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# User's Manual

# IE-789026-NS-EM1

## Emulation Board

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## Target devices $\mu$ PD789026 Subseries

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## Major Revisions in This Edition

Page	Description
Throughout	<ul style="list-style-type: none"> <li>• Addition of description of IE-78K0S-NS-A as supported in-circuit emulator</li> <li>• Addition of NP-H44GB-TQ and NP-H44GB-TQ as supported emulation probes</li> <li>• Deletion of NP-42CU from supported emulation probes</li> </ul>
pp.12 and 13	<p><b>Figure 1-1 System Configuration</b></p> <ul style="list-style-type: none"> <li>• Change of supply medium of debugger ID78K0S-NS to CD-ROM</li> <li>• Modification of <b>Notes 1 to 3</b></li> </ul>
p.15	Thorough modification of <b>Table 1-1 Basic Specifications</b>
pp.20 to 22	<p><b>3.2.1 Overview of clock settings</b></p> <ul style="list-style-type: none"> <li>• Change of “internal clock” to “clock oscillator”</li> <li>• <b>Figure 3-2 External Circuits Used as System Clock Oscillator</b> Addition of V<sub>ss</sub> pin to figure of <b>(a) Clock oscillator</b></li> <li>• <b>Figure 3-3 When Using Clock That Is Already Mounted on Emulation Board and Figure 3-4 When Using User-Mounted Clock</b> Change of “resonator” in target system to “clock oscillator or external clock”</li> <li>• Change of “clock generator” to “external clock” in <b>Figure 3-5 When Using an External Clock</b></li> </ul>
p.29 in previous revision	Deletion of <b>3.4 Low-Voltage Emulation Setting</b>
p.27	Addition of <b>3.3 Power Supply Voltage Setting of Target Interface</b>
p.29	<p><b>3.5 Switch and Jumper Settings on IE-78K0S-NS or IE-78K0S-NS-A</b></p> <ul style="list-style-type: none"> <li>• Addition of <b>Caution</b></li> <li>• Addition of <b>(2) Settings on the IE-78K0S-NS-A</b></li> </ul>
p.35	Addition of <b>APPENDIX B CAUTIONS ON DESIGNING TARGET SYSTEM</b>

The mark ★ shows major revised points.

## INTRODUCTION

### Product Overview

The IE-789026-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.

- $\mu$ PD789026 Subseries:  $\mu$ PD789022, 789024, 789025, 789026, 78F9026

### Target Readers

This manual is intended for engineers who will use the IE-789026-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-789026-NS-EM1, refer to not only this manual (supplied with the IE-789026-NS-EM1) but also the manual that is supplied with the IE-78K0S-NS or IE-78K0S-NS-A.

IE-78K0-NS  
User's Manual

- Basic specifications
- System configuration
- External interface functions

IE-789026-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-789026-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 (real chip).
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 IE-78K0S-NS or IE-78K0S-NS-A and the IE-789026-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	U13549E
IE-78K0S-NS-A	U15207E
IE-789026-NS-EM1	This manual
ID78K0-NS, ID78K0S-NS Integrated Debugger Ver. 2.20 or Later Operation Windows™ Based	U14910E
μPD789026 Subseries	U11919E

**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-789026-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-789026-NS-EM1's system configuration and basic specifications.

