User's Manual

E1 Emulator

Additional Document for User's Manual
(Notes on Connection)

Supported Devices:
78K0R Family

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Table of Contents

Chapter 1 Outline

1.1 Features

E1/E20 Emulator (hereinafter referred to as E1/E20) is an on-chip debug emulator with flash programming function, which is used for debugging and programming a program to be embedded in on-chip flash memory microcontrollers. This product can debug with the target microcontroller connected to the user system, and can write programs to the on-chip flash memory of microcontrollers.

1.2 Cautions on Using E20

The functions used for debugging of the 78K0R device by using the E20 are the same as in the E1. Large trace function, characteristic functions of the E20, cannot be used. The power supply function from the E20 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 the 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 has the following contents:

- Components of the emulators
- Emulator hardware specification
- Connection to the emulator and the host computer and user system

(2) E1/E20 Emulator Additional Document for User's Manual

The E1/E20 Emulator Additional Document for User's Manual has the following contents:

- For use in hardware design, an example of connection and the interface circuit required to connect the emulator.
- Notes on using the emulator
- Software specifications and so on for using each microcomputers

Chapter 2 Designing the 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 section of this manual and the hardware manual for the MCUs.

2.1 Connecting the Emulator with the User System

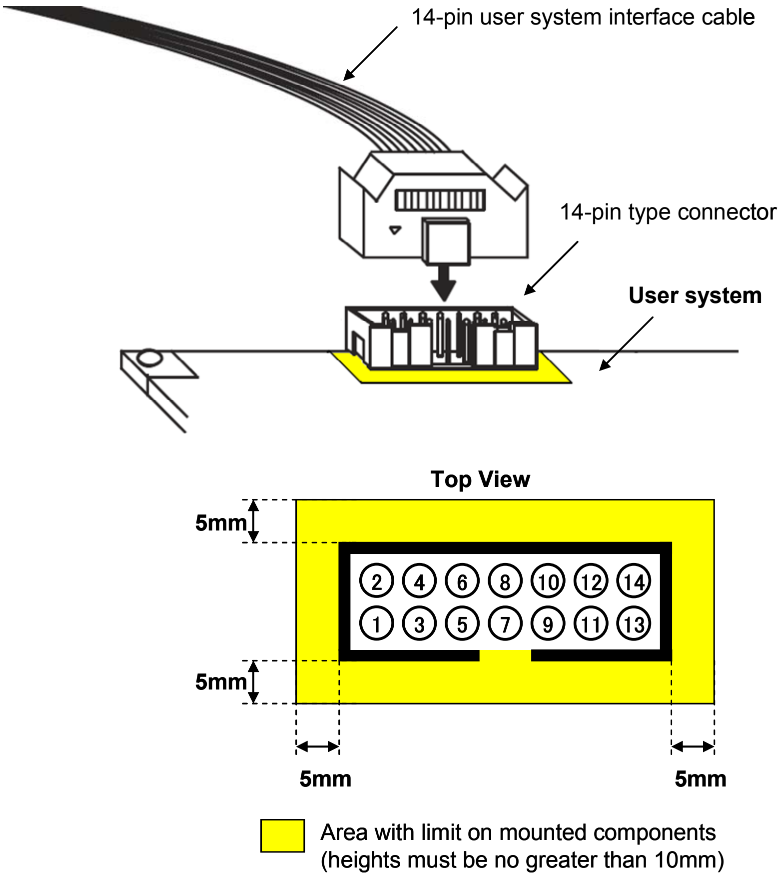
Table 2-1 shows the connector type numbers of the E1 emulators.

Table 2-1 Connector Type Numbers

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

Figure 2.1 shows examples of the connection between a user system interface cable of the 14-pin type. Do not mount other components with a height exceeding 10 mm within 5 mm of the connector on the user system. 38-pin of the E20 is not supported. To use the E20, use the 38-pin/14-pin conversion adapter [R0E000200CKA00] that comes with the E20 for connection.

