User's Manual

RENESAS

E1/E20 Emulator

Additional Document for User's Manual (Notes on Connection of V850E2M and V850E2S)

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(2012.4)

Contents

1. Outline

1.1 Features of an E1 or E20 emulator

An E1 or E20 emulator (hereafter referred to as an E1/E20) is an on-chip debugging emulator that includes a flash programming function, which is used for debugging and programming programs to be embedded in microcontrollers that have on-chip flash memory. That is, either product can debug a program while the target microcontroller is connected to the user system, and can write programs to the on-chip flash memory of microcontrollers.

1.2 Caution on using the E20 emulator

The functions used for debugging of the V850E2M and V850E2S devices by using the E20 emulator are the same as in the E1 emulator. Large trace function, characteristic function of the E20 emulator, cannot be used. The power-supply function from the E20 emulator is not supported.

1.3 Configuration of manuals

Documentation for the E1/E20 emulator manual is in two parts: the E1/E20 Emulator User’s Manual and E1/E20 Emulator Additional Document for User’s Manual (this manual). Be sure to read both of the manuals before using the E1/E20 emulator.

(1) E1/E20 emulator user’s manual

The E1/E20 Emulator User’s Manual describes hardware specifications including the following items:

- Components of the emulators
- Emulator hardware specifications
- Connecting the emulator to a host computer and user system

(2) E1/E20 emulator additional document for user’s manual

An E1/E20 Emulator Additional Document for User’s Manual describes functions of an emulator debugger, and its contents depend on the given set of MCUs. In general, an additional document has notes on items including the following:

- For use in hardware design, an example of connection and the interface circuits required to connect the emulator.
- Notes on using the emulator

2. Connecting the Emulator and User System

To connect the E1/E20 emulator, a connector for the user system interface cable must be mounted on the user system. When designing the user system, read this chapter of this manual and the hardware manual for the MCUs to be used.

2.1 Connector mounted on the user system

Table 2-1 shows the recommended connectors for connection of the E1/E20 emulator.

Table 2-1 Recommended Connectors

	Type Number	Manufacturer	Specification
14-pin connector	7614-6002	Sumitomo 3M Limited	14-pin straight type (Japan)
	2514-6002	3M Limited	14-pin straight type (other countries)

Figures 2-1 shows an example of the connection of the user system interface cable of an E1 emulator to a 14-pin connector. If you intend to use the 14-pin connector, do not mount components with heights exceeding 10 mm within 5 mm of the connector on the user system. If you are using a 16-pin connector, the QB-F14T16-01 adapter (optional product) is available for connection to the user system interface cable. Note that this connector does not support direct connection of an E20 emulator, which has a 38-pin connection. To use an E20 emulator with a 14-pin connector, use the 38-pin/14-pin conversion adapter [R0E000200CKA00] that comes with the E20.

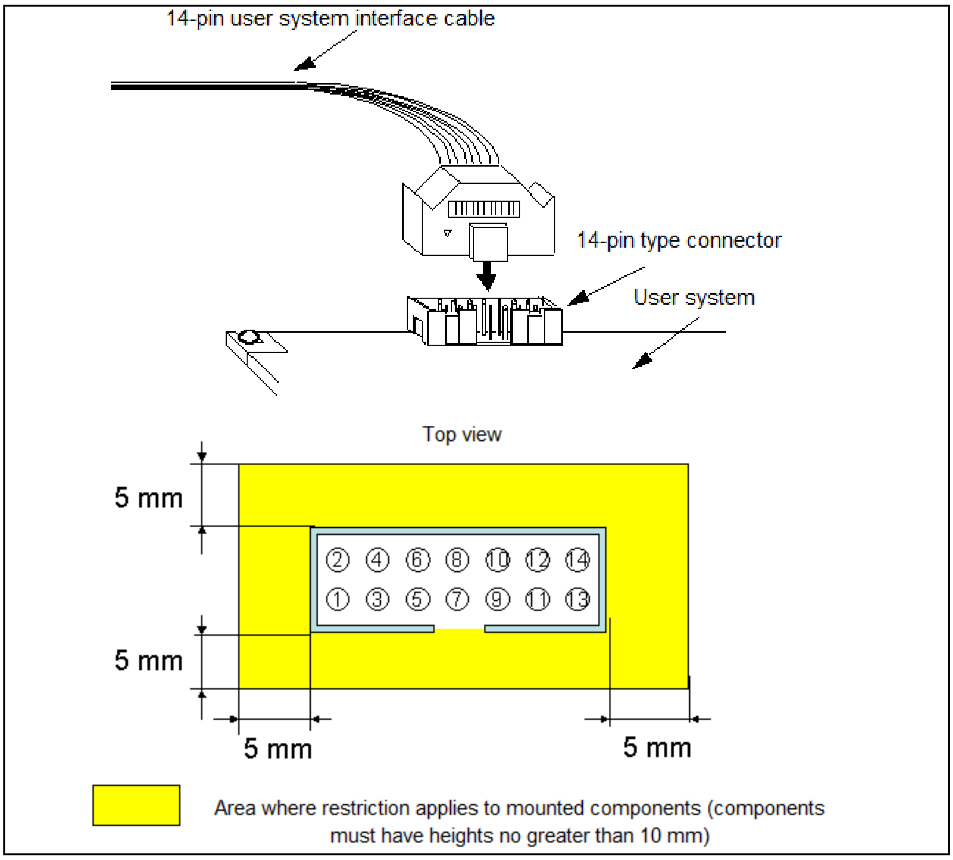

14-pin user system interface cable
14-pin type connector
User system
Top view
5 mm
5 mm
5 mm
5 mm
②④⑥⑧⑩⑫⑭
①③⑤⑦⑨⑪⑬
Area where restriction applies to mounted components (components must have heights no greater than 10 mm)

Figure 2-1 Connecting the User System Interface Cable to the 14-pin Connector in the E1/E20 Emulator

⚠CAUTION

Note on connector insertion and removal:

When connecting or disconnecting the user-system interface cable and the emulator or user system, grasp the connector cover at the end of the cable. Pulling the cable itself will damage the wiring.

Also, be aware that the user-system interface cable has the direction in which it must be inserted. If the cable is connected in the wrong direction, it may be damaged.

2.2 Pin assignments of the connector

Table 2-2 shows the pin assignments of the 14-pin connector.

Table 2-2 Pin Assignments of the 14-pin Connector

Pin No.	Signal Name (#:active low)				I/O (*3)
	JTAG (Debugging)	LPD (Debugging)	UART (= Serial OCD) (Programming & Debugging)	CSI (Programming)	
1	TCK	-	-	FPCK	Input
2 (*2)	GND	GND	GND	GND	-
3	TRST#	-	-	-	Input
4	-	-	FLMD0	FLMD0	Input
5	TDO	-	-	FPDT	Output
6	-	-	RESET_IN#	-	Output
7	TDI	LPDIO	FPDR	FPDR	I/O
8	VDD	VDD	VDD	VDD	-
9	TMS	-	(FLMD1)	(FLMD1)	Input
10	-	-	RESET_OUT# (*2)	RESET_OUT# (*2)	Input
11	RDY#	-	-	-	Output
12 (*1)	GND	GND	GND	GND	-
13	RESET_OUT#	RESET_OUT#	RESET_OUT# (*2)	RESET_OUT# (*2)	Input
14 (*1)	GND	GND	GND	GND	-

Notes **1.** Securely connect pins 2, 12, and 14 of the connector to GND of the user system. These pins are used for electrical GND and to monitor connection with the user system by the E1 or E20.

2. Be particularly sure to connect both pins 10 and 13 before using the emulator. These pins are also used to monitor the user system.