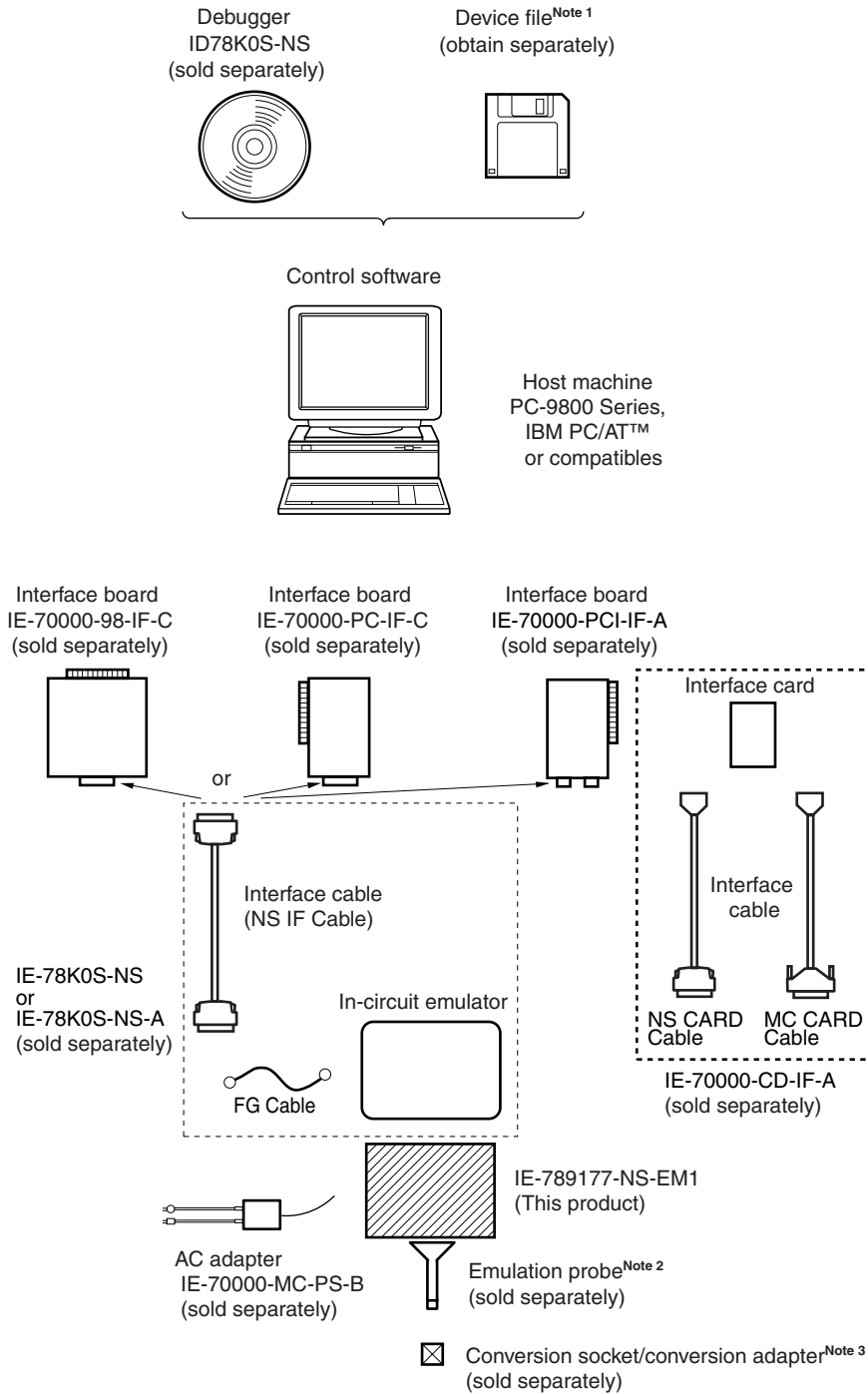
- Target devices
  - $\mu$ PD789026 Subseries

## 1.1 System Configuration

Figure 1-1 illustrates the IE-789026-NS-EM1's system configuration.

★

**Figure 1-1. System Configuration**



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

$\mu$ SxxxxDF789026:  $\mu$ PD789022, 789024, 789025, 789026, 78F9026A

Device files can be downloaded from the NEC Electron Devices Web site  
(URL: <http://www.ic.nec.co.jp/micro>).

2. The emulation probe is as follows, in accordance with the package.

NP-44GB, NP-44GB-TQ, NP-H44GB-TQ: 44-pin plastic QFP (GB-8ES type)

The NP-44GB, NP-44GB-TQ, and NP-H44GB-TQ are products made by Naito Densai Machida Mfg. Co., Ltd.

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

3. The conversion socket and conversion adapter are as follows.

EV-9200G-44: 44-pin plastic QFP (GB-8ES type)

TGB044SAP: 44-pin plastic QFP (GB-8ES type)

TGB044SAP is a product of TOKYO ELETECH CORPORATION.

