User's Manual

NEC

IE-789882-NS-EM1

Emulation Board

Target Devices
μPD789881 Subseries

[MEMO]

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- Ordering information

- Product release schedule

- Availability of related technical literature

- Development environment specifications (for example, specifications for third-party tools and components, host computers, power plugs, AC supply voltages, and so forth)

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INTRODUCTION

Product Overview   The IE-789882-NS-EM1 is designed to be used with the IE-78K0S-NS or IE-78K0S-NS-A to debug the following target devices that belong to the 78K/0S Series of 8-bit single-chip microcontrollers.

- μPD789881 Subseries: μPD789881, 78F9882, 789881(A)

Target Readers   This manual is intended for engineers who will use the IE-789882-NS-EM1 with the IE-78K0S-NS or IE-78K0S-NS-A to perform system debugging.
Engineers who use this manual are expected to be thoroughly familiar with the target device's functions and use methods and to be knowledgeable about debugging.

Organization   When using the IE-789882-NS-EM1, refer to not only this manual (supplied with the IE-789882-NS-EM1) but also the manual that is supplied with the IE-78K0S-NS or IE-78K0S-NS-A.

IE-78K0S-NS User's Manual

- Basic specifications
- System configuration
- External interface functions

IE-789882-NS-EM1 User's Manual

- General
- Part names
- Installation
- Differences between target devices and target interface circuits

IE-78K0S-NS-A User's Manual

- Basic specifications
- System configuration
- External interface functions

Purpose   This manual's purpose is to explain various debugging functions that can be performed when using the IE-789882-NS-EM1.

Terminology   The meanings of certain terms used in this manual are listed below.

Term	Meaning
Emulation device	This is a general term that refers to the device in the emulator that is used to emulate the target device. It includes the emulation CPU.
Emulation CPU	This is the CPU block in the emulator that is used to execute user-generated programs.
Target device	This is the device to be emulated.
Target system	This includes the target program and the hardware provided by the user. When defined narrowly, it includes only the hardware.
IE system	This refers to the combination of the in-circuit emulator (IE-78K0S-NS or IE-78K0S-NS-A) and the emulation board (IE-789882-NS-EM1).

Conventions   Data significance: Higher digits on the left and lower digits on the right

                                    Note: Footnote for item marked with **Note** in the text

                                    Caution: Information requiring particular attention

                                    Remark: Supplementary information

Related Documents   The related documents (user's manuals) indicated in this publication may include preliminary versions. However, preliminary versions are not marked as such.

Document Name	Document Number
IE-78K0S-NS In-Circuit Emulator	U13549E
IE-78K0S-NS-A In-Circuit Emulator	U15207E
IE-789882-NS-EM1 Emulation Board	This manual
ID78K Series Integrated Debugger Ver. 2.30 or Later Operation Windows™ Based	U15185E
μPD789881 Subseries	U15172E

Caution   **The documents listed above are subject to change without notice. Be sure to use the latest documents when designing.**

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CHAPTER 1   GENERAL

The IE-789882-NS-EM1 is a development tool for efficient debugging of hardware or software when using one of the following target devices that belong to the 78K/0S Series of 8-bit single-chip microcontrollers.

This chapter describes the IE-789882-NS-EM1's system configuration and basic specifications.

- Target devices
  - μPD789881 Subseries

1.1 System Configuration

Figure 1-1 illustrates the IE-789882-NS-EM1's system configuration.

Figure 1-1. System Configuration

Debugger
ID78K0S-NS
(sold separately)

Device file[Note 1]
(available separately)

Control software

Host machine
PC-9800 Series,
IBM PC/AT™
or compatibles

Interface board
IE-70000-98-IF-C
(sold separately)

Interface board
IE-70000-PC-IF-C
(sold separately)

Interface board
IE-70000-PCI-IF-A
(sold separately)

Interface card

or

IE-78K0S-NS
or
IE-78K0S-NS-A
(sold separately)

Interface cable
(NS IF Cable)

In-circuit emulator

FG Cable

Interface
cable

NS CARD
Cable

MC CARD
Cable

IE-70000-CD-IF-A
(sold separately)

IE-789882-NS-EM1
(this product)

AC adapter
IE-70000-MC-PS-B
(sold separately)

Emulation probe[Note 2]
(sold separately)

Conversion adapter[Note 3]
(sold separately)

Notes 1. The device file is as follows, in accordance with the subseries.

μS$\times\times\times\times$DF789882: μPD789881 Subseries

The device file can be downloaded from the website of NEC Electronics

(http://www.necel.com/micro/)

2. The emulation probe NP-H64GB-TQ is a product of Naito Densei Machida Mfg. Co., Ltd.

For further information, contact Naito Densei Machida Mfg. Co., Ltd. (TEL: +81-45-475-4191)

3. The conversion adapter TGB-064SDP is a product of TOKYO ELETECH CORPORATION.

For further information, contact Daimaru Kogyo Co., Ltd.

Tokyo Electronics Department (TEL: +81-3-3820-7112)

Osaka Electronics Department (TEL: +81-6-6244-6672)

Table 1-1. Correspondence Between Emulation Probe and Conversion Adapter

Package	Emulation Probe	Conversion Adapter
64-pin plastic LQFP (GB type)	NP-H64GB-TQ (probe length: 400 mm)	TGB-064SDP

1.2 Hardware Configuration

Figure 1-2 shows the IE-789882-NS-EM1's position in the basic hardware configuration.

Figure 1-2. Basic Hardware Configuration
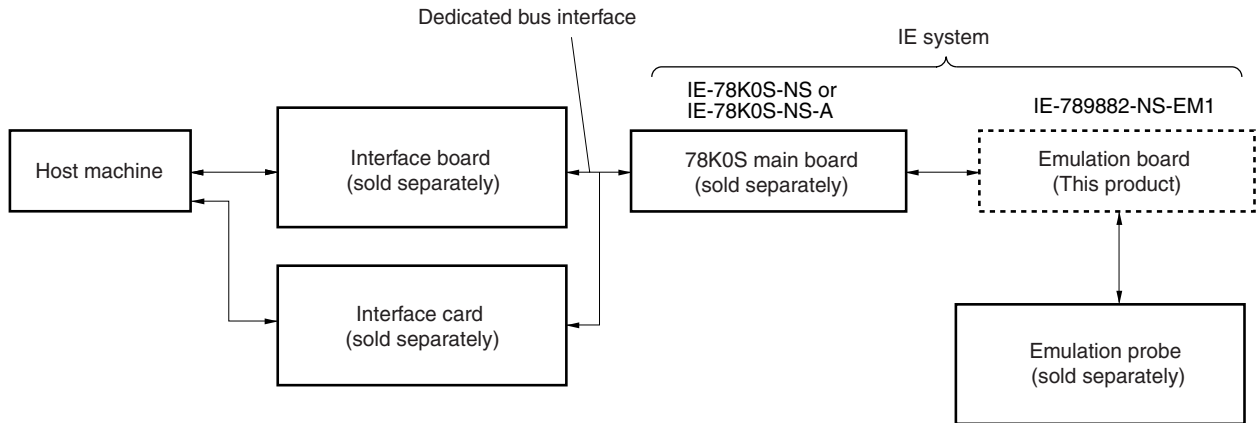
1.3 Basic Specifications

The basic specifications of the IE-789882-NS-EM1 are listed in Table 1-2.