3. Input and output are defined from the perspective of the user system.

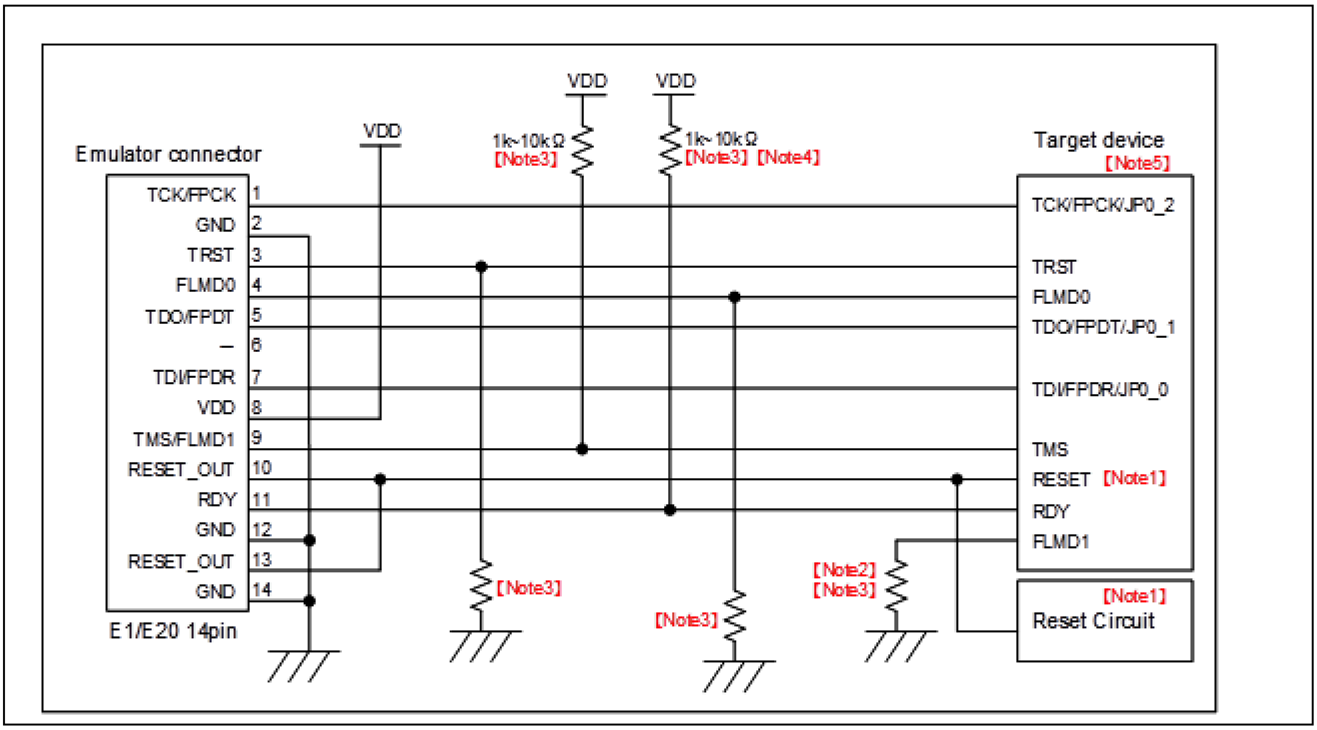
2.3 Examples of recommended connections between the connector and MCU

This section describes examples of recommended connections between the target device and interface circuit. The supported interfaces differ according to the target device, so check the specifications of the device you are using.

2.3.1 Example of recommended connections

Multiple recommended examples for connection are given in accord with the purposes for which the emulator is to be used. Select the appropriate circuit with reference to the table shown below. Be sure to take the specifications of the target device as well as measures to prevent noise into consideration when designing your circuit.

Purpose	Figure
Both debugging (JTAG) and programming (CSI)	Figure 2-2
Only debugging (JTAG)	Figure 2-3
Only programming (CSI)	Figure 2-4
Both debugging (UART) and programming (UART) (serial OCD)	Figure 2-5
Only programming (UART)	Figure 2-6
Both debugging (LPD) and programming (UART)	Figure 2-7
Only debugging (LPD)	Figure 2-8



Caution: Make wiring runs between the connector and the target device as short as possible.

Figure 2-2 Example of Recommended Connection (Both Debugging (JTAG) and Programming (CSI))

- Make wiring runs between the 14-pin connector and target device as short as possible (within 50 mm is recommended). Do not connect the signal lines between the connector and MCU to other signal lines.

- Use GND to apply a guard ring for the wiring which runs between the 14-pin connector and target device. Do not route high-speed signal lines parallel to each other or allow them to cross each other.

- Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.

- Proceed with appropriate processing for pins of target devices which do not require connection to the emulator in accord with the descriptions in “Handling of Unused Pins” in the user’s manual for the target device.

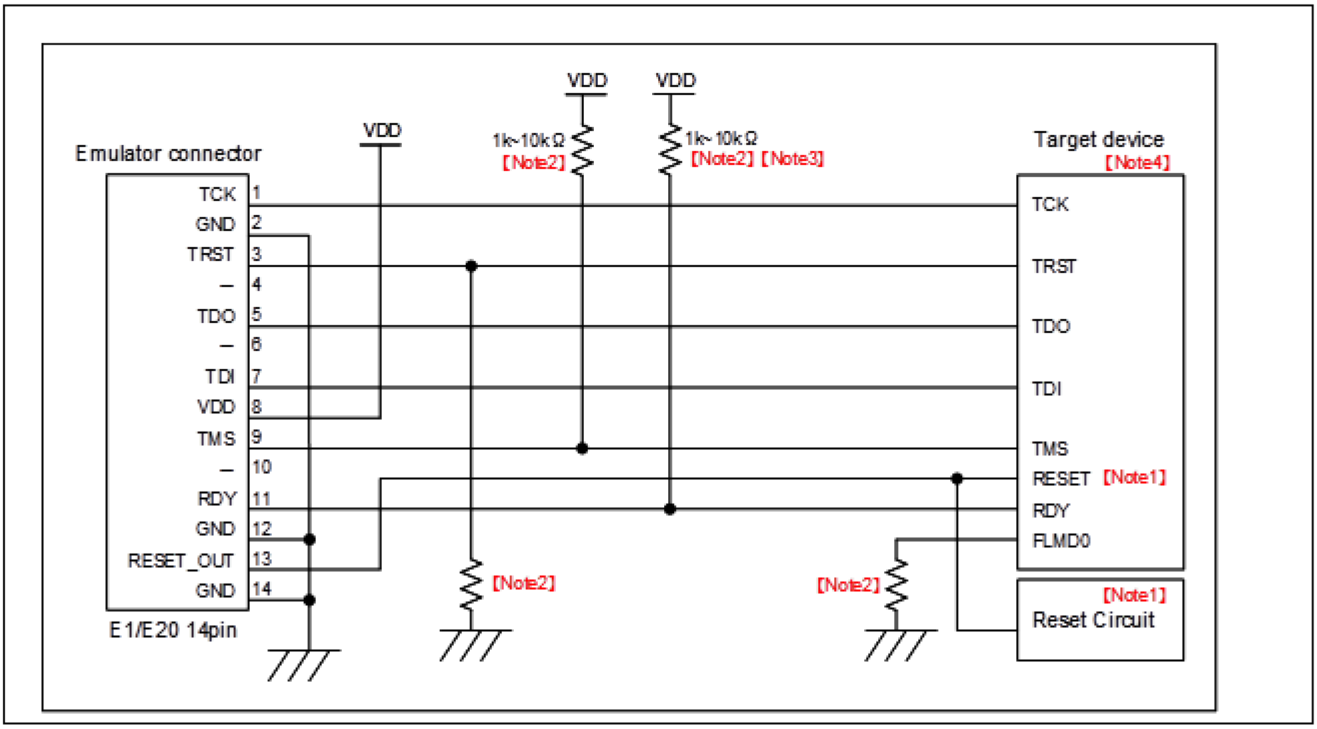
Notes:
1. This connection is designed on the assumption that the RESET signal output is from an N-channel open-drain buffer. For details, refer to section 2.3.2, Connecting the RESET pin.

2. This signal must be set to the low level during a reset. If you are using a multiplexed function, make sure that this signal is not at the high level on release from the reset state.

3. Refer to the datasheet of the device regarding the resistance and whether the resistor should be pulling up or pulling down.

4. Design the circuit so that this resistor is separated by a switch, etc., when the emulator is not in use.

5. Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.



Caution: Make wiring runs between the connector and the target device as short as possible.