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

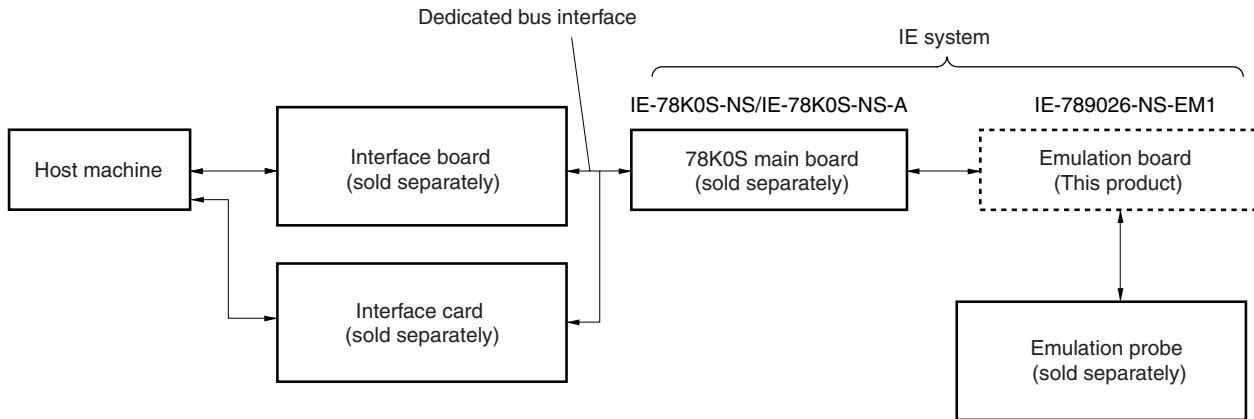
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## 1.2 Hardware Configuration

Figure 1-2 shows the IE-789026-NS-EM1's position in the basic hardware configuration.

**Figure 1-2. Basic Hardware Configuration**





### 1.3 Basic Specifications

The IE-789026-NS-EM1's basic specifications are listed in Table 1-1.

★

**Table 1-1. Basic Specifications**

Parameter	Description
Target device	$\mu$ PD789026 Subseries
System clock	Main system clock: 1.0 to 5.0 MHz
Main system clock supply	External: Input via an emulation probe from the target system Internal: Mounted on emulation board (5.0 MHz), or mounted on the board by the user
Target interface voltage	$V_{DD} = 1.8$ to 5.5 V (same as that of target device) Operates on internal power supply (5 V) when target system is not connected

## CHAPTER 2 PART NAMES

This chapter introduces the parts of the IE-789026-NS-EM1 main unit.