Table 1-2. Basic Specifications

Parameter	Description
Target device	μPD789881 Subseries
System clock	Main system clock: 500 kHz Subsystem clock: 32.768 kHz, 38.4 kHz
Main system clock supply	Internal: Mounted on emulation board
Subsystem clock supply	Internal: Mounted on the emulation board or mounted on the socket by the user
Target interface voltage	V_{DD} = 2.7 to 3.6 V (same as that of target device) Operates on internal power supply (3.9 V) when target system is not connected

CHAPTER 2   PART NAMES

This chapter introduces the parts of the IE-789882-NS-EM1 main unit.

The packing box contains the emulation board (IE-789882-NS-EM1), packing list, user's manual, and guarantee card.

If there are any missing or damaged items, please contact an NEC Electronics sales representative.

Fill out and return the guarantee card that comes with the main unit.

2.1 Parts of Main Unit

Figure 2-1 shows the part names of the IE-789882-NS-EM1.

Figure 2-1. IE-789882-NS-EM1 Part Names
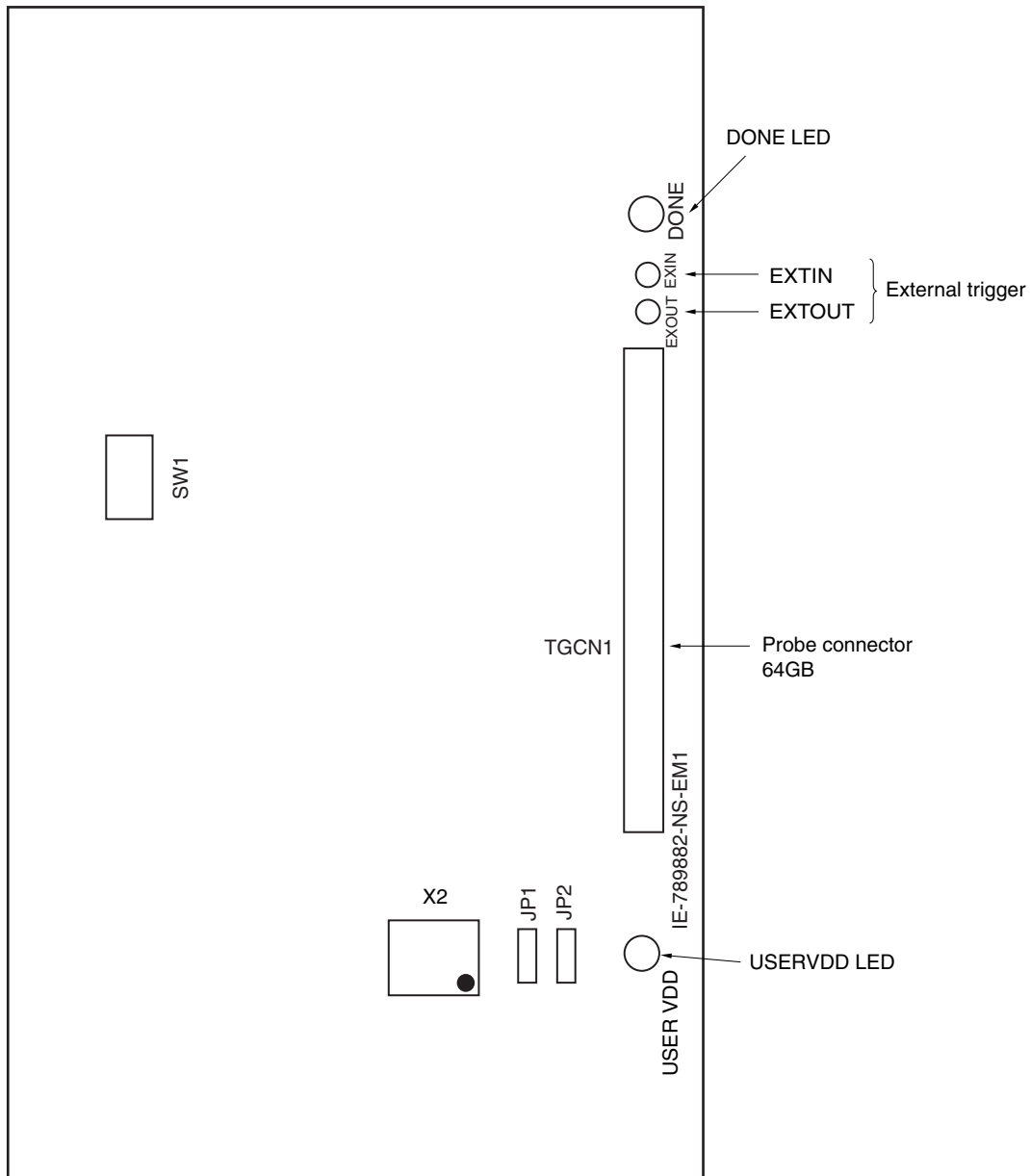
2.2 Initial Settings of Switches and Jumpers

Table 2-1 shows the initial settings of the switches and jumpers on the IE-789882-NS-EM1.

For the setting of SW1, refer to **3.5 Mask Option Settings**.

Use the IE-789882-NS-EM1 with jumpers JP1 and JP2 set to the initial settings.

Table 2-1. Initial Settings of Switches and Jumpers

	SW1			
	1	2	3	4
Initial setting	OFF	OFF	OFF	OFF

	JP1	JP2
Initial setting	1 and 2 shorted (Fixed)	2 and 3 shorted (Fixed)

CHAPTER 3   INSTALLATION

This chapter describes methods for connecting the IE-789882-NS-EM1 to the IE-78K0S-NS or IE-78K0S-NS-A, emulation probe, etc. Mode setting methods are also described.

Caution **Connecting or removing components to or from the target system, or making switch or other setting changes must be carried out after the power supply to both the IE system and the target system has been switched OFF.**

3.1   Connection

(1) Connection with IE-78K0S-NS or IE-78K0S-NS-A main unit
See the **IE-78K0S-NS User's Manual (U13549E)** for a description of how to connect the IE-789882-NS-EM1 to the IE-78K0S-NS**Note**.

Note When using the IE-78K0S-NS-A, see the **IE-78K0S-NS-A User's Manual (U15207E)**.

(2) Connection with emulation probe
See the **IE-78K0S-NS User's Manual (U13549E)** for a description of how to connect an emulation probe to the IE-789882-NS-EM1**Note**.
On this board, connect the emulation probe to TGCN1.

Note When using the IE-78K0S-NS-A, see the **IE-78K0S-NS-A User's Manual (U15207E)**.