Figure 2-3 Example of Recommended Connection (Only Debugging (JTAG))

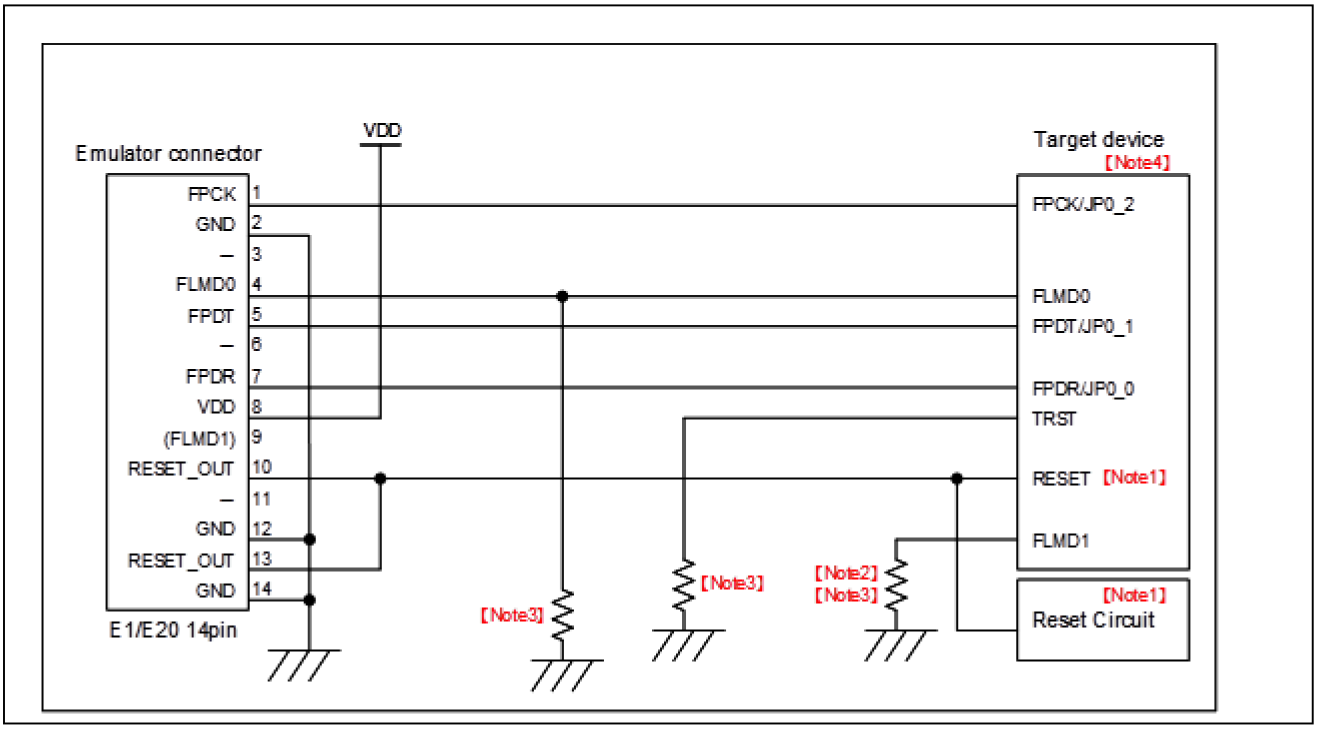
- Make wiring runs between the 14-pin connector and target device as short as possible (within 50 mm is recommended). Do not connect the signal lines between the connector and MCU to other signal lines.
- Use GND to apply a guard ring for the wiring which runs between the 14-pin connector and target device. Do not route high-speed signal lines parallel to each other or allow them to cross each other.
- Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.
- Proceed with appropriate processing for pins of target devices which do not require connection to the emulator in accord with the descriptions in “Handling of Unused Pins” in the user’s manual for the target device.

Notes: 1. This connection is designed on the assumption that the RESET signal output is from an N-channel open-drain buffer. For details, refer to section 2.3.2, Connecting the RESET pin.

2. Refer to the datasheet of the device regarding the resistance and whether the resistor should be pulling up or pulling down.

3. Design the circuit so that this resistor is separated by a switch, etc., when the emulator is not in use.

4. Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.



Caution: Make wiring runs between the connector and the target device as short as possible.

Figure 2-4 Example of Recommended Connection (Only Programming (CSI))

- Make wiring runs between the 14-pin connector and target device as short as possible (within 50 mm is recommended). Do not connect the signal lines between the connector and MCU to other signal lines.

- Use GND to apply a guard ring for the wiring which runs between the 14-pin connector and target device. Do not route high-speed signal lines parallel to each other or allow them to cross each other.

- Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.

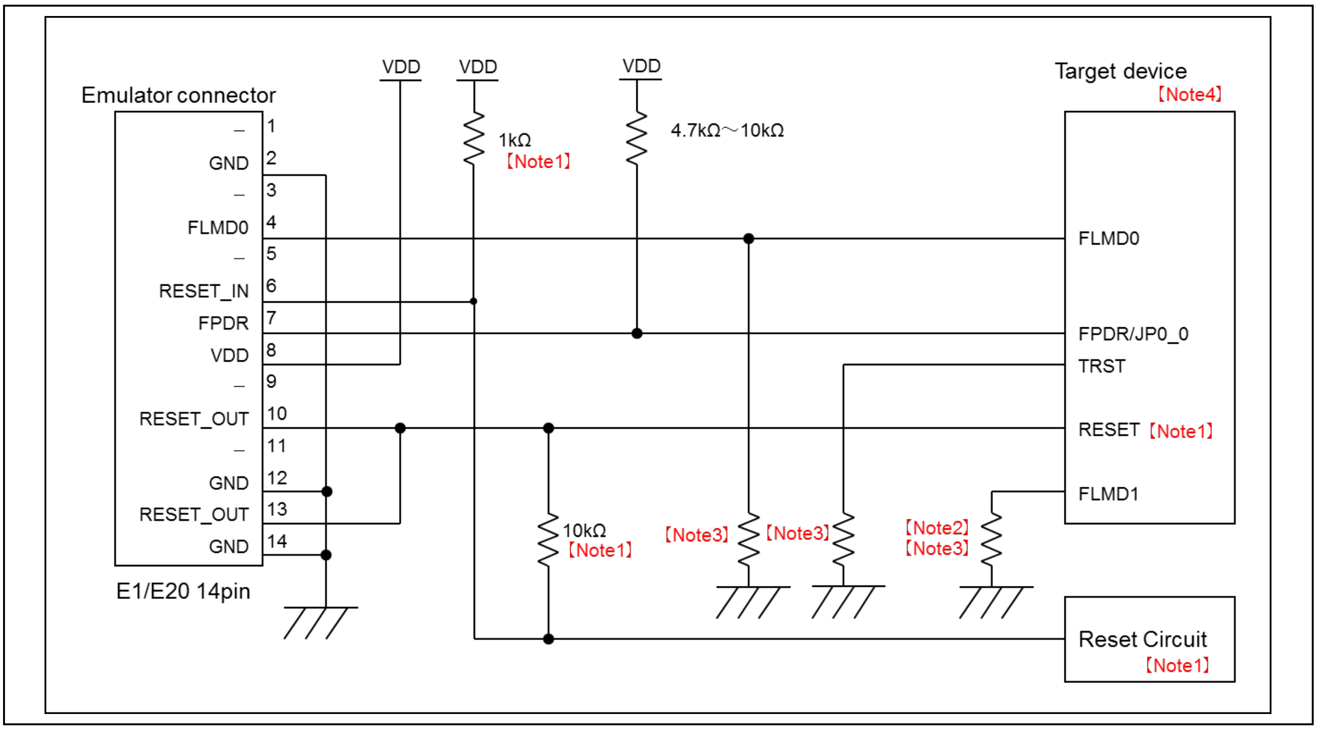
- Proceed with appropriate processing for pins of target devices which do not require connection to the emulator in accord with the descriptions in “Handling of Unused Pins” in the user’s manual for the target device.

Notes: 1. This connection is designed on the assumption that the RESET signal output is from an N-channel open-drain buffer. For details, refer to section 2.3.2, Connecting the RESET pin.

2. This signal must be set to the low level during a reset. If you are using a multiplexed function, make sure that this signal is not at the high level on release from the reset state. If you are using a multiplexed function which requires that this signal be pulled up, connect it to pin 9 (FLMD1) of the emulator before it is set to the low level during programming of the flash memory.

3. Refer to the datasheet of the device regarding the resistance and whether the resistor should be pulling up or pulling down.

4. Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.



Caution: Make wiring runs between the connector and the target device as short as possible.

Figure 2-5 Example of Recommended Connection (Both Debugging (UART) and Programming (UART) (Serial OCD))

- Make wiring runs between the 14-pin connector and target device as short as possible (within 50 mm is recommended). Do not connect the signal lines between the connector and MCU to other signal lines.

- Use GND to apply a guard ring for the wiring which runs between the 14-pin connector and target device. Do not route high-speed signal lines parallel to each other or allow them to cross each other.

- Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.