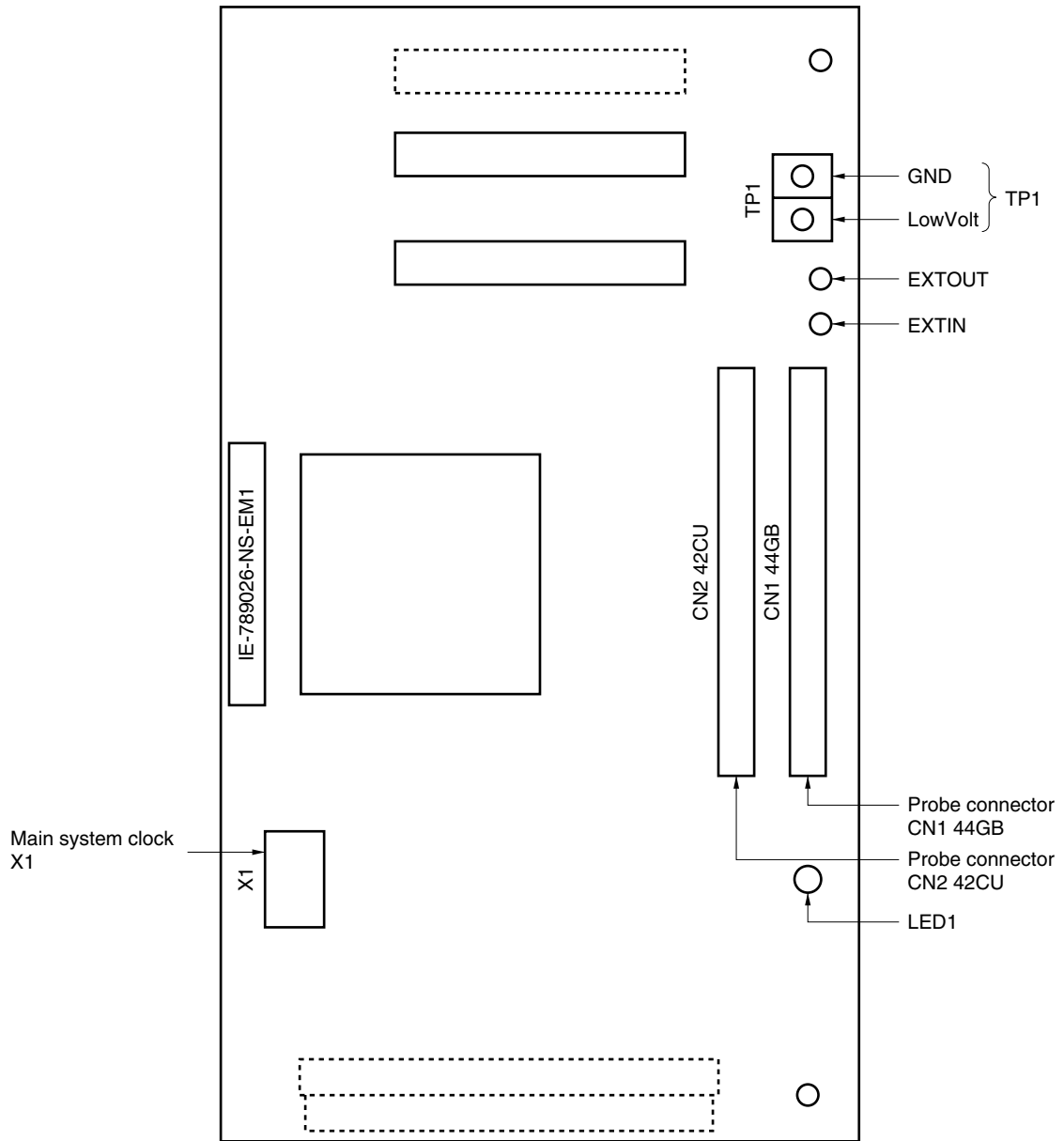
The packing box contains the emulation board (IE-789026-NS-EM1), packing list, user's manual, and guarantee card.

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

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

2.1 Parts of Main Unit

Figure 2-1. IE-789026-NS-EM1 Part Names



## CHAPTER 3 INSTALLATION

This chapter describes methods for connecting the IE-789026-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-789026-NS-EM1 to the IE-78K0S-NS<sup>Note</sup>.

**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-789026-NS-EM1<sup>Note</sup>.

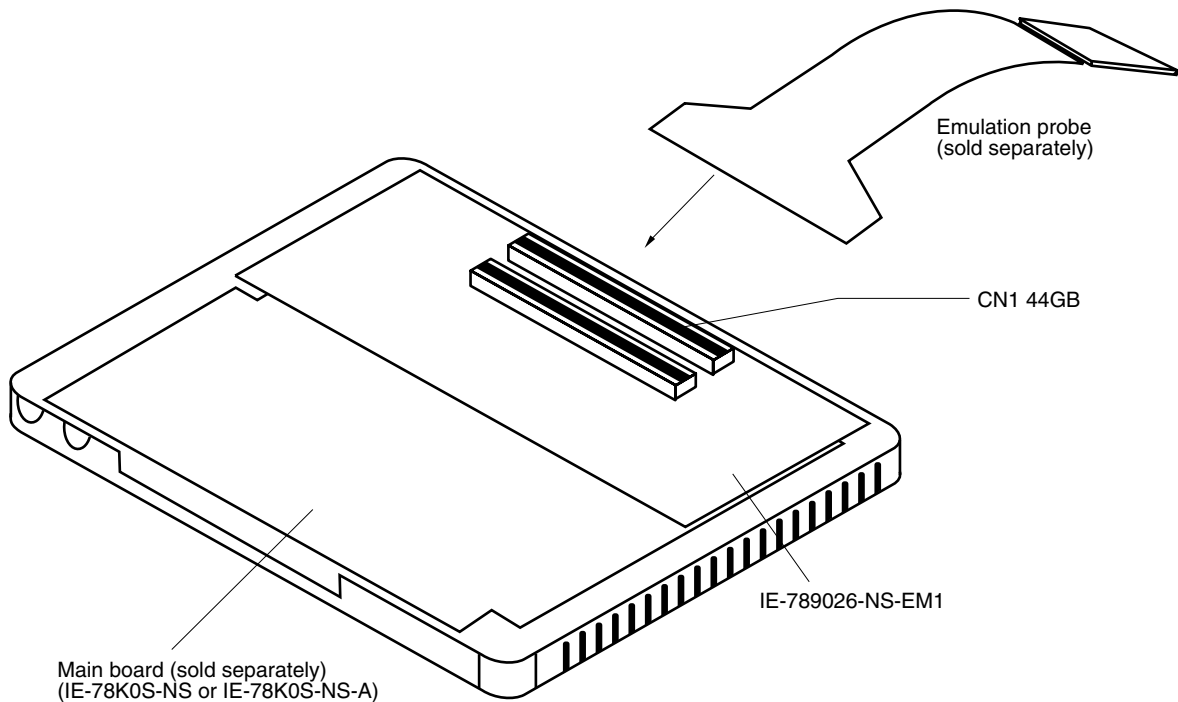
On this board, connect NP-44GB to CN1.