**Caution   Incorrect connection may damage the IE system.
Be sure to read the emulation probe's user's manual for a detailed description of the connection method.**

Figure 3-1. Connection of Emulation Probe

Emulation probe
(sold separately)

TGCN1 64GB

IE-789882-NS-EM1

Main board of
IE-78K0S-NS (sold separately) or
IE-78K0S-NS-A (sold separately)
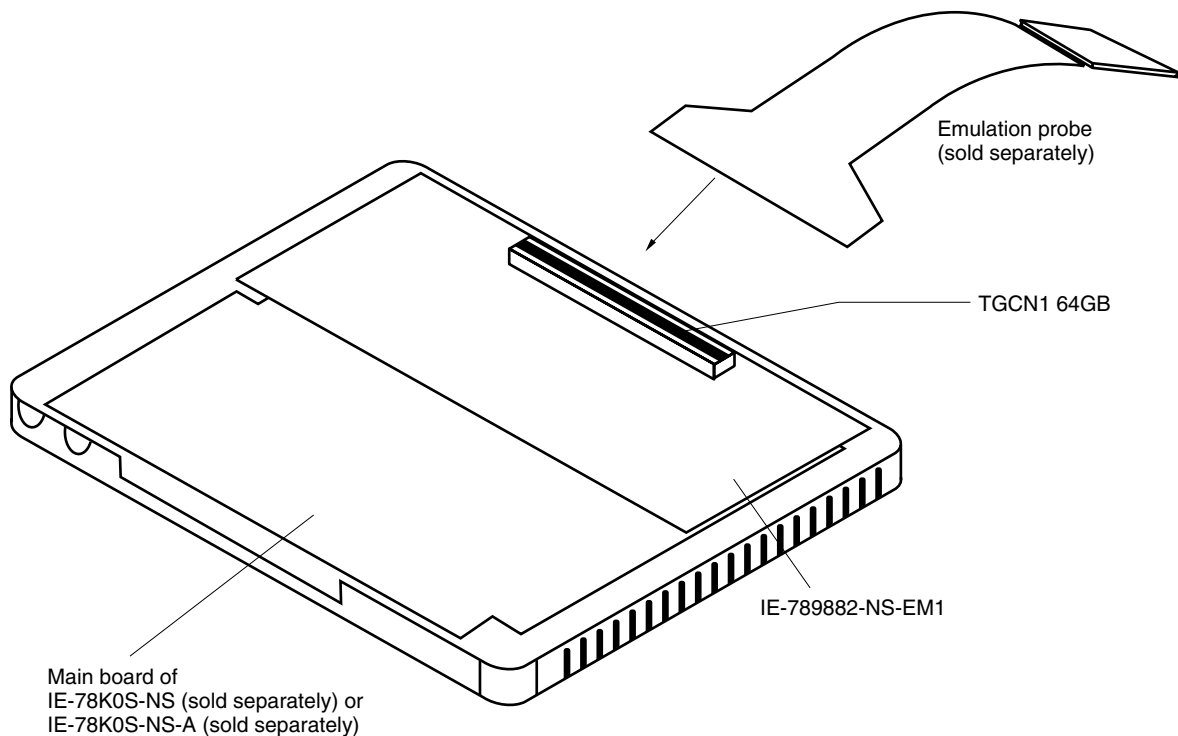
3.2   Switch and Jumper Settings on Main Unit

(1) Settings on the IE-78K0S-NS

When using the IE-789882-NS-EM1, set the switches and jumpers on the IE-78K0S-NS as shown in Table 3-1.

For details of these switch and jumper settings, refer to the **IE-78K0S-NS User's Manual (U13549E)**.

Table 3-1. Switch and Jumper Settings on IE-78K0S-NS

	SW1	SW3	SW4	JP1	JP4
Setting	OFF	All switches ON (Fixed)	All switches ON (Fixed)	1 and 2 shorted	2 and 3 shorted

Caution   Incorrect connection may damage the IE-789882-NS-EM1.

(2) Settings on the IE-78K0S-NS-A

When using the IE-789882-NS-EM1, set the switches and jumpers on the IE-78K0S-NS-A as shown in Table 3-2. For details of these switch and jumper settings, refer to the **IE-78K0S-NS-A User's Manual (U15207E)**.

Table 3-2. Switch and Jumper Settings on IE-78K0S-NS-A

	SW1	JP1	JP3
Setting	OFF	2 and 3 shorted (fixed)	Shorted (fixed)

Caution   Incorrect connection may damage the IE-789882-NS-EM1.

3.3   Setting Power Supply Voltage of Target Interface

In the IE system, emulation is possible with a voltage of the same level as the power supply voltage of the target system.

When the target system is not connected, the IE system automatically operates with the emulator's internal power supply (3.9 V). When debugging with a voltage that is the same level as that of the target system, supply the same voltage (2.7 to 3.6 V: same as that of the device) as that of the target system to the V_{DD} pin of the emulation probe.

For how to select the operating power supply, refer to the **ID78K Series Ver.2.30 or Later Operation Windows-Based User's Manual (U15185E)**.

- Maximum current consumption
  2.7 to 3.6 V: 50 mA

Table 3-3. Setting Power Supply of Target Interface

Power Supply of Target Interface (LV$_{CC}$)		Integrated Debugger (ID78K0S-NS)
		Operating Power Supply Selection
When connecting target system	2.7 to 3.6 V	Target
When not connecting target system	3.9 V	Internal

Figure 3-2. Connecting Power Supply Voltage to Target System
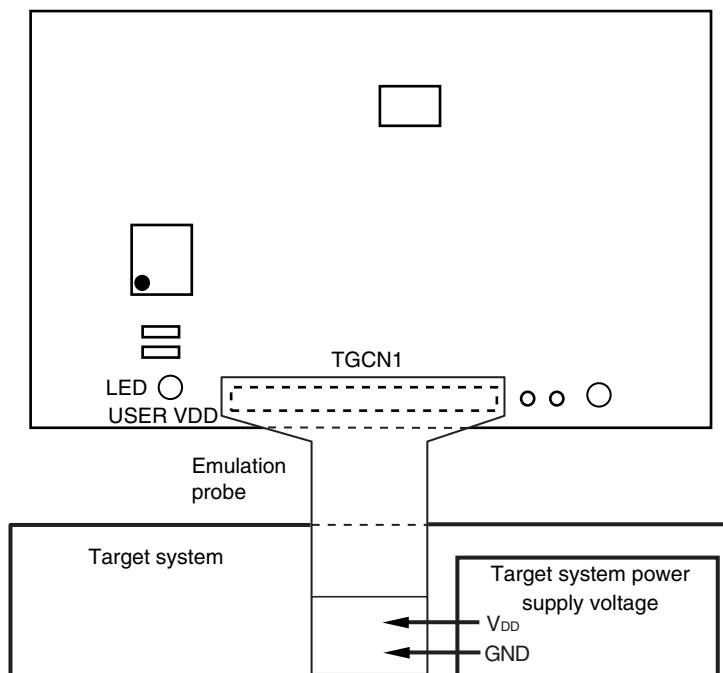
Caution   Before connecting the board and the target system power supply voltage, turn off the power to the IE-78K0S-NS or IE-78K0S-NS-A.

3.4   Clock Settings

3.4.1   Overview of clock settings

The main system clock and subsystem clock to be used during debugging can be selected from (1) and (1) and (2) below, respectively.