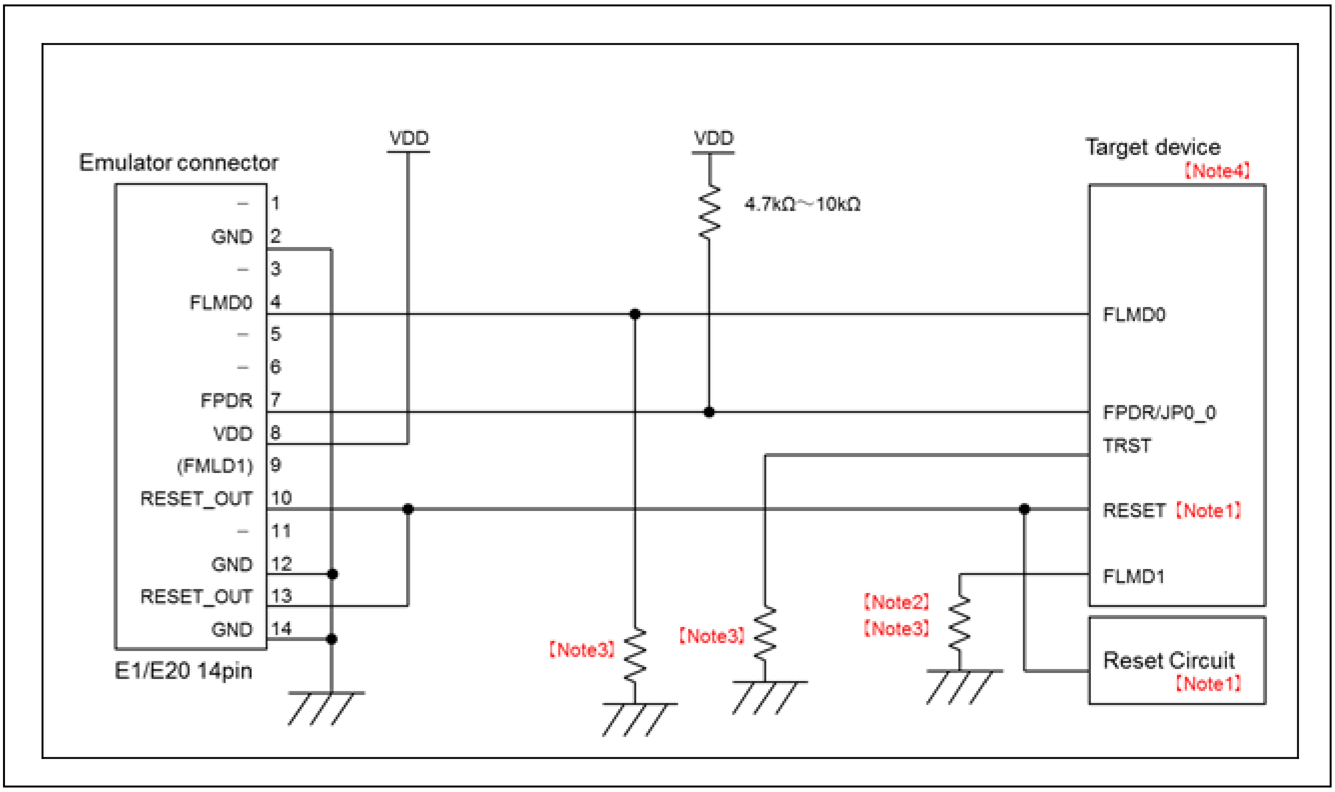
- Proceed with appropriate processing for pins of target devices which do not require connection to the emulator in accord with the descriptions in “Handling of Unused Pins” in the user’s manual for the target device.

Notes: 1. This connection is designed on the assumption that the RESET signal output is from an N-channel open-drain buffer. For details, refer to section 2.3.2, Connecting the RESET pin.

2. This signal must be set to the low level during a reset. If you are using a multiplexed function, make sure that this signal is not at the high level on release from the reset state.

3. Refer to the datasheet of the device regarding the resistance and whether the resistor should be pulling up or pulling down.

4. Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.



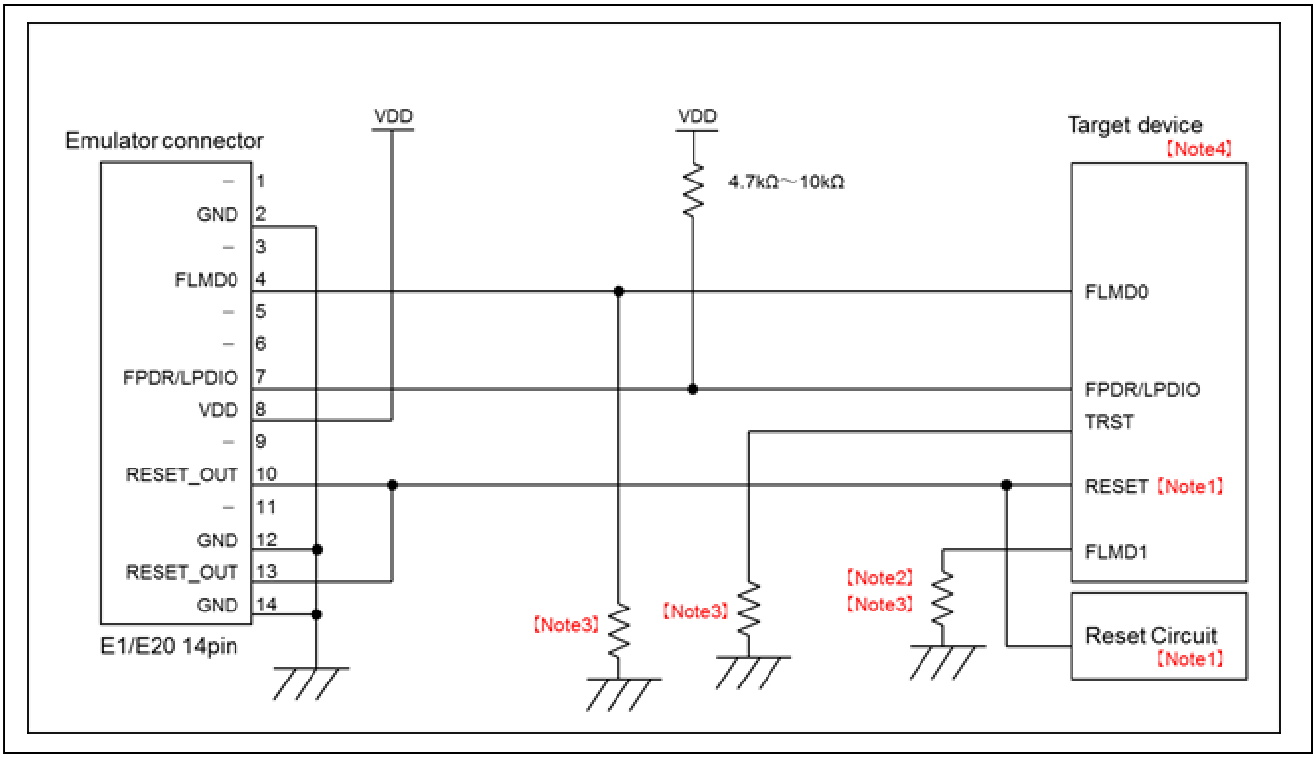
Caution: Make wiring runs between the connector and the target device as short as possible.

Figure 2-6 Example of Recommended Connection (Only Programming (UART))

- Make wiring runs between the 14-pin connector and target device as short as possible (within 50 mm is recommended). Do not connect the signal lines between the connector and MCU to other signal lines.
- Use GND to apply a guard ring for the wiring which runs between the 14-pin connector and target device. Do not route high-speed signal lines parallel to each other or allow them to cross each other.
- Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.
- Proceed with appropriate processing for pins of target devices which do not require connection to the emulator in accord with the descriptions in “Handling of Unused Pins” in the user’s manual for the target device.

Notes:

1. This connection is designed on the assumption that the RESET signal output is from an N-channel open-drain buffer. For details, refer to section 2.3.2, Connecting the RESET pin.
2. This signal must be set to the low level during a reset. If you are using a multiplexed function, make sure that this signal is not at the high level on release from the reset state. If you are using a multiplexed function which requires that this signal be pulled up, connect it to pin 9 (FLMD1) of the emulator before it is set to the low level during programming of the flash memory.
3. Refer to the datasheet of the device regarding the resistance and whether the resistor should be pulling up or pulling down.
4. Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.