**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



## 3.2 Clock Settings

### 3.2.1 Overview of clock settings

The main system clock to be used during debugging can be selected from (1) to (3) below.

- (1) Clock that is already mounted on emulation board
- (2) Clock that is mounted by user
- (3) Pulse input from target system

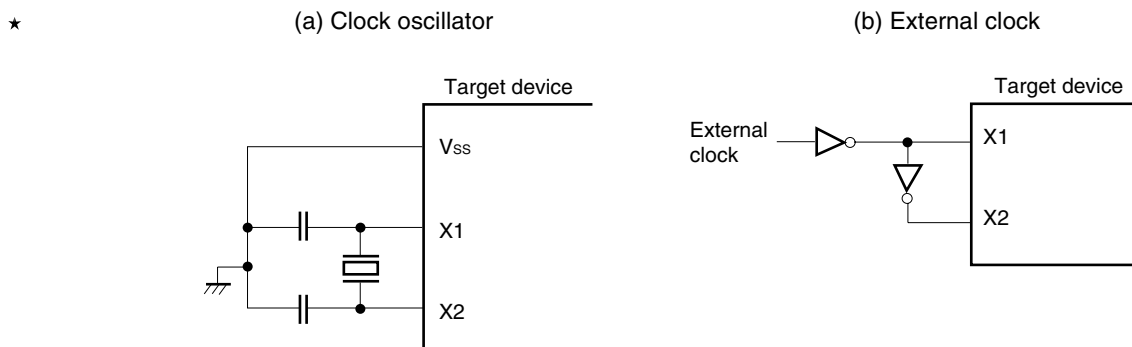
- ★ If the target system includes a clock oscillator, select either “(1) Clock that is already mounted on emulation board” or “(2) Clock that is mounted by user”. For the clock oscillator, a resonator is connected to the target device and the target device’s internal oscillator is used. An example of the external circuit is shown in part (a) of Figure 3-2. 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.

If the target system includes an external clock, select “(3) Pulse input from target system”.

For the external clock, a clock signal is supplied from outside of the target device and the target device’s internal oscillator is not used. An example of the external circuit is shown in part (b) of Figure 3-2.

**Caution** The IE system will be hung-up if the main system clock is not supplied normally. Moreover, be sure to input a rectangular wave as the clock from the target. There is no need to supply a clock to the X2 pin.