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



2.2 Comumunication Mode

E1/E20 performs serial communication with the target device on the target system. For serial communication, 1-wire mode (single-wire UART communication) using the TOOL0 pin, or 2-wire modeusing the TOOL0 and TOOL1 pins is used. Use 1-wire mode when performing flash programming. Use 1-wire modeor 2-wire mode when performing on-chip debugging. Differences between 1-wire mode and 2-wire mode are shown below. There are no functional differences.

Table 2-2 Difference Between 1-Wire Mode and 2-Wire Mode

Communication Mode.	During Flash Programming	During Debuging
1-wire mode	No differences	User resources secured for debugging Internal ROM: 1036 bytes Internal RAM: 6 bytes (stack)
2-wire mode		User resources secured for debugging [Pseudo RRM/DMM function is used] Internal ROM: 1036 bytes Internal RAM: 6 bytes (stack) [Pseudo RRM/DMM function is not used] Internal ROM: 100 bytes Internal RAM: 6 bytes (stack)

2.3 Pin Assignment of the Connector on the User System

Table 2-3 shows the pin assignments of the 14-pin connectors.

Table 2-2 Pin assignments of the connector (14-pin)

Pin No.	Pin Name	Input/Output[Note 1]
1	TOOL1	Input
2	GND[Note 2]	-
3	R.F.U	-
4	FLMD0	Output
5	R.F.U	-
6	RESET_IN	Input
7	TOOL0	Output/Input
8	VDD	-
9	R.F.U	-
10	RESET_OUT[Note 3]	Output
11	R.F.U	-
12	GND[Note 2]	-
13	RESET_OUT[Note 3]	Output
14	GND[Note 2]	-

Note 1 As seen from E1/E20.

Note 2 Securely connect pins 2, 12, and 14 of the connector to GND of the user system. These pins are used for electrical grounding as well as for monitoring of connection with the user system by the E1/E20.

Note 3 Securely connect both pin 10 and pin 13. These pins are also used to monitor the user system.