(1)   Clock that is already mounted on emulation board

(2)   Clock that is mounted by user

If the target system includes a clock oscillator, select either **(1) Clock that is already mounted on emulation board** or **(2) Clock that is mounted by user**. For the clock oscillator, a resonator is connected to the target device and the target device's internal oscillator is used. An example of the external circuit is shown in Figure 3-3. During emulation, the oscillator that is mounted on the target system is not used. Instead, the clock that is mounted on the emulation board installed in the IE-78K0S-NS or IE-78K0S-NS-A is used.

Caution   The IE system will be hung-up if the main system clock is not supplied normally. There is no need to supply a clock to the X2 and XT2 pins. Also, even if a crystal resonator is connected directly to X1 (for the main system clock) or XT1 (for the subsystem clock), the target device will not operate.

Figure 3-3. External Circuits Used as System Clock Oscillator

Clock oscillator

Target device

V_{SS}

X1 or XT1

X2 or XT2

Crystal or ceramic resonator
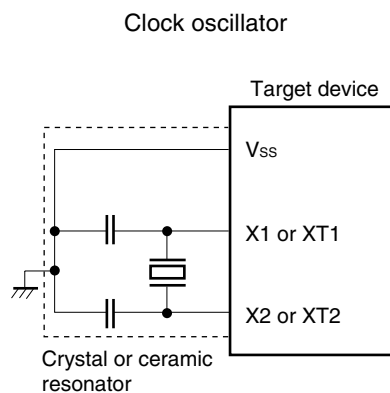
(1) Clock that is already mounted on emulation board

The crystal oscillator mounted on the IE-789882-NS-EM1 can be used.

(a) Main system clock

A crystal oscillator (X1) is already mounted on the emulation board. Its frequency is fixed to 500 kHz and cannot be changed.

Figure 3-4. When Using Clock That Is Already Mounted on Emulation Board (Main System Clock)
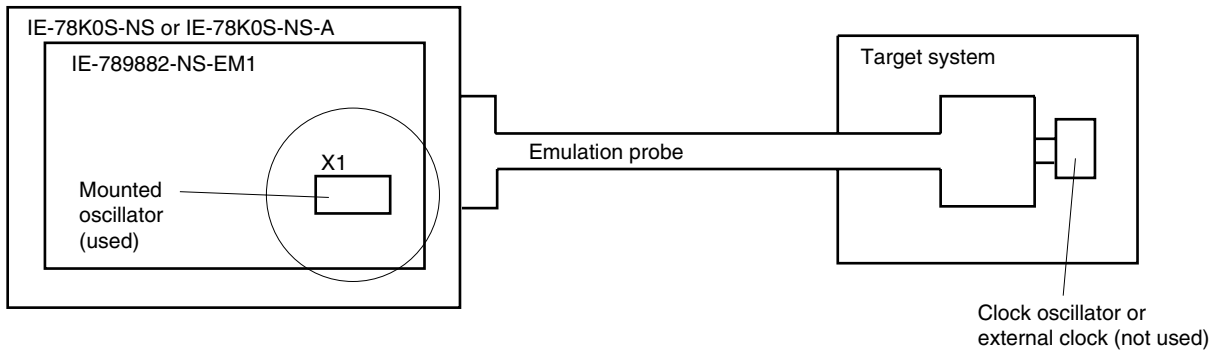
Remark   The clock that is supplied by the oscillator of the IE-789882-NS-EM1 (encircled in the figure) is used.

(b) Subsystem clock

A crystal oscillator (X2) is already mounted on the emulation board. Its frequency is 32.768 kHz.

Figure 3-5. When Using Clock That Is Already Mounted on Emulation Board (Subsystem Clock)
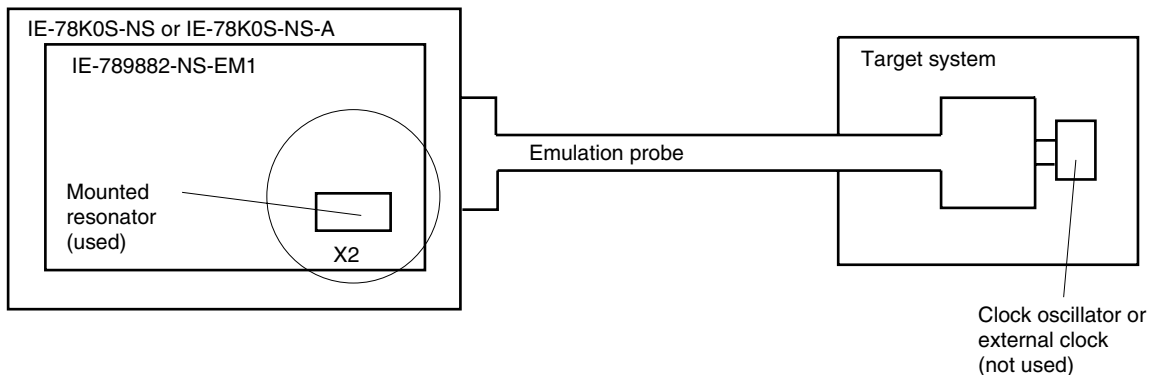
Remark   The clock that is supplied by the oscillator of the IE-789882-NS-EM1 (encircled in the figure) is used.

(2) Clock that is mounted by user

The user can mount any clock supported by the set specifications on the IE-789882-NS-EM1. This feature is effective when debugging at a different frequency than the clock already mounted.

Subsystem clock

Remove the crystal oscillator (X2) that is already mounted on the emulation board, and mount the crystal oscillator to be used.

Figure 3-6. When Using User-Mounted Clock (Subsystem Clock)
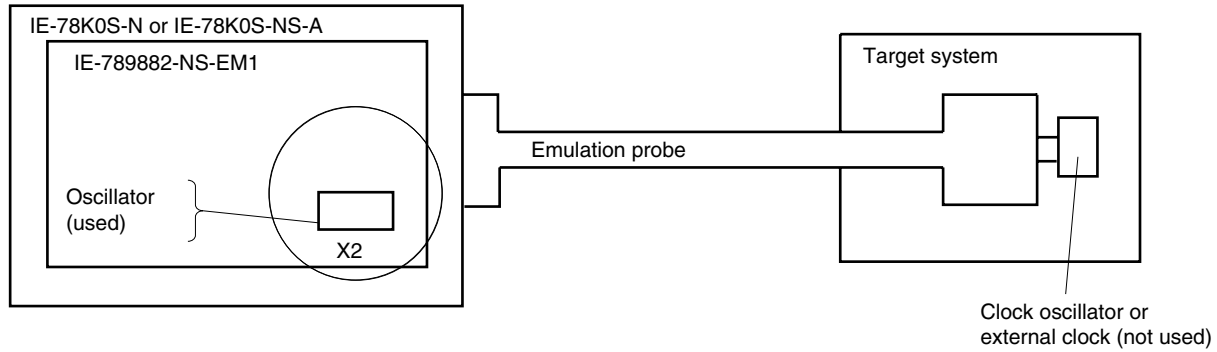
> **Remark** The clock that is supplied by the oscillator of the IE-789882-NS-EM1 (encircled in the figure) is used.