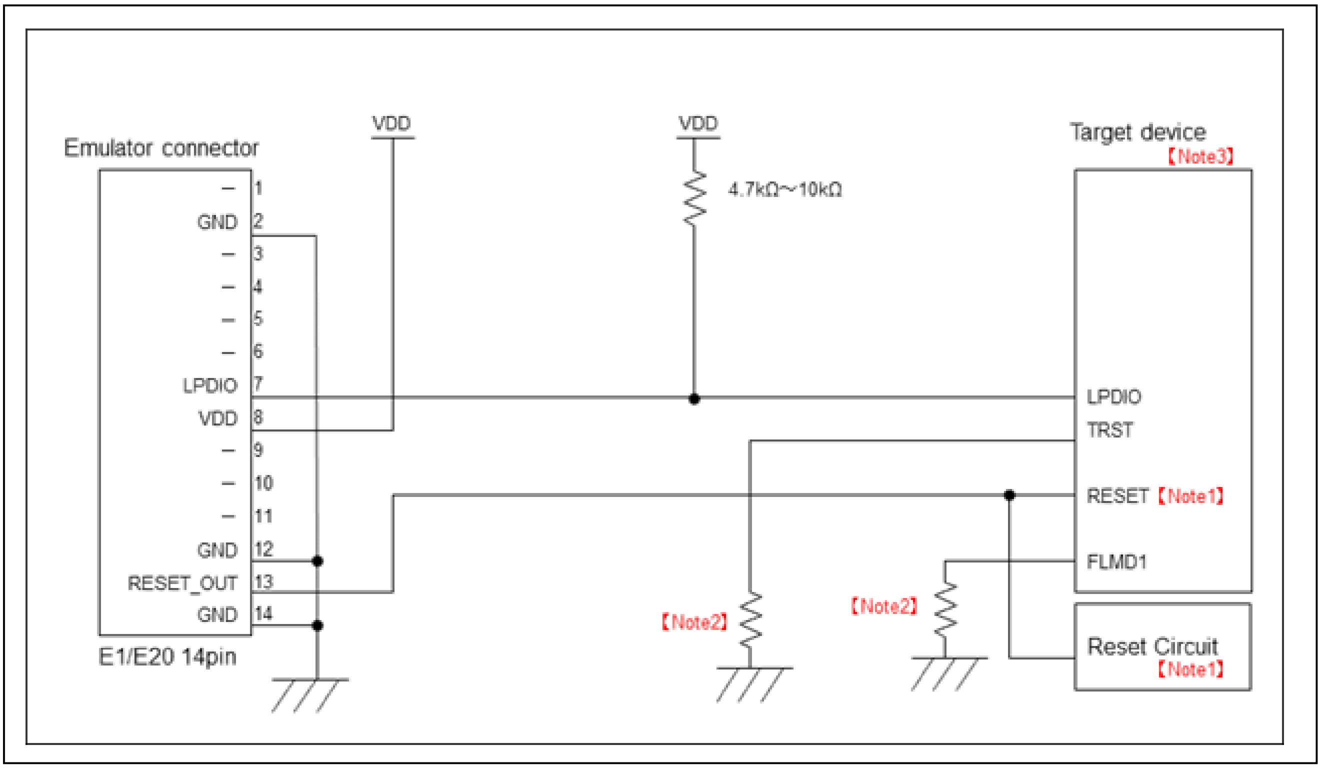
Caution: Make wiring runs between the connector and the target device as short as possible.

Figure 2-7 Example of Recommended Connection (Both Debugging (LPD) and Programming (UART))

- Make wiring runs between the 14-pin connector and target device as short as possible (within 50 mm is recommended). Do not connect the signal lines between the connector and MCU to other signal lines.
- Use GND to apply a guard ring for the wiring which runs between the 14-pin connector and target device. Do not route high-speed signal lines parallel to each other or allow them to cross each other.
- Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.
- Proceed with appropriate processing for pins of target devices which do not require connection to the emulator in accord with the descriptions in “Handling of Unused Pins” in the user’s manual for the target device.

Notes:

1. This connection is designed on the assumption that the RESET signal output is from an N-channel open-drain buffer (the output resistance is 100 Ω or lower). For details, refer to section 2.3.2, Connecting the RESET pin.
2. This signal must be set to the low level during a reset. If you are using a multiplexed function, make sure that this signal is not at the high level on release from the reset state. If you are using a multiplexed function which requires that this signal be pulled up, connect it to pin 9 (FLMD1) of the emulator before it is set to the low level during programming of the flash memory.
3. Refer to the datasheet of the device regarding the resistance and whether the resistor should be pulling up or pulling down.
4. Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.



Caution: Make wiring runs between the connector and the target device as short as possible.

Figure 2-8 Example of Recommended Connection (Only Debugging (LPD))

- Make wiring runs between the 14-pin connector and target device as short as possible (within 50 mm is recommended). Do not connect the signal lines between the connector and MCU to other signal lines.
- Use GND to apply a guard ring for the wiring which runs between the 14-pin connector and target device. Do not route high-speed signal lines parallel to each other or allow them to cross each other.
- Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.
- Proceed with appropriate processing for pins of target devices which do not require connection to the emulator in accord with the descriptions in “Handling of Unused Pins” in the user’s manual for the target device.

Notes: 1. This connection is designed on the assumption that the RESET signal output is from an N-channel open-drain buffer (the output resistance is 100 Ω or lower). For details, refer to section 2.3.2, Connecting the RESET pin.

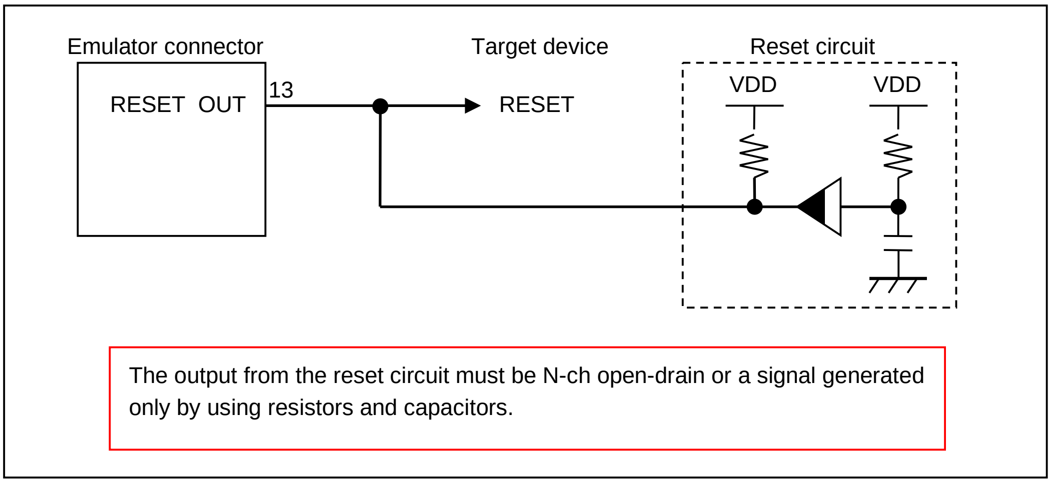
2. Refer to the datasheet of the device regarding the resistance and whether the resistor should be pulling up or pulling down.

3. Pin names may vary among target devices. Refer to the user’s manual for the target device you are using for the actual pin names.

2.3.2 Connecting the RESET pin

Connect the RESET signal as shown in Figure 2-9 if any of the conditions listed below is satisfied.
If none of the conditions is satisfied, leave the RESET pin producing the signal output from the emulator open-circuit.

- The target device must be kept in the reset state before the debugger is started up and after the debugger is stopped.
- The E1/E20 emulator is being used for programming flash memory.
- The emulator is using the serial OCD (debugging via a UART).



The output from the reset circuit must be N-ch open-drain or a signal generated only by using resistors and capacitors.

Figure 2-9 Example of Connecting a Reset Circuit

2.3.3 Connecting VDD

Connect VDD of the emulator connector to the power supply pin of the debugging or programming interface on the user system.

Use the emulator within the range of power-supply voltages from 1.8 V to 5.5 V and within the operating voltage range of the MCU.

The power supply connected to VDD of the emulator connector draws about 10 mA for the power supplies of the first stage input buffer and final stage output buffer of the emulator.

If there is a possibility you will be using hot plug-in, you will need to configure the circuit as shown below.

Pin 8 (VDD) of the E1/E20 emulator is connected to a 4.7-uF capacitor as shown in Figure 2-10, so hot plug-in connection of the emulator may lead to a momentary drop in the power-supply voltage on the user system. This might cause the MCU to be reset.

As shown in Figure 2-11, this effect can be reduced by placing a ferrite bead (or inductor) and relatively large capacitor with low equivalent series resistance near the TVDD line of the connector for connection of the emulator. Note that this measure will not completely eliminate the voltage drop. Hot plug-in is only for use during debugging with a JTAG connection or LPD connection, and requires a hot plug-in adapter that is separately available from Renesas.