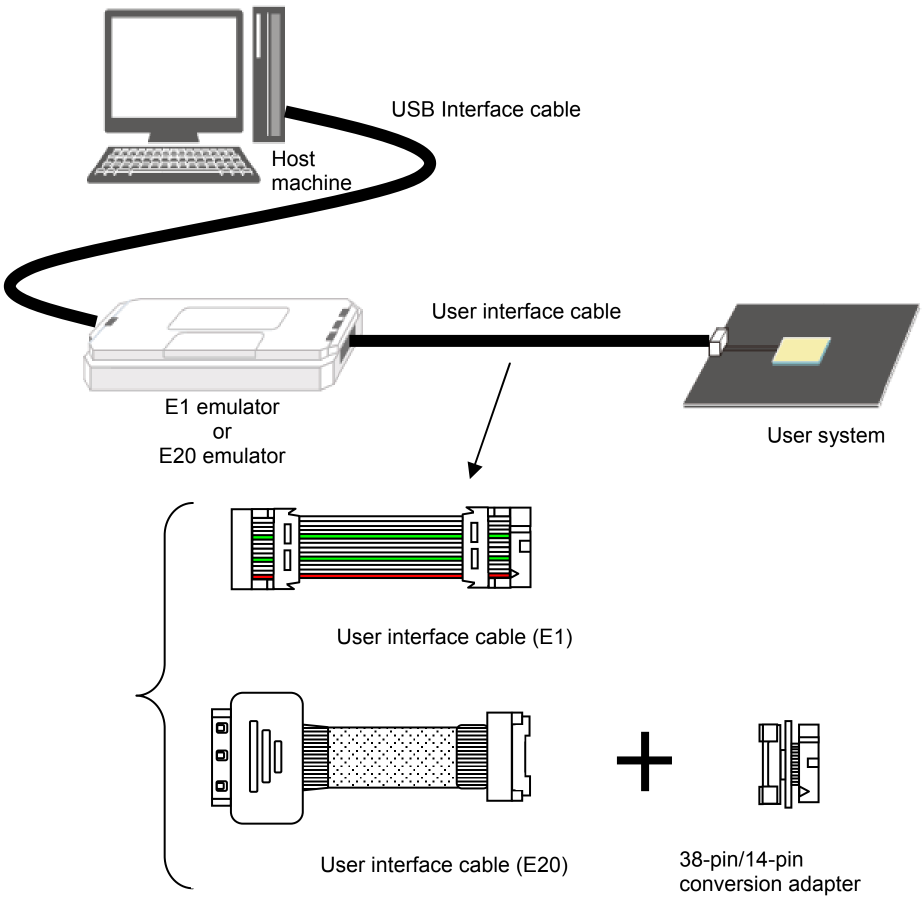
Table 2-4 Pin Functions

Pin Name	Input/Output[Note 1]	Description
RESET_IN	Input	Pin used to input reset signal from the user system
RESET_OUT	Output	Pin used to output reset signal to the target device
FLMD0	Output	Pin used to set the target device to debug mode or programming mode.
TOOL0	Output/Input	Pin used to transmit command/data to the target device
TOOL1	Input	Pin used to input clock signal to the target device
R.F.U.	–	This pin is reserved. For the connection of the reserved pins, see each circuit related to the pins.

2.4 System Configuration

Figure 2-2 shows the system configuration used for the E1/E20. For cautions on connection, refer to the E1/E20 User's Manual.

Figure 2-2 Connection Diagram of E1/E20



Remark To use it with the E20, connect the 38-pin/14-pin conversion adapter to the user interface cable (E20). 38-pin is not supported.

Note 1 As seen from E1/E20

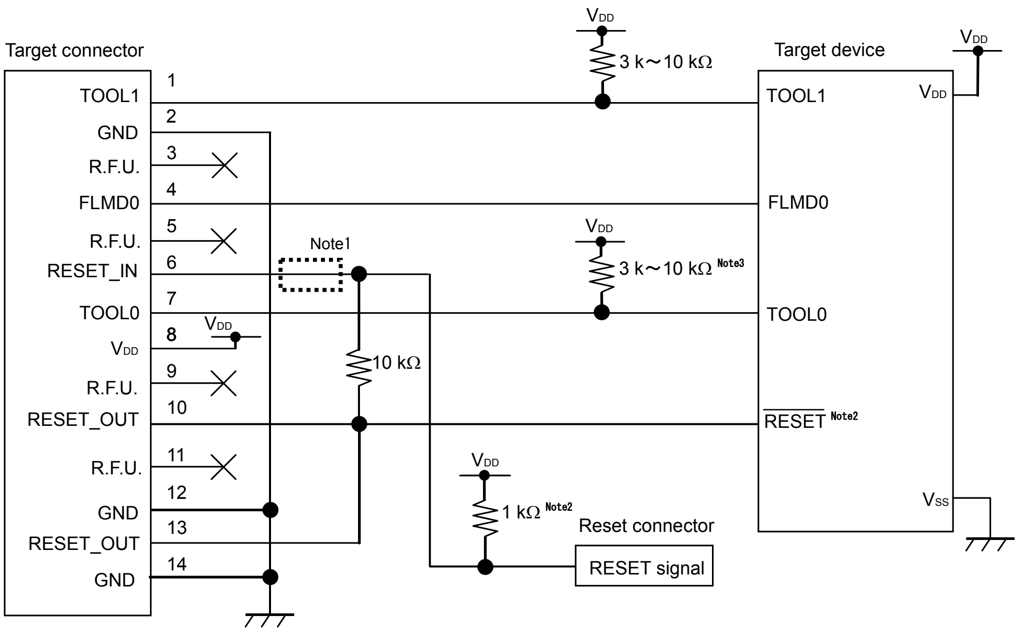
2.5 Recommend Circuit between the Connector and the CPU

2.5.1 Recommend Circuit Connection

Refer to Figure 2-3 and design an appropriate circuit.