3.4.2 Main system clock settings

Table 3-4 shows the main system clock settings of the IE-789882-NS-EM1.

Table 3-4. Main System Clock Settings

| Frequency of Main System Clock		IE-789882-NS-EM1	CPU Clock Source Selection (ID78K0S-NS)
		X1 Socket	
(1) When using clock that is already mounted on emulation board	500 kHz (fixed)	Oscillator	Internal

> **Caution** **Open the configuration dialog box when starting the integrated debugger (ID78K0S-NS) and select "Internal" in the area (Clock) for selecting the CPU's clock source. Setting the main system clock so that a pulse input from the target system (using an external clock) causes the system to hang up.**

3.4.3 Subsystem clock setting

Table 3-5 shows the subsystem clock settings of the IE-789882-NS-EM1.

Table 3-5. Subsystem Clock Settings

X2 Socket of IE-789882-NS-EM1	Frequency of Subsystem Clock[Note]	
	Subsystem Clock	X4 Subsystem Clock
4.194304 MHz oscillator mounted (mounted at shipment)	32.768 kHz	131.072 kHz
4.9152 MHz oscillator mounted (supplied)	38.4 kHz	153.6 kHz

Note   The subsystem clock is generated by dividing the clock mounted in the IE system (X2) by 128.

Caution   **Before replacing the oscillator on the board, turn off the power of the IE-78K0S-NS or IE-78K0S-NS-A.**

(1) When using clock that is already mounted on emulation board
When the IE-789882-NS-EM1 is shipped, a 4.194304 MHz oscillator (X2) is already mounted on the IE-789882-NS-EM1. No settings are required on the integrated debugger (ID78K0S-NS).

(2) When using clock mounted by user
No settings are required on the integrated debugger (ID78K0S-NS).

When replacing crystal oscillator

- Items to be prepared
  - Crystal oscillator (see pinouts shown in Figure 3-7)

Figure 3-7. Crystal Oscillator (Subsystem Clock)

<Steps>
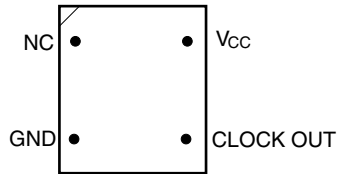
<1> Prepare the IE-789882-NS-EM1.

<2> Remove the crystal oscillator that is mounted in the X2 socket of the IE-789882-NS-EM1.

<3> Connect a crystal oscillator to the X2 socket from which the crystal oscillator was removed (in <2> above). Insert the crystal oscillator pins into the socket aligning the pins as shown in the figure below.

Figure 3-8. Pin Alignment of Crystal Oscillator and Socket (Subsystem Clock)

Crystal Oscillator Pin Name	Socket Pin No.
NC	1
GND	4
CLOCK OUT	5
V$_{CC}$	8
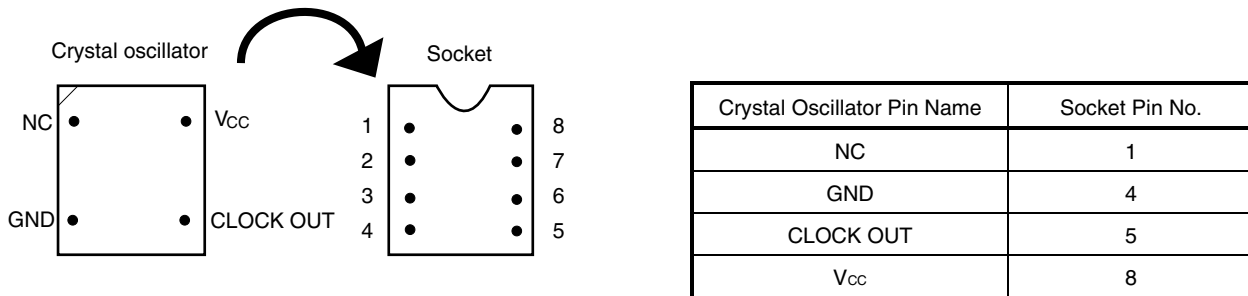
<4> Install the IE-789882-NS-EM1 in the IE-78K0S-NS or IE-78K0S-NS-A.

3.5   Mask Option Settings

By setting the DIP switch (SW1) in the IE-789882-NS-EM1, a 33 kΩ pull-up resistor can be connected to P50 to P53 by mask option.

Use the mask option setting dialog box of the integrated debugger (ID78K0S-NS) to set the mask option. When reading a project file, however, setting is not required. The results of reading a project file are reflected in the mask option setting dialog box.

For the usage method, refer to the **ID78K Series Ver.2.30 or Later Operation Windows Based User's Manual (U15185E)**.

Table 3-6. Mask Option Setting

	SW1			
	1	2	3	4
Connected to:	P50	P51	P52	P53

When the DIP switch is ON, the corresponding pin is pulled up by the target interface power supply voltage (LV$_{CC}$). When it is OFF, the corresponding pull-up resistor is disconnected. Set the DIP switch to OFF for ports that do not exist.

Figure 3-9. Mask Option Setting

The initial setting of all these switches is OFF.

27
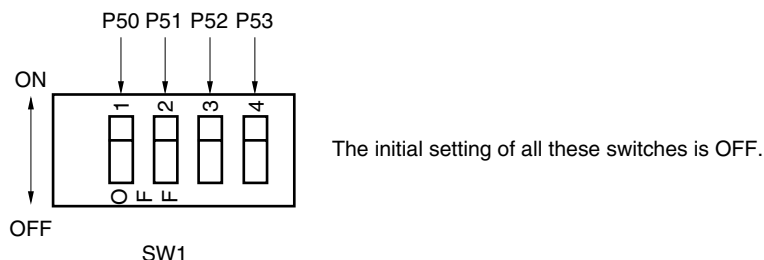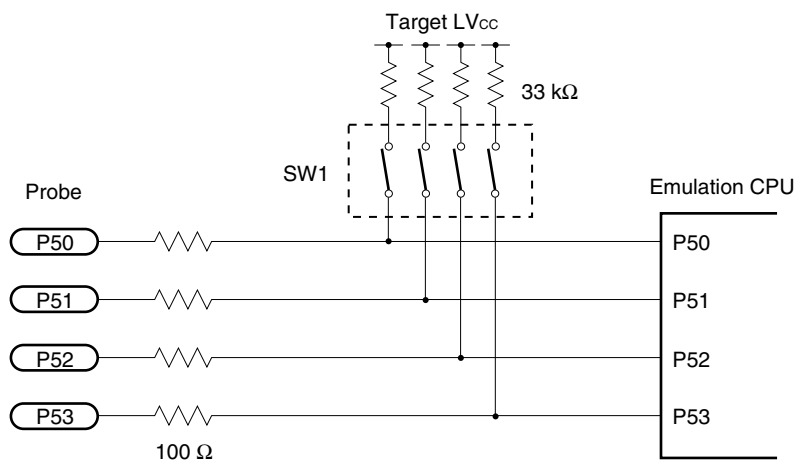
3.6   External Trigger

To set an external trigger, connect the IE-789882-NS-EM1's check pins EXTOUT and EXTIN as shown below.

