condition (Count)	Internal I/O Break	LDTLB Instruction Break
[Break Condition 1] dialog box	O	O	O	O	O	X	X
[Break Condition 2] dialog box	O	X	O	O	X	X	X
[Break Condition 3] dialog box	X	X	X	X	X	O	O

Note: O: Can be set in the dialog box.

X: Cannot be set in the dialog box.

## 2.2.2 Trace Functions

Table 2.6 shows the trace functions.

**Table 2.6 Trace Functions**

Function	Description
Internal trace	Branch instruction trace functions which are built into the chip. This function displays the branch source and branch destination addresses and enables a realtime trace.
AUD trace*	<p data-bbox="254 368 406 392">Realtime trace</p> <p data-bbox="479 368 1112 480">This function is operational when the AUD pin is connected to the emulator. This function displays the branch source and branch destination addresses, and instruction words at the branch destination.</p> <p data-bbox="479 496 1112 608">When the next branch occurs while the trace information is being output, the information is stopped and the next trace information is output. The user program can be executed in realtime, but some trace information will not be output.</p> <ul data-bbox="479 624 735 647" style="list-style-type: none"><li>• Trace continue mode:</li></ul> <p data-bbox="479 663 1096 748">When the trace buffer becomes full, this function always overwrites the oldest trace information to acquire the latest trace information.</p> <ul data-bbox="479 764 687 788" style="list-style-type: none"><li>• Trace stop mode:</li></ul> <p data-bbox="479 804 1112 852">After the trace buffer becomes full, the trace information is not acquired. (The user program is continuously executed.)</p>
Non realtime trace	<p data-bbox="479 868 1112 979">This function is operational when the AUD pin is connected to the emulator. This function displays the branch source and branch destination addresses, and instruction words at the branch destination.</p> <p data-bbox="479 995 1112 1080">When the next branch occurs while the trace information is being output, the CPU stops operations until the information is output. The user program is not executed in realtime.</p> <ul data-bbox="479 1096 735 1120" style="list-style-type: none"><li>• Trace continue mode:</li></ul> <p data-bbox="479 1136 1096 1220">When the trace buffer becomes full, this function always overwrites the oldest trace information to acquire the latest trace information.</p> <ul data-bbox="479 1236 687 1260" style="list-style-type: none"><li>• Trace stop mode:</li></ul> <p data-bbox="479 1276 1112 1331">After the trace buffer becomes full, the trace information is not acquired. (The user program is continuously executed.)</p>

Note: When HS0005KCU01H is used, the AUD function cannot be used.

**Table 2.7 Type Name and AUD Function**

Type Name	AUD Function
HS0005KCU01H	Not available
HS0005KCU02H	Available

Notes: 1. In the internal trace of the SH7727, trace acquisition of the eight latest branch instructions is enabled. In addition, when the user program execution starts, the following one-branch trace is displayed:

Branch source address: Previous user program execution end address

Branch destination address: User program execution start address

2. In the internal trace of the SH7727, the upper 4-bit address values are not acquired by trace. When the MMU is used, do not use the internal trace. Since the internal trace acquires only lower 28 bits, a TLB error may occur when the instruction code is displayed. When the emulator supports the AUD trace function, it is recommended to use the AUD trace.
3. The AUD trace function outputs the differences between newly output branch source addresses and previously output branch source addresses. The window trace function outputs the differences between newly output addresses and previously output addresses. If the previous branch source address is the same as the upper 16 bits, the lower 17 bits are output. If it matches the upper 24 bits, the lower 9 bits are output. If it matches the upper 28 bits, the lower 5 bits are output.  
The emulator regenerates the 32-bit address from these differences and displays it in the [Trace] window. If the emulator cannot display the 32-bit address, it displays the difference from the previously displayed 32-bit address.
4. In realtime trace, when the cache is on, the CPU clock is 33 MHz, and the AUD clock is 30 MHz, trace information will be lost under the following condition:  
Continuous nine NOP instructions and the non-limited loop of the BRA instruction at the 10th instruction
5. When the AUD trace function is used, the AUD clock (AUDCK) does not operate correctly at 40 MHz or higher.
6. When the SH7727 is used, the maximum number of trace display pointers is 52428 (26214 branches).

### 2.2.3 Notes on Using the JTAG Clock (TCK) and AUD Clock (AUDCK)

1. When JTAG clock (TCK) is used, set the JTAG clock (TCK) frequency to lower than the frequency of half of the CPU clock.
2. Set the AUD clock (AUDCK) frequency to 40 MHz or lower. The upper limit of the AUD clock must be lower than the CPU clock and the lower limit must be the quarter of the CPU clock.