Be sure to take into consideration the specifications of the target device as well as measures to prevent noise when designing your circuit.

Figure 2-3 Recommended Circuit Connection



Note 1 The circuit enclosed by a dashed line is not required when only flash programming is performed.

Note 2 Refer to **2.5.2 connection of reset pin (1) Automatically switching the reset signal via resistor** about the pull-up resistor value of the reset circuit.

Note 3 This is for pin processing when not used as a device.

Caution

- Securely connect both pin 10 and pin 13. These pins are also used to monitor the user system.
- The circuits and resistance values listed are recommended but not guaranteed. Determine the circuit design and resistance values by taking into account the specifications of the target device and noise. For flash programming for mass production, perform sufficient evaluation about whether the specifications of the target device are satisfied.
- For processing of pins not used by the E1/E20, refer to the user's manual of the device.
- Securely connect pins 2, 12, and 14 of the connection to GND of the user system. These pins are used for electrical grounding as well as for monitoring of connection with the user system by the E1/E20.

2.5.2 Connection of reset pin

This section describes the connection of the reset pin, for which special attention must be paid, in circuit connection examples shown in the previous section.

During on-chip debugging, a reset signal from the target system is input to E1/E20, masked, and then output to the target device. Therefore, the reset signal connection varies depending on whether E1/E20 is connected.

For flash programming, the circuit must be designed so that the reset signals of the user system and E1/E20 do not conflict.

Select one of the following methods and connect the reset signal in the circuit. The details of each method are described on the following pages.

(1) Automatically switching the reset signal via series resistor (recommended; described in recommended circuit connection in the previous section)

(2) Manually switching the reset signal with jumper

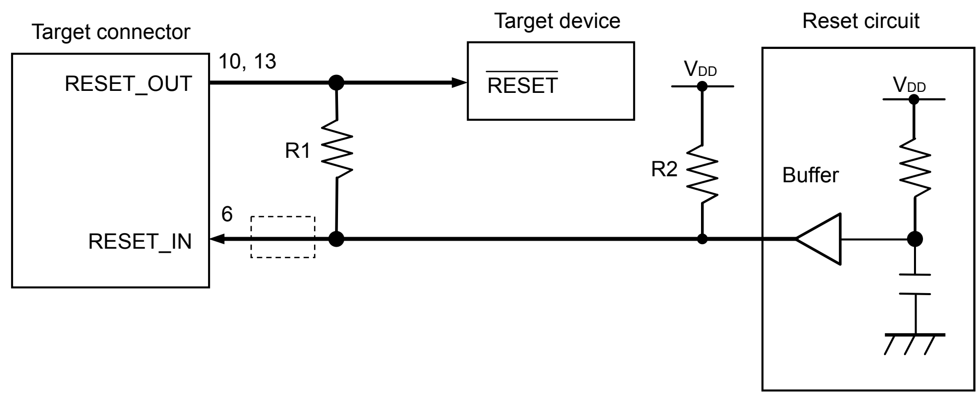
(3) Resetting the target device by power-on reset (POC) only

(1) Automatically switching the reset signal via series resistor

Figure 2-4 illustrates the reset pin connection described in 2.5.1 Recommend Circuit Connection.

This connection is designed assuming that the reset circuit on the target system contains an N-ch open-drain buffer (output resistance: 100Ω or less). The V_{DD} or GND level may be unstable when the logic of RESET_IN/OUT of E1/E20 is inverted, so observe the conditions described below in **Remark**.