See the **IE-78K0S-NS User's Manual (U13549E)** or **IE-78K0S-NS-A User's Manual (U15207E)** for pin characteristics.

For the use methods, see the **ID78K Series Ver.2.30 or Later Operation Windows Based User's Manual (U15185E)**.

(1) EXTOUT

The EXTOUT pin on the IE-789882-NS-EM1 outputs a low level for 1.3 μs when a break event occurs.

Caution   Connect a pull-up resistor on the target system because this is an open drain output.

(2) EXTIN

An event signal can be input from the EXTIN pin on the IE-789882-NS-EM1. Input a high-level pulse signal for 2 CPU operation clocks or more.

Figure 3-10. External Trigger Input Position
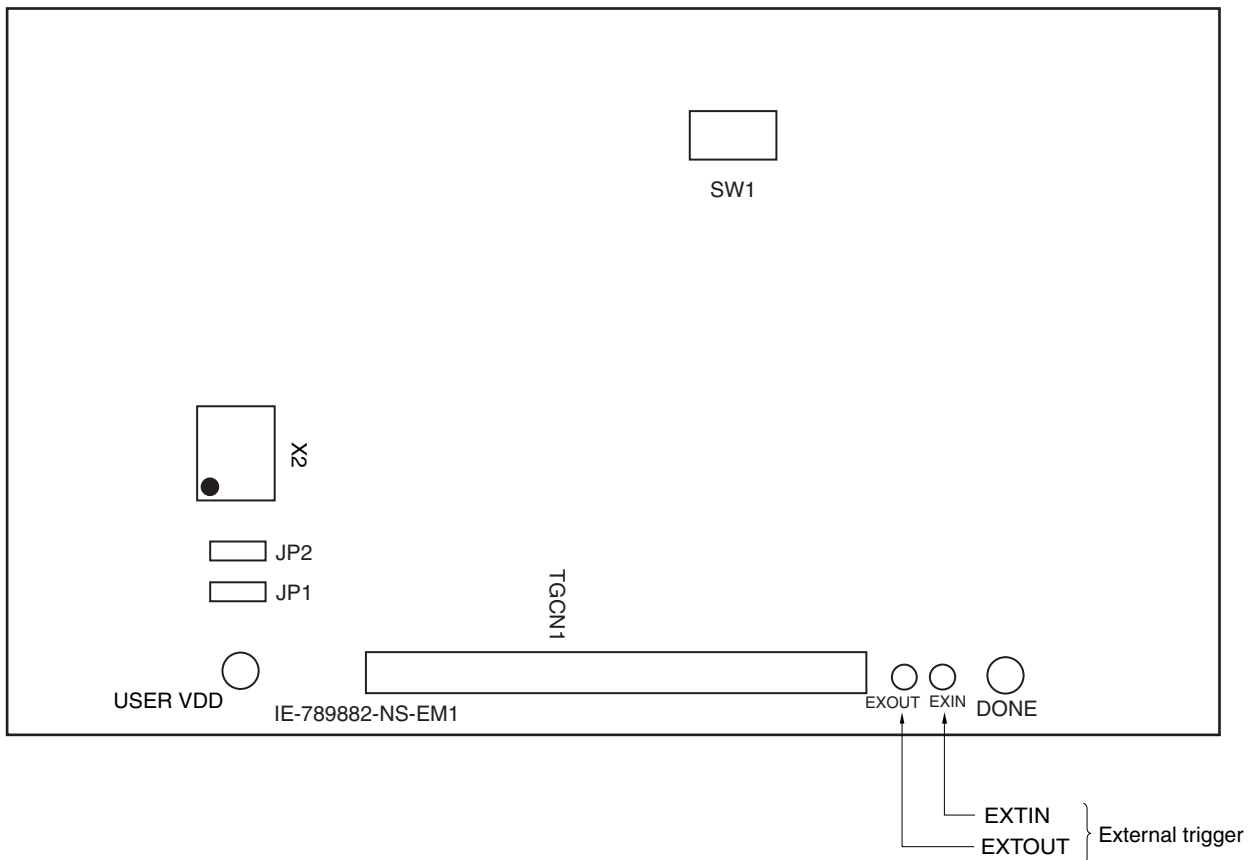
CHAPTER 4   DIFFERENCES BETWEEN TARGET DEVICE AND TARGET INTERFACE CIRCUIT

This chapter describes differences between the target device's signal lines and the signal lines of the target interface circuit of the IE system.

The target interface circuit of the IE system realizes emulation via an emulation circuit configured by an emulation CPU, TTL, CMOS-IC, and other components. The electrical characteristics are different from those of the target device because a protector and other circuits are provided.

(1) Signals input to or output from the emulation CPU (μPD789009A)
(2) Signals input to or output from the pin emulator (μPD7880)
(3) Signals input to or output from the pin emulator (μPD7883)
(4) Other signals

The circuits of the IE-789882-NS-EM1 are used as follows for signals listed in (1) to (4) above. The same applies to handling alternate-function pins, for which no circuit is provided in the IE system.

(1) Signals input to or output from the emulation CPU (μPD789009A)
- Signals related to port 0
- Signals related to port 1
- $\overline{\text{RESET}}$

(2) Signals input to or output from the pin emulator (μPD7880)
- Signals related to port 3
- Signals related to port 5

(3) Signals input to or output from the pin emulator (μPD7883)
- Signals related to port 2
- Signals related to port 8
- Signals related to port 9
- Signals related to port LCD
- COM, S