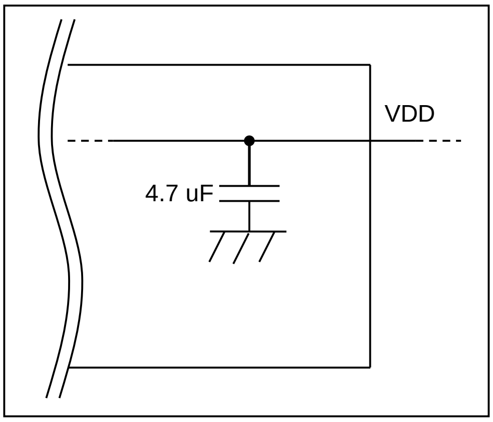


Figure 2-10 E1/E20 Emulator Internal Circuit

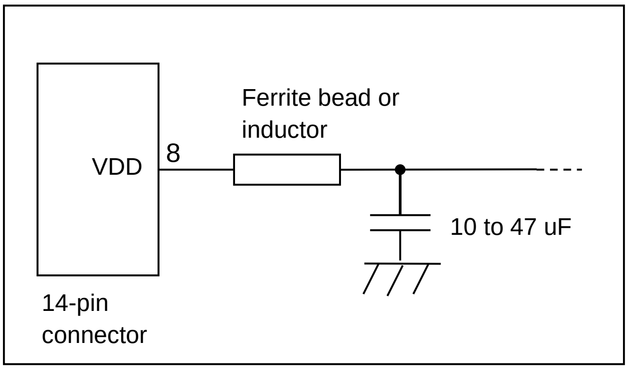


Figure 2-11 The Measure Method of E1 Emulator

2.3.4 Power supply function (applies only to the E1 emulator)

The E1 emulator can supply power to a system for simple evaluation. It can supply up to 200 mA of current.

If you are using the power-supply function of the E1 emulator, check the voltage supplied to the user system. In particular, the 5.0-V supply depends on the USB VBUS power-supply voltage and the voltage might be lower than 5.0 V by 0.5 V or more.

Power supply from the E1 emulator depends on the quality of the USB power supply of the host machine, and as such, precision is not guaranteed. When writing a program that requires reliability, do not use the power supply function of the E1 emulator. Use a stable, separate power supply for the user system. When writing a program for mass production processes, use the Flash Development Toolkit or the Renesas Flash Programmer.
For details on the flash programming software, refer to
http://www.renesas.com/products/tools/flash_prom_programming/ .

⚠WARNING

Warning for Turning the Power On/Off:

When supplying power, ensure that there are no shorts between the user system and power circuit. Only connect the E1 or E20 after confirming that there are no mismatches of alignment on the user system port connector. Incorrect connection will result in the host machine, the emulator, and the user system emitting smoke or catching fire.

2.3.5 16-pin conversion adapter for the E1 emulator

When the E1 emulator is connected to a user system having the 16-pin connector, which was supported by the QB-MINI2, QB-V850MINI, QB-V850MINIL, PG-FP5, etc., use the 16-pin conversion adapter for the E1 emulator (QB-F14T16-01) that is separately available from Renesas.

2.3.6 Hot plug-in adapter for the E1 emulator

For hot plug-in connection, use the hot plug-in adapter for the E1 emulator (R0E000010ACB00) that is separately available from Renesas.

2.3.7 Isolator for the E1 emulator

For a debugging environment where there is a GND gap between the user system and host PC, use the isolator for the E1 emulator (R0E000010ACB20) that is separately available from Renesas.

2.3.8 Small connector conversion adapter for the E1 emulator

The small connector conversion adapter for the E1 emulator (R0E000010CKZ11) is separately available from Renesas for a user system board which is too small to mount the 14-pin connector that is the standard connector for the E1 emulator. By using the adapter, you can reduce the area taken up by the connector mounted on your system.

When you use the small connector conversion adapter for the E1 emulator (R0E000010CKZ11), be aware that the connector pin assignments differ from those of the E1 emulator’s standard interface connector.

2.3.9 14- to 38-pin conversion adapter for the E1 emulator (for the V850)

When the E1 emulator is connected to a user system having the Mictor connector, use the 14- to 38-pin conversion adapter for the E1 emulator (QB-F14T38V850-01) that is separately available from Renesas. Table 2-3 shows the pin assignments of the Mictor connector for the V850.

Table 2-3 Pin Assignments of the Mictor Connector for the V850

Pin No.	Signal Name (#: active low)	I/O (*1)
1	GND	-
2	GND	-
3	TCK	Input
4	VDD	-
5	TMS	Input
6	TRST#	Input
7	TDI	Input
8	RESET_OUT#	Input
9	TDO	Output
10	FLMD0	Input
11	MSEO0 (*2)	Output
12	RDY#	Output
13	MSEO1 (*2)	Output
14	EVTO# (*2)	Output
15	-	-
16	EVTI# (*2)	Input
17	MCKO (*2)	Output
18	-	-
19	-	-
20	-	-
21	MDO0 (*2)	Output
22	MDO8 (*2)	Output
23	MDO1 (*2)	Output
24	MDO9 (*2)	Output
25	MDO2 (*2)	Output
26	MDO10 (*2)	Output
27	MDO3 (*2)	Output
28	MDO11 (*2)	Output
29	MDO4 (*2)	Output
30	MDO12 (*2)	Output
31	MDO5 (*2)	Output
32	MDO13 (*2)	Output
33	MDO6 (*2)	Output
34	MDO14 (*2)	Output
35	MDO7 (*2)	Output
36	MDO15 (*2)	Output
37	GND	-
38	GND	-

Notes 1. Input and output are defined from the perspective of the user system.
2. The E1 and E20 emulators do not support event and trace signals from the V850.

The E20 emulator has a Mictor connector as a user interface, but this is not connectable to V850 user systems that have been designed according to the pin assignments in Table 2-3.

If you are using an E20 emulator, use the 14- to 38-pin conversion adapter (R0E000200CKA00) that comes with the E20. Connect the user system, QB-F14T38V850-01, R0E000200CKA00, and the E20 emulator in that order.

⚠WARNING
Warning Regarding Connecting the E20 Emulator to the Mictor Connector: If the E20 emulator is directly connected to the Mictor connector on a V850 user system, the result will be the host machine, the emulator, and the user system emitting smoke or catching fire.

3. Securing Debugging Resources for a Serial OCD Interface

When a serial OCD interface (debugging through a UART) is in use, the user must prepare the following to handle communications between the E1/E20 emulator and the target device. Refer to the descriptions on the following pages and set these items in the user program or by using compiler options. When using the JTAG or LPD interface, the settings in this section are not required.

- Modification of the reset handler
- Allocation of memory spaces for debugging
- Allocation of a serial interface for communications

3.1 Reset handler

The reset handler must include an instruction to jump to the debug monitor program.

[Securing the area]

It is not necessary to secure this area intentionally. When downloading a program, however, the debugger rewrites the reset vector as described below in the various cases given. If the rewriting pattern does not match the following cases, the software tool is generating an error.

• When three nop instructions are consecutively placed from address 0

Before rewriting	After rewriting
0x0 nop	Instruction to jump to the debug monitor program at 0x0
0x2 nop	
0x4 nop	
0x6 xxxx	0x6 xxxx

• When three 0xFFFFs are consecutively placed from address 0 (applies to erased devices)

Before rewriting	After rewriting
0x0 0xFFFF	Instruction to jump to the debug monitor program at 0x0
0x2 0xFFFF	
0x4 0xFFFF	
0x6 xxxx	0x6 xxxx

• The jr instruction is placed at address 0 (when using the CX compiler from Renesas Electronics)

Before rewriting	After rewriting
0x0 jr disp22	Instruction to jump to the debug monitor program at 0x0
0x4 xxx	
0x6 xxx	0x6 jr disp22 – 6