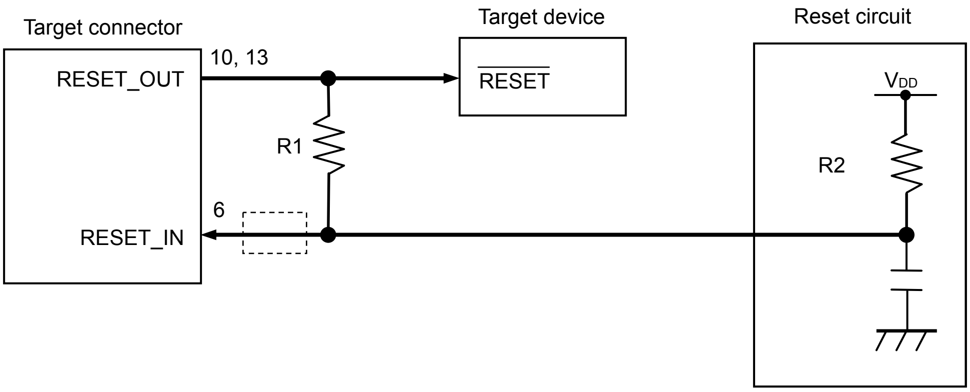
Figure 2-4 Circuit Connection with Reset Circuit That Contains Buffer



Remark **Make the resistance of R1 at least ten times that of R2, R1 being 10 kΩ or more. Pull-up resistor R2 is not required if the buffer of the reset circuit consists of CMOS output. The circuit enclosed by a dashed line is not required when only flash programming is performed.**

Figure 2-5 illustrates the circuit connection for the case where the reset circuit on the target system contains no buffers and the reset signal is only generated via resistors or capacitors. Design the circuit, observing the conditions described below in **Remark**.

Figure 2-5 Circuit Connection with Reset Circuit That Contains No Buffers

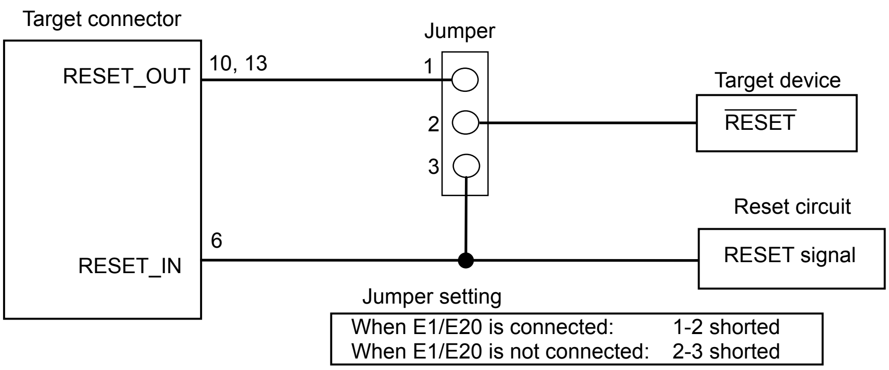


Remark **Make the resistance of R1 at least ten times that of R2, R1 being 10 kΩ or more. The circuit enclosed by a dashed line is not required when only flash programming is performed.**

(2) Manually switching the reset signal with jumper

Figure 2-6 illustrates the circuit connection for the case where the reset signal is switched using the jumper, with or without E1/E20 connected. This connection is simple, but the jumper must be set manually.

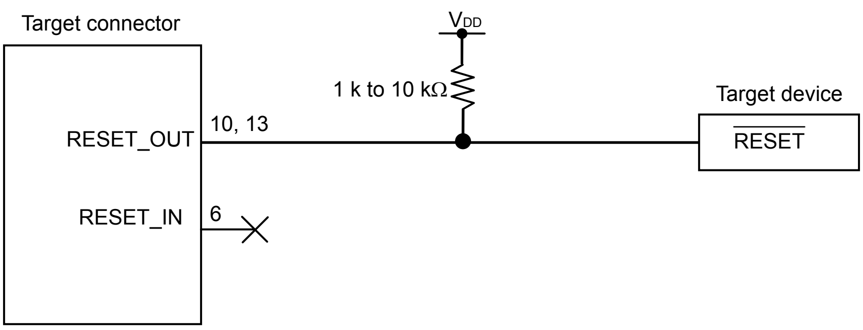
Figure 2-5 Circuit in connection for Switching Reset Signal with Jumper



(3) Resetting the target device by power-on reset (POR) only

Figure 2-7 illustrates the circuit connection for the case where the target device is only reset via POC without using the reset pin. RESET_OUT becomes active when power is applied to E1/E20. Even if power supply to the target system is turned off during debugging, pseudo POC function emulation is available because RESET_OUT becomes active.