(4) Other signals
- V_{DD} (target voltage input from the probe)
- V_{SS}

Figure 4-1. Equivalent Circuit 1 of Emulation Circuit
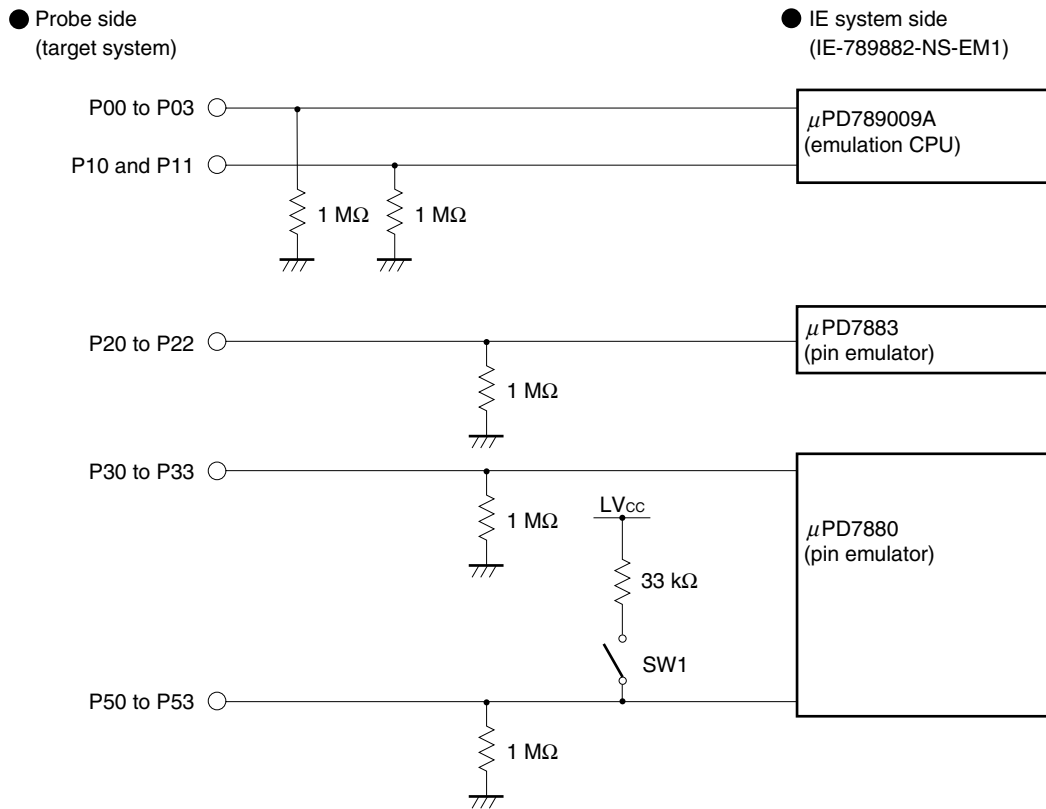
Figure 4-2. Equivalent Circuit 2 of Emulation Circuit
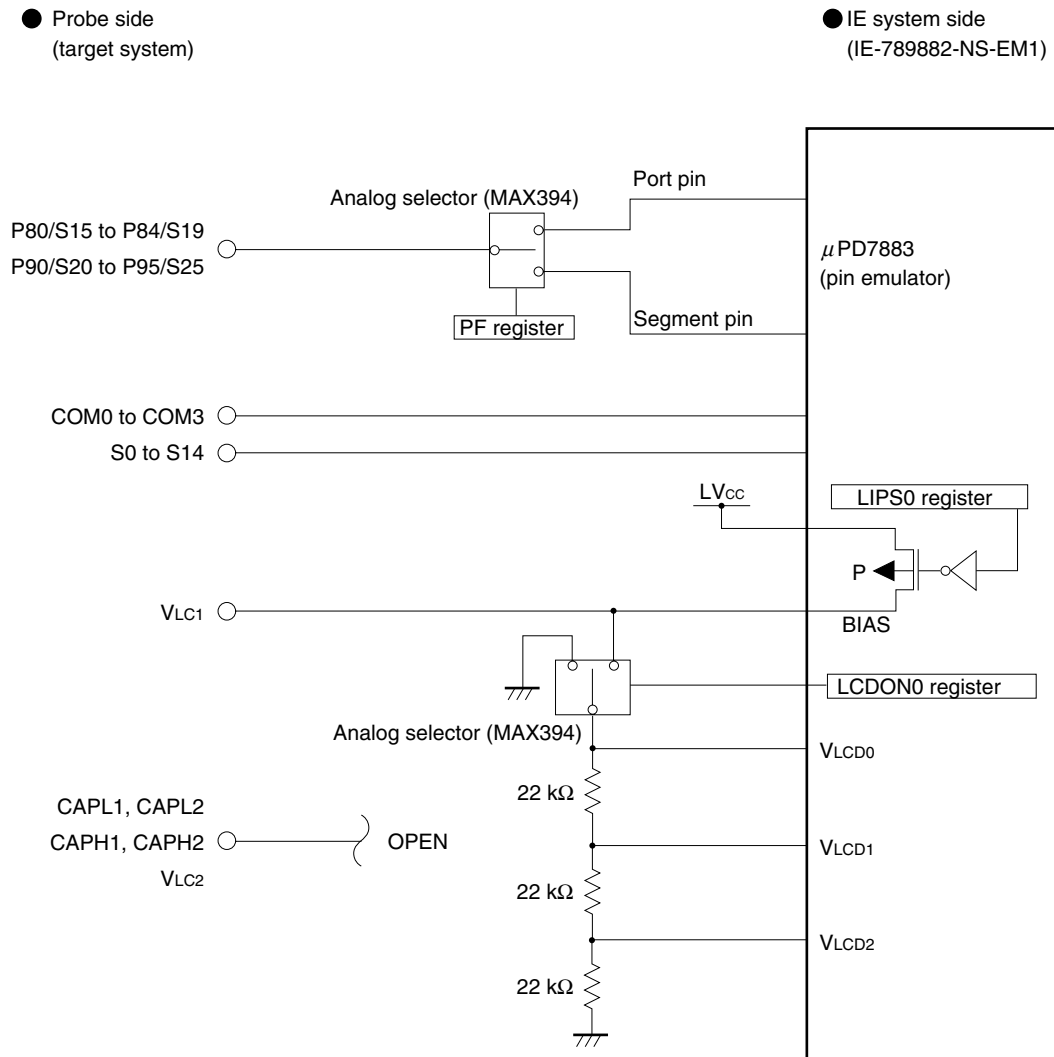
- Difference between target device and emulation circuit

  In dynamic mode, the voltage for driving an LCD is generated by dividing the LV_{CC} voltage by the LIPS0 register regardless of the type of capacitor connected to the V_{LC1} pin.

  In static mode, the voltage of the V_{LC1} pin is connected to a 66 kΩ (22 k$\Omega \times 3$) resistor in parallel with the pin for driving the LCD (V_{LCD0} of the μPD7883).

Figure 4-3. Equivalent Circuit 3 of Emulation Circuit
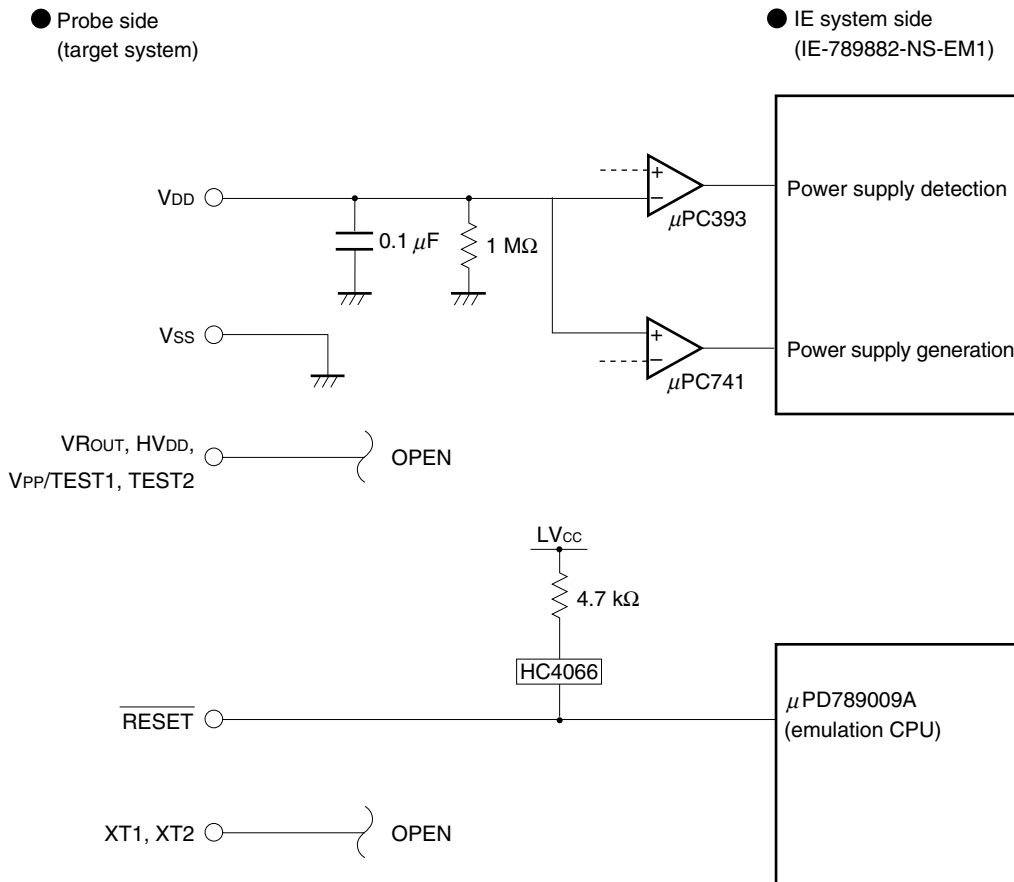
CHAPTER 5 OPERATIONAL DIFFERENCES BETWEEN TARGET DEVICE AND EMULATION BOARD