### 2.2.4 Notes on Setting the [Breakpoint] Dialog Box

1. When an odd address is set, the next lowest even address is used.
2. A BREAKPOINT is accomplished by replacing instructions of the specified address. Accordingly, it can be set only to the internal RAM area. However, a BREAKPOINT cannot be set to the following addresses:
  - An area other than CS0 to CS6 and the internal RAM
  - An instruction in which Break Condition 2 is satisfied
  - A slot instruction of a delayed branch instruction
  - An area that can be only read by MMU
3. During step operation, a BREAKPOINT is disabled.
4. Conditions set at Break Condition 2 are disabled when an instruction to which a BREAKPOINT has been set is executed. Do not set a BREAKPOINT to an instruction in which Break Condition 2 is satisfied.
5. When execution resumes from the address where a BREAKPOINT is specified, single-step operation is performed at the address before execution resumes. Therefore, realtime operation cannot be performed.
6. When a BREAKPOINT is set to the slot instruction of a delayed branch instruction, the PC value becomes an illegal value. Accordingly, do not set a BREAKPOINT to the slot instruction of a delayed branch instruction.
7. When a BREAKPOINT is set to the cacheable area, the cache block containing the BREAKPOINT address is filled immediately before and after user program execution.
8. Note on DSP repeat loop:  
A BREAKPOINT is equal to a branch instruction. In some DSP repeat loops, branch instructions cannot be set. For these cases, do not set BREAKPOINTS. Refer to the hardware manual for details.
9. When the [Normal] option is selected in the [Memory area] group box in the [General] page of the [Configuration] dialog box, a BREAKPOINT is set to a physical address or a virtual address according to the SH7727 MMU status during command input when the VPMAP\_SET command setting is disabled. The ASID value of the SH7727 PTEH register during command input is used. When VPMAP\_SET command setting is enabled, a BREAKPOINT is set to a physical address into which address translation is made according to the VP\_MAP table.

However, for addresses out of the range of the VP\_MAP table, the address to which a BREAKPOINT is set depends on the SH7727 MMU status during command input. Even when the VP\_MAP table is modified after BREAKPOINT setting, the address translated when the BREAKPOINT is set valid.

10. When the [Physical] option is selected in the [Memory area] group box in the [General] page of the [Configuration] dialog box, a BREAKPOINT is set to a physical address. A BREAKPOINT is set after disabling the SH7727 MMU upon program execution. After setting, the MMU is returned to the original state. When a break occurs at the corresponding virtual address, the cause of termination displayed in the status bar and the [Output] window is ILLEGAL INSTRUCTION, not BREAKPOINT.
11. When the [Virtual] option is selected in the [Memory area] group box in the [General] page of the [Configuration] dialog box, a BREAKPOINT is set to a virtual address. A BREAKPOINT is set after enabling the SH7727 MMU upon program execution. After setting, the MMU is returned to the original state. When an ASID value is specified, the BREAKPOINT is set to the virtual address corresponding to the ASID value. The emulator sets the BREAKPOINT after rewriting the ASID value to the specified value, and returns the ASID value to its original value after setting. When no ASID value is specified, the BREAKPOINT is set to a virtual address corresponding to the ASID value at command input.
12. An address (physical address) to which a BREAKPOINT is set is determined when the BREAKPOINT is set. Accordingly, even if the VP\_MAP table is modified after BREAKPOINT setting, the BREAKPOINT address remains unchanged. When a BREAKPOINT is satisfied with the modified address in the VP\_MAP table, the cause of termination displayed in the status bar and the [Output] window is ILLEGAL INSTRUCTION, not BREAKPOINT.
13. If an address of a BREAKPOINT cannot be correctly set in the ROM or flash memory area, a mark ● will be displayed in the [BP] area of the address on the [Editor] or [Disassembly] window by refreshing the [Memory] window, etc. after Go execution. However, no break will occur at this address. When the program halts with the break condition, the mark ● disappears.

### **2.2.5 Notes on Setting the [Break Condition] Dialog Box and the BREAKCONDITION\_SET Command**

1. When [Go to cursor], [Step In], [Step Over], or [Step Out] is selected, the settings of Break Condition 2 are disabled.
2. Break Condition 2 is disabled when an instruction to which a BREAKPOINT has been set is executed. Accordingly, do not set a BREAKPOINT to an instruction which satisfies Break Condition 2.
3. When a Break Condition is satisfied, emulation may stop after two or more instructions have been executed.

4. If a PC break address condition is set to the slot instruction after a delayed branch instruction, user program execution cannot be terminated before the slot instruction execution; execution stops before the branch destination instruction.
5. A break will not occur with the execution counts specified on the execution of the multi-step instruction.

### **2.2.6 Note on Setting the UBC\_MODE Command**

In the [Configuration] dialog box, if [User] is set while the [UBC mode] list box has been set, the STEP-type commands that use Break Condition 2 for implementation cannot be used.



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