- mov32 and jmp are consecutively placed from address 0

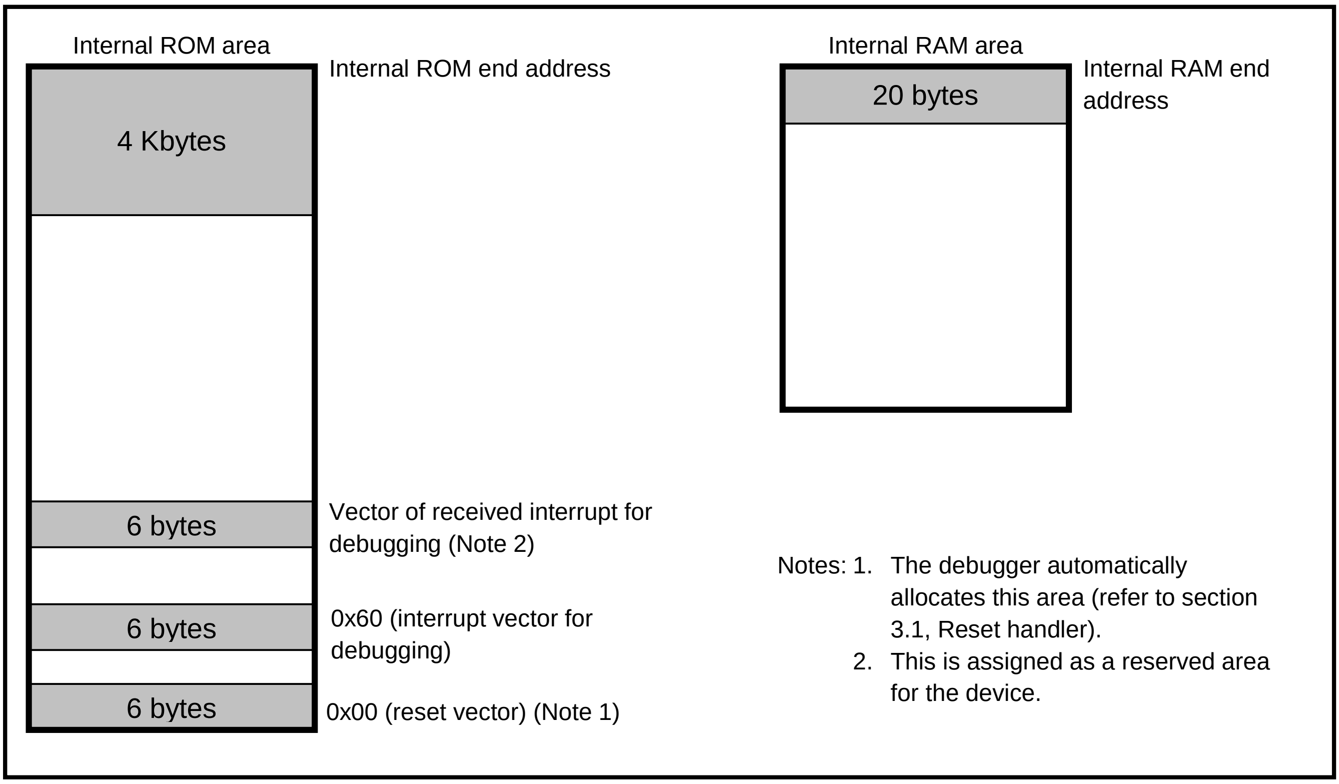
Before rewriting	After rewriting
0x0 mov imm32,reg1	Instruction to jump to the debug monitor program at 0x0
0x6 jmp [reg1]	0x6 mov imm32,reg1
	0xc jmp [reg1]

- The instruction to jump to the debug monitor program has been placed at address 0

Before rewriting	After rewriting
Instruction to jump to the debug monitor program at 0x0	Not changed

3.2 Securing memory areas for debugging

Since the shaded areas in Figure 3-1 are the areas reserved for the debugging monitor program, user programs and data cannot be allocated to these areas. These areas must be secured so that they are not used by the user program.



Notes: 1. The debugger automatically allocates this area (refer to section 3.1, Reset handler).
2. This is assigned as a reserved area for the device.

Figure 3-1 Memory Areas Required by the Debug Monitor Program

3.3 Securing a serial interface for communications

The debugging monitor program secures a serial interface for communications (by setting the I/O registers). However, a user program changing the settings may lead to an error in communications.

To prevent such a problem from occurring, the user program must not change the values set by the debugging monitor program.

Settings other than those shown overleaf are prohibited.

Do not change bit 0 of any register for port JP0 which is not shown below from its initial value.

[Port group JP0]

- Port IP control register

x: Any value

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
JPIPC0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0

- Port bidirectional control register

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
JPBDC0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1

- Port open-drain control register

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
JPODC0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1

- Port function control expansion register

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
JPFCE0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1

- Port function control register

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
JPFC0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1

- Port mode control register

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
JPMC0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1

- Port mode register

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
JPM0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0

4. Specifications

Specifications are shown in the table below.

Broad Category	Medium Category	Narrow Category	Specification
Hardware in general	Corresponding host machine		Computer equipped with a USB port, OS depends on the software
	User system interface		14-pin connector
	Host machine interface		USB 2.0 (full speed or high speed)
	Connection to the user system		Connection by the provided user system interface cable
	Power supply function (only when the emulator is an E1)		3.3 V or 5.0 V (with current up to 200 mA) can be supplied to the user system (make settings with the debugger)
	Power supply for the emulator		No need (the host computer supplies power through the USB)
Debugging-related items	Break*1	Software break	ROM area: 8 points RAM area: 2000 points
		Hardware break	4 points including those used for both execution and access conditions
		Forced break	Available
	Event*1	Number of events that can be set	4 points including those used for both execution and access conditions
		Available function	Hardware break only
		Combination of events	OR, sequential
	Tracing		Unavailable
	Performance measurement	Measurement item	From run to break
		Performance	JTAG connection: Resolution: 200 ns, maximum measurement time: 7 minutes Serial OCD connection: Resolution: 100 us, maximum measurement time: 119 hours and 18 minutes LPD connection (Px4-L is in use): (*: CPU clock) Resolution: 100 ns, maximum measurement time: 3.5 minutes (80 MHz*) Resolution: 125 ns, maximum measurement time: 4.5 minutes (64 MHz*) Resolution: 166 ns, maximum measurement time: 6 minutes (48 MHz*)
	Real-time RAM monitoring (RRM)		Available*2
	Direct memory modification (DMM)		Available*2
	Debugging console		Unavailable
	Downloading to the external flash memory		Aavailable (depending on the software)
	Hot plug-in		Debugging with JTAG or LPD: Available (requires a hot plug-in adapter separately available from Renesas) Not available with a serial OCD connection
	Peripheral breaks		Available*3
	Security		12-byte ID code authentication
Programming-related items	Clock supply		Clock on the user system is usable.
	Security flag settings		Available
	Stand-alone operation		Not available (requires connection to the host machine)

Notes:
1. The number of breaks that can be set depends on the specification of the device.
2. With a serial connection, short breaks in monitoring or delays in modification will occur.
   With a JTAG or LPD connection, such short breaks or delays will only occur if the bus is occupied and access is to an area other than the RAM.
3. A function for stopping the operation of peripheral I/O modules during a break is called the peripheral break function. Whether or not peripheral breaks are generated is specifiable in the debugger.
   For how to specify peripheral breaks, check the manual for the debugger you are using. For selecting whether peripheral breaks can be generated or not, check the manual for the MCU you are using.

   Details on setting of peripheral breaks (this depends on whether the MCU you are using does or does not support the setting described)

   • Setting the generation of peripheral breaks by the debugger
   The SVSTOP bit in the EPC register of the MCU is set to 1. Do not set the EPC register from the user program because the debugger sets this.
   This setting can be enabled or disabled for individual peripheral modules by the *xxx*SVSDIS bit in the *xxx*EMU register.
   If you require them, make these settings from the user program. For details, check the user's manual for the MCU you are using.
   Settings of the EPC and *xxx*EMU registers will not affect operation while the emulator is not connected.

SVSTOP bit in the EPC register	*xxx*SVSDIS bit in the *xxx*EMU register	Peripheral module during a break
0	*	Operating
1	0	Stopped
1	1	Operating

5. Notes on Usage

Cautionary notes on using the E1/E20 emulator are given below.

5.1 List

Table 5-1 List of Notes on Usage

No.	Item
1	Handling of devices which were used for debugging
2	Condition for breaks not being usable (serial OCD connection only)
3	Conditions for the pseudo real-time RAM monitor (RRM) and DMM functions not operating (serial OCD connection only)
4	Cancellation of power-save modes (HALT, STOP, and DEEPSTOP modes)
5	Using the DMM function to write values to peripheral I/O registers which require a specific sequence
6	Flash self-programming
7	Operation after a reset (serial OCD connection only)
8	Debugging only with the actual device, i.e. without using an E1/E20 emulator (serial OCD connection only)
9	Multiplexed pin functions for pins of the connection
10	Current drawn
11	Power-saving modes
12	WAKE pin
13	PWGD pin
14	Debugging when the POC function and the power supply are turned off
15	ECC errors
16	Stopping the high-speed internal oscillator (high-speed IntOsc)
17	Iso0 and Iso1 areas
18	Reset through the external pin
19	Hardware breaks in the internal RAM area
20	Quality of flash programming
21	Data read break (Fx4-L series only)
22	Turning the power on/off
23	Note on hot plug-in connection (JTAG or LPD connection only)
24	Note on internal watchdog timer and flash programming
25	Cautionary note on connecting an emulator

5.2 Details

No. 1 Handling of devices which were used for debugging

Description: Do not use devices that were used for debugging in mass-production. This is because writing to the flash memory of such devices has already proceeded during debugging, so we cannot guarantee the number of times rewriting of the flash memory can proceed. Software errors occur when programming of the flash memory is no longer possible. Replace the device in such situations.

No. 2 Condition for breaks not being usable (serial OCD connection only)

Description: Forced breaks are not usable if the following condition is satisfied.

- Interrupts are disabled (DI).