Figure 2-6 Circuit Connection for the Case Where Target Device Is Only Reset via POC



Chapter 3 Specification

Specifications are shown in Table 3-1 below.

Table 3-1 E1/E20 Specification List

Large	Middle Item	Small Item	Specification	
			E1	E20
Hardware Common	Target host machine		Computer equipped with a USB port OS depends on the software.	←
	User system interface		14-pin connector	←
	Host machine interface		USB2.0 (Full speed/High speed)	←
	Connection to the user system		Connection by the provided user-system interface cable	←
	Power supply function		3.3 V or 5.0 V, set in software tool, can be supplied to the user system (with current up to 200 mA)	Cannot supply power.
	Power supply for the emulator		No need (the host computer supplies power through the USB)	←
Related debugging	Break	Software break	2000 points	←
		Hardware break	1 point (commonly used by execution and access)	←
		Forced break	Available	←
	Event	Number of events	1 point (commonly used by execution and access)	←
		Available function	Hardware break only	←
	Trace		Unavailable	←
	Performance measurement	Measurement item	From run to break	←
		Performance	Resolution 100 μs, Max. measurement time 100 hours	←
	Pseudo realtime RAM monitor (RRM)		Available (CPU is used when monitoring)	←
	Dynamic memory modification (DMM)		Available (CPU is used when changing)	←
	Hot plug-in		Unavailable	←
	Security		10-byte ID code authentication	←
Related programming	Clock supply		Clock mounted on the user system can be used	←
	Security flag setting		Available	←
	Standalone operation		Unavailable (must be connected to host machine)	←

Chapter 4 Notes on Usage

This section describes cautions on use of the E1/E20 emulator. To use the E1/E20 properly, read the cautions thoroughly.

4.1 List

Table 4-1 List of notes on usage

No.	Item
1	Handling the device used for debugging
2	Flash self programming
3	Operation after a reset
4	Debugging with real machine running without using E1/E20
5	Operation when debugger starts
6	Debugging after program is written by flash programming
7	LVI default start function setting (address C1H)
8	On-chip debugging option byte setting (address C3H)
9	FLMD0 pin output status while debugger is running
10	Operation at voltage with which flash memory cannot be written
11	Debugging in 1-wire mode
12	Pseudo real-time RAM monitor function
13	Relation between Standby function and Break function
14	Cautions on using step-in (step execution)
15	Step-in (step execution) of Division operation

4.2 Details

No. 1 Handling of device that was used for debugging

Do not mount a device that was used for debugging on a mass-produced product, because the flash memory was rewritten during debugging and the number of rewrites of the flash memory cannot be guaranteed.

Do not embed the debug monitor program into mass-produced products.

No. 2 Flash self programming

If a space where the debug monitor program is allocated is rewritten by flash self programming, the debugger can no longer operate normally. This caution also applies to boot swapping for such an area.

No. 3 Operation after reset

After an external pin reset or internal reset, the monitor program performs debug initialization processing.

Consequently, the time from reset occurrence until user program execution differs from that in the actual device operation. If “No” is selected in Permit flash programming in property of the debug tool, the time until the user program is executed compared with the time when “Yes” is selected is delayed several 100 ms.

No. 4 Debugging with real machine running without using E1/E20

If debugging is performed with a real machine running, without using E1/E20, write the user program using the Renesas Flash Programmer. Programs downloaded by the debugger include the monitor program, and such a program malfunctions if it includes processing to make the TOOL0 pin low level.

No. 5 Operation when debugger starts

When the debugger is started, if “Communicatuin method” in the property of the debug tool is different from the setting for the previous debugging, the internal flash memory is erased.