This chapter describes the operational differences between the target device and the IE-789882-NS-EM1.

(1) There is no wait corresponding to one subsystem clock when HALT is released.
Because the clock mounted in the IE system is used, the x4 subsystem clock is supplied to the peripheral functions even during HALT.

(2) There is no oscillation stabilization time when reset is released.
Immediately after reset is released, the CPU starts operating.

(3) The subsystem clock on the target system cannot be emulated.
Use the subsystem clock on the emulation board for emulation.

APPENDIX A   EMULATION PROBE PIN ASSIGNMENT TABLE

Table A-1. NP-H64GB-TQ Pin Assignments

Emulation Probe	TGCN1 Pin No.	Emulation Probe	TGCN1 Pin No.
1	108	33	14
2	107	34	13
3	104	35	18
4	103	36	17
5	100	37	22
6	99	38	21
7	94	39	28
8	93	40	27
9	30	41	92
10	29	42	91
11	24	43	98
12	23	44	97
13	20	45	102
14	19	46	101
15	16	47	106
16	15	48	105
17	43	49	77
18	44	50	78
19	47	51	73
20	48	52	74
21	51	53	69
22	52	54	70
23	57	55	63
24	58	56	64
25	59	57	61
26	60	58	62
27	55	59	65
28	56	60	66
29	49	61	71
30	50	62	72
31	45	63	75
32	46	64	76

Remarks 1. NP-H64GB-TQ is a product of Naito Densei Machida Mfg. Co., Ltd.
2. The numbers in the "Emulation probe" column indicate the corresponding pin number on the emulation probe tip.

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APPENDIX B   NOTES ON TARGET SYSTEM DESIGN

The following shows the conditions when connecting the emulation probe to the conversion adapter. Follow the configuration below and consider the shape of parts to be mounted on the target system when designing a system.

Among the products described in this appendix, NP-H64GB-TQ is a product of Naito Densei Machida Mfg. Co., Ltd, and TGB-064SDP is a product of TOKYO ELETECH CORPORATION.

Table B-1. Distance Between IE System and Conversion Adapter

Emulation Probe	Conversion Adapter	Distance Between IE System and Conversion Adapter
NP-H64GB-TQ	TGB-064SDP	370 mm

Figure B-1. Distance Between In-Circuit Emulator and Conversion Socket/Conversion Adapter
(When 64GB Is Used)

In-circuit emulator
IE-78K0S-NS or IE-78K0S-NS-A

Emulation board
IE-789882-NS-EM1

370 mm**Note**

Target system

TGCN1

Emulation probe
NP-H64GB-TQ
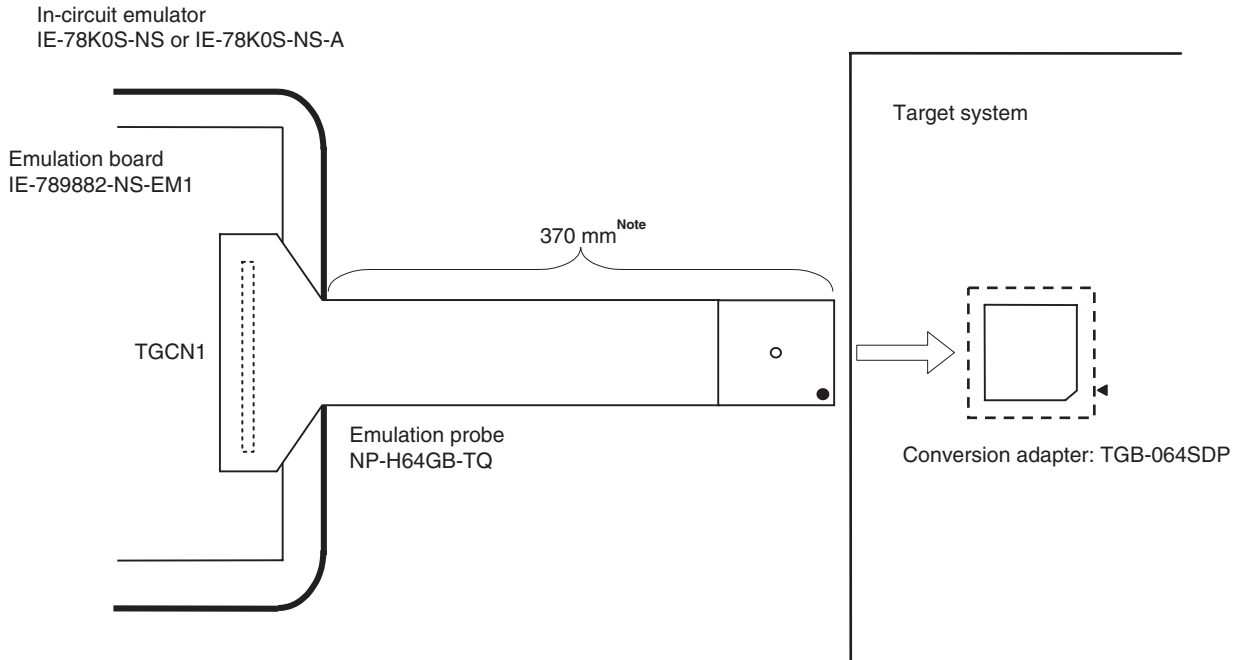
Conversion adapter: TGB-064SDP

Figure B-2. Connection Conditions of Target System (When NP-H64GB-TQ Is Used)

Emulation board
IE-789882-NS-EM1

Emulation probe
NP-H64GB-TQ

21.4 mm

Conversion adapter
TGB-064SDP

11 mm

16 mm

16 mm

42.6 mm

45 mm

Target system