No. 3 Conditions for the pseudo real-time RAM monitor (RRM) and DMM functions not operating (serial OCD connection only)

Description: The pseudo-RRM and DMM functions do not operate if either of the following conditions is satisfied.

- Interrupts are currently disabled (DI).
- The operating clock differs from that specified in the debugger.

No. 4 Release from power-saving modes (HALT, STOP, and DEEPSTOP modes)

Description: Using the following functions leads to release from a power-saving mode.

- The pseudo-RRM and DMM functions (serial OCD connection only)
- Generation of a break

No. 5 Using the DMM function to write values to peripheral I/O registers which require a specific sequence

Description: The DMM function cannot be used to write to peripheral I/O registers that require a specific sequence of write operations for writing to succeed.

No. 6 Flash self-programming

Description: With a serial OCD connection

If the space containing the debugging monitor program is overwritten by flash self-programming, the debugger will not operate correctly. The following operations must be avoided.

- Generation of breaks during flash self-programming
- Stepped execution of a program where a step leads to flash self-programming

With a JTAG or LPD connection

Do not access or have breakpoints set in the ROM area during flash self-programming.

No. 7 Operation after a reset (serial OCD connection only)

Description: Since the monitor program handles initialization for debugging after a reset, whether due to the signal on the external pin or an internal reset, the time from release from the reset state to execution of the user program differs from that in actual operation of the device.

No. 8 Debugging only with the actual device, i.e. without using an E1/E20 emulator (serial OCD connection only)

Description: For debugging only with an actual device, i.e. without using an E1/E20 emulator, the user program must be programmed by the Renesas flash programmer (RFP). The programs downloaded by the debugger include the monitor program, and this operates incorrectly if it is not controlled by the E1/E20 emulator.

No. 9 Multiplexed pin functions for pins of the connection

Description: Multiplexed functions for pins of the connection cannot be used during debugging.

No. 10 Current drawn

Description: The target device consumes more power during debugging than in normal operation since the debugging functions are operating.

No. 11 Power-saving modes

Description: Before setting isolated areas 0 and 1 (Iso0 and Iso1) to a power-saving mode, clear the wake-up factor masks (WUPMSKH0-WUPMSKH015 and WUPMSKH1-WUPMSKH115) of Iso0 and Iso1, respectively. Before setting only Iso1 to a power-saving mode, clear the wake-up factor masks (WUPMSKH1-WUPMSKH115).

If these settings are not made, debugger operation is disabled in power-save mode and the debugger may hang.

No. 12 WAKE pin

Description: The WAKE pin is fixed to the high level in some devices during periods in DeepStop mode and resets.

No. 13 PWGD pin

Description: The PWGD pin must be fixed to the high level when not in use. Even if the PWGDEN option byte is cleared to 0, handle the PWGD pin by fixing it to the high level when not in use.

No. 14 Debugging when the POC function and the power supply are turned off

Description: The power supply of the user system must not be turned off during debugging. Check the operation when the POC function and the power supply of the user system are turned off while the emulator is not connected. If the power supply of the user system is even momentarily turned off, the debugger may hang.

No. 15 ECC errors

Description: In flash self-programming, a program is downloaded to initialize the internal RAM area so that no ECC errors occur. Therefore, ECC errors cannot be emulated after downloading of a program.

No. 16 Stopping the high-speed internal oscillator (high-speed IntOsc)

Description: Generation of break while the high-speed IntOsc is stopped may cause the debugger to hang. Apply a reset to restore debugger operation.

No. 17 Iso0 and Iso1 areas

Description: During debugging, power to the Iso0 and Iso1 areas is not shut down during an internal or external reset, or while in deep stop mode (so that values in RAM are retained).

No. 18 Reset through the external pin

Description: Do not allow the generation of a reset in the form of a pin reset other than while the program is in execution. If a reset is generated in this way, the debugger may hang. Even if the reset mask setting in the debugger is for masking, the debugger may still hang.

If a pin reset is generated regardless of the above, starting the debugger and connecting the emulator are not possible.

No. 19 Hardware breaks in the internal RAM area

Description: If a hardware break is set at a location in the internal RAM area, a break will occur when lower-order address bits match and this leads to breaks at unintended positions, as described by the example below.

Example: When a break is set at 0x0FED_C000H, breaks will also occur at the following addresses.

0x01ED_C000H, 0x03ED_C000H, 0x05ED_C000H, 0x07ED_C000H, 0x09ED_C000H, 0x0BED_C000H, and 0x0DED_C000H

No. 20 Quality of flash programming

Description: To improve the quality, follow the guidelines below.

- Circuits are designed as described in the user's manuals for the MCU and E1/E20 emulator.
- The MCU, E1/E20 emulator, and the software are used as described in respective user's manuals.
- The supply of power to the user system is stable.

No. 21 Data read break (Fx4-L series only)

Description: The data read break is not available on these devices. Do not set data conditions if you are debugging a program on an Fx4-L series device.

No. 22 Turning the power on/off

Description: Turn the power of the E1/E20 emulator and the user system following the procedure below.

- When a separate power supply is used for the user system

<When using the emulator>

(1) Check the power is off.
Check that the user system is turned off. When using the E20 emulator, check its power switch is off.

(2) Connect the user system.
Connect the emulator and the user system with a user-system interface cable.

(3) Connect the host machine and turn on the emulator.
Connect the emulator and the host machine with a USB interface cable. The E1 emulator is turned on by connecting the USB interface cable. When using the E20 emulator, turn on its power switch.

(4) Turn on the user system.
Turn on the user system.

(5) Launch the emulator debugger.
Launch the debugger.

<When finished using the emulator>

(1) Close the emulator debugger.
Close the emulator debugger.

(2) Turn off the user system.
Turn off the user system.

(3) Turn off the emulator and disconnect the emulator.
When using the E20 emulator, turn off its power switch. Disconnect the USB interface cable from the E1/E20 emulator. The E1 emulator is turned off by disconnecting from the USB interface cable.

(4) Disconnecting the user system.
Disconnect the user-system interface cable from the user system.

⚠CAUTION

Notes on the User System Power Supply:

❗ While the power of the user system is on, do not turn off the host machine, unplug the USB interface cable, or turn off the power switch of the E20 emulator.
The user system may be damaged due to leakage current.

- When power is supplied to the user system from the emulator (E1 emulator)

<When using the emulator>

(1) Connect the user system.
Connect the emulator and user system with a user-system interface cable.

(2) Connect the host machine and turn on the emulator.
Connect the emulator and host machine with a USB interface cable, then turn on the emulator.

(3) Launch the emulator debugger.
Launch the emulator debugger and select the setting of power supply to the user system.

<When finished using the emulator>

(1) Close the emulator debugger.
Close the emulator debugger.

(2) Turn off the emulator and disconnect the emulator.
Disconnect the USB interface cable from the emulator, then turn off the emulator.

(3) Disconnecting the user system.
Disconnect the user-system interface cable from the user system.

No. 23 Note on hot plug-in connection (JTAG or LPD connection only)

Description: Hot plug-in connection cannot be used in DeepSTOP mode.

No. 24 Note on internal watchdog timer and flash programming

Description: When a break is generated while an internal watchdog timer is enabled, and the contents of flash memory are changed by the debugger (downloading or editing from the memory window) and an option byte is read, apply a reset from the debugger before continuing with execution of the program.

No. 25 Cautionary note on connecting an emulator

Description: When the debugger has been started and an emulator is connected, care must be taken over the period until the emulator generates a break in the MCU, because the program in the MCU will still run (automatically) from the reset vector for a certain time.

This still applies in cases where the emulator is connected to the reset pin of the MCU. The program runs for about 3 msec if the connection is JTAG and for about 140 msec if the connection is LPD while the emulator is being released from the reset state until it generates a break in the MCU. This period over which the program runs is called the automatic program-running period, and depends on the environment of the host machine for the E1/E20 emulator.

Due to the specifications of the microcontrollers, starting the debugger then connecting an emulator is not possible during a pin or internal reset, or during periods in DeepSTOP mode.

To connect the emulator, release the MCU from any pin reset other than from the E1/E20 emulator and ensure that an internal reset is not generated or a transition to DeepSTOP mode is not made during the automatic program-running period described above.

When a program that generates an internal reset or causes a transition to DeepSTOP mode running on the MCU is being debugged during the automatic-running period, the contents of the flash memory must be erased once by using the flash programming software (RFP) or a flash programmer (e.g. the PG-FP5).

Also, review the setting of the option byte which is used to set operation of the internal watchdog timer as required.

E1/E20 Emulator
Additional Document for User's Manual (Notes on Connection of V850E2M and V850E2S)

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E1/E20 Emulator

Additional Document for User’s Manual
(Notes on Connection of V850E2M and V850E2S)

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