No. 6 Debugging after program is written by flash programming

If a program is written to the internal flash memory using the Renesas Flash Programmer or PG-FP5, debugger erase internal flash ROM memory automatically and download the program to the memory area.

No. 7 LVI default start function setting (address C1H)

During debugging, the debug monitor program stops the LVI default start function at address C1H. Consequently, the LVI default start function is kept stopped even after debugging is completed, unless the setting to address C1H is changed through flash programming.

No. 8 On-chip debugging option byte setting (address C3H)

The on-chip debugging option byte setting is rewritten arbitrarily by the debugger.

No. 9 FLMD0 pin output status while debugger is running

In accordance with the setting in Permit flash programming in property of the debugger, the FLMD0 pin output status while the debugger is running changes as follows. Rewriting by flash self-programming is not possible when the output status is low level.

- When “Yes” is selected: High level (low level for about 100 μs after reset release)
- When “No” is selected: Low level

No. 10 Operation at voltage with which flash memory cannot be written

If any of the following debugger operations <1> to <7>, which involve flash memory rewriting, is performed while flash memory cannot be rewritten, the debugger automatically changes the register setting so as to enable flash memory rewriting, and restores the register setting after the operation is completed. If any of the following operations <1> to <7> is performed while flash memory rewriting has been disabled or operation is performed at a voltage with which flash memory cannot be rewritten, however, the debugger outputs an error and the operation is ignored.

To prevent the flash memory from being rewritten, select “No” in permit flash programming in property of debug tool. To prevent the frequency from being switched automatically, select “User” in the Monitor clock in property of debug tool.

<1> Writing to internal flash memory

<2> Setting or canceling of software breakpoint

<3> Starting execution at the set software breakpoint position

<4> Step execution at the set software breakpoint position

<5> Step-over execution, Return Out execution

<6> Come Here

<7> If “Yes” is selected in Permit flash programming in property of debug tool, the following operations cannot be performed.

a) Setting, changing, or canceling of hardware breaks

b) Masking/unmasking of internal reset

c) Switching of peripheral breaks

No. 11 Debugging in 1-wire mode

In the condition that debugging is performed in 1-wire mode, when the internal high-speed oscillator is used for the CPU operating clock, breaks may not occur normally if the frequency variation between debugger startup and break occurrence (except for when changing the register) is too large. This situation may occur when the variation of operating voltage or temperature is too large.

No. 12 Pseudo real-time RAM monitor function

Note the following points when using the pseudo real-time RAM monitor function.

<1> Standby mode (HALT or STOP) may be cancelled during monitoring.

<2> The pseudo real-time RAM monitor function does not operate while the CPU operating clock is stopped.

<3> If the targets to be monitored are too numerous, the operability of the debugger may be affected because the monitoring speed is slow when using the pseudo RRM function in 1-wire mode.

No. 13 Relation between Standby function and Break function

The break is interrupt function of CPU. The standby mode is released by the break for using the following debug function.

- Stops execution of the user program.
- Step execution of the standby instruction (Stops user program after execution instruction)
- Pseudo real-time RAM monitor function (Break When Readout)
- Pseudo Dynamic Memory Modification (Break When Write)
- Breakpoint setting executing of the user program.

No. 14 Cautions on using step-in (step execution)

The value of some SFRs (special function registers) might remain unchanged while stepping into code. If the value of the SFRs does not change while stepping into code, operate the microcontroller by continuously executing the instructions instead of executing them in steps.

Stepping into code: Instructions in the user-created program are executed one by one.

Continuous execution: The user-created program is executed from the current PC value.

No. 15 Step-in (step execution) of Division operation

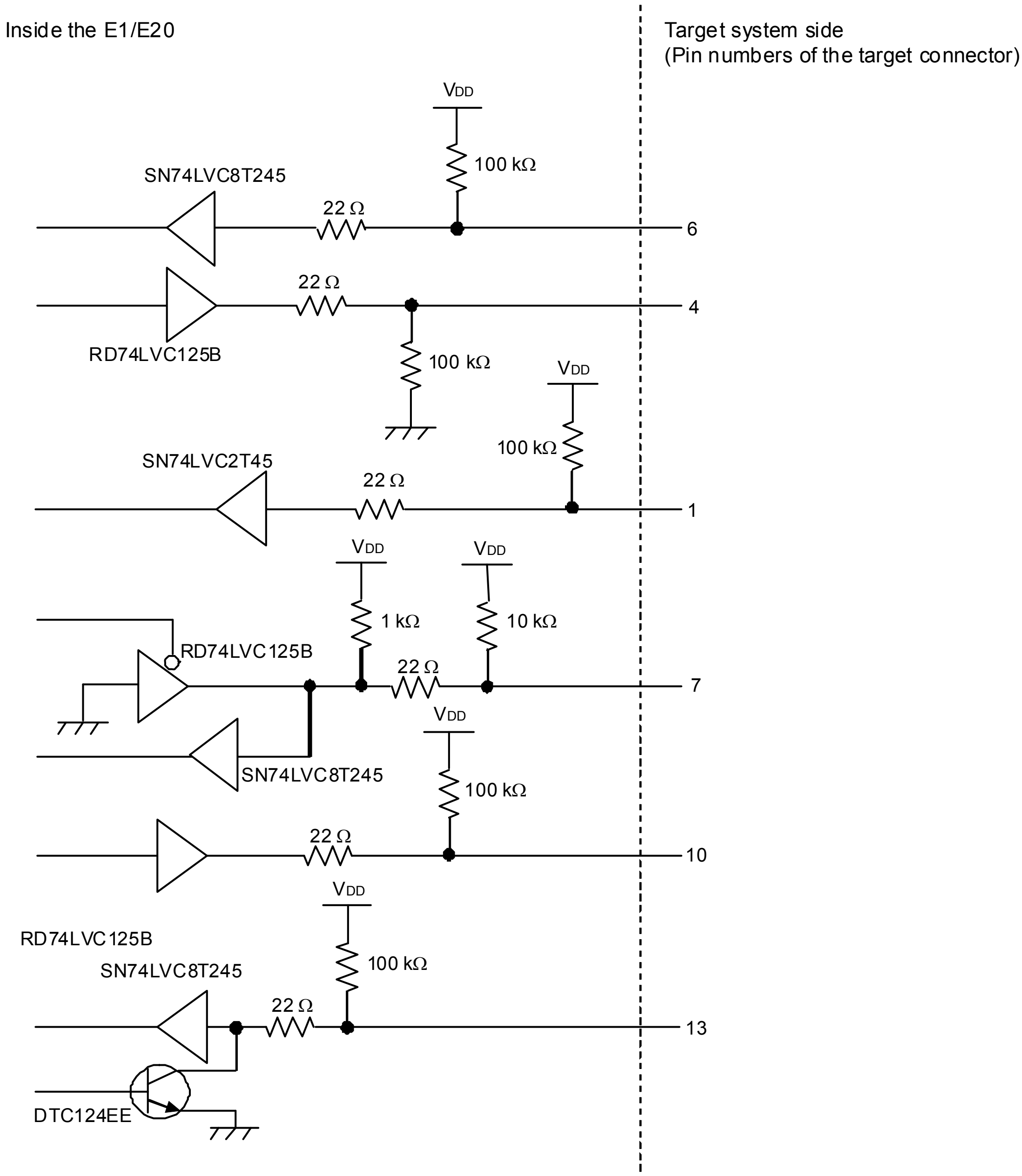
When the instruction which sets (1) the bit 0 (DIVST) of Multipllcation/Division control register (MDUC) is stepped, the division operation is not finished.

The step execution of the division operation by a C source level is not relevant.

Appendix Equivalent Circuit for E1/E20-78K0R Connection

The internal equivalent circuit related to the communication interface between the E1/E20 and user system is shown below. An example of circuit connection for the user system is shown in this document. Please use it as a reference when determining parameters in board design.

Figure A-1 E1/E20 Equivalent Circuit



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