**Figure 3-2. External Circuits Used as System Clock Oscillator**

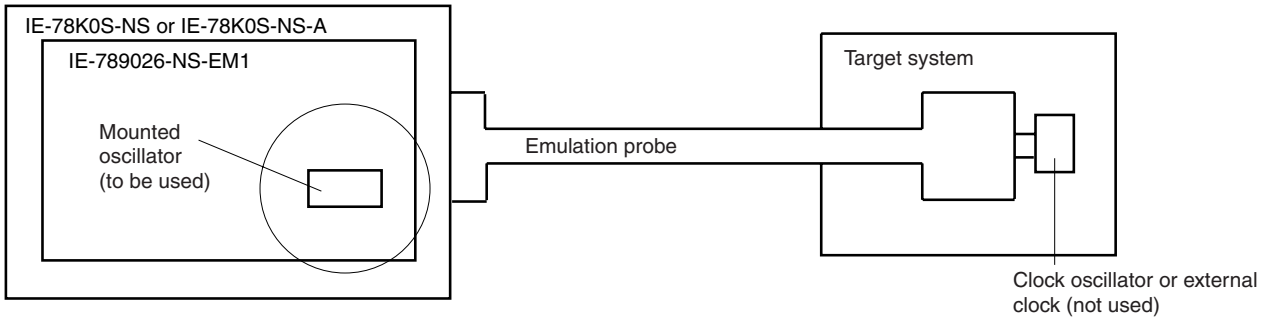


**(1) Clock that is already mounted on emulation board**

A crystal oscillator (X1) is already mounted on the emulation board. Its frequency is 5.0 MHz.

★

**Figure 3-3. When Using Clock That Is Already Mounted on Emulation Board**



**Remark** The clock that is supplied by the IE-789026-NS-EM1's oscillator (encircled in the figure) is used.

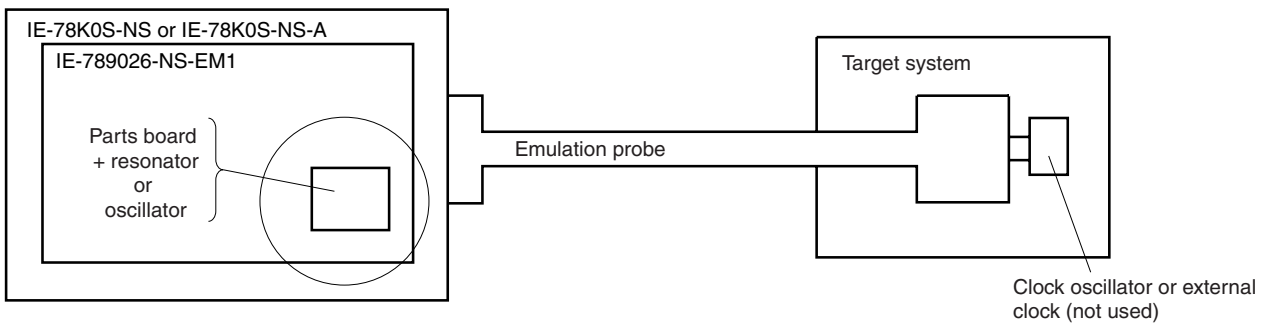
**(2) Clock that is mounted by user**

The user is able to mount any clock supported by the set specifications on the IE-789026-NS-EM1.

Remove the crystal oscillator (X1) that is already mounted on the emulation board, and mount the parts board on which the resonator to be used is mounted or the oscillator to be used. This method is useful when using a different frequency from that of the pre-mounted clock.

★

**Figure 3-4. When Using User-Mounted Clock**



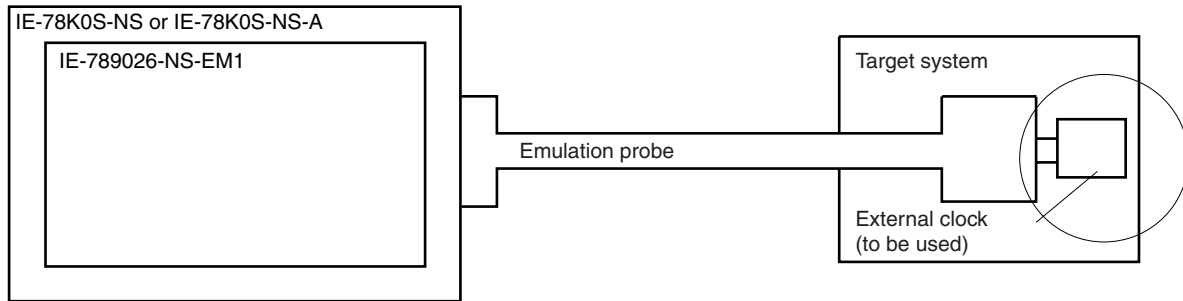
**Remark** The clock that is supplied by the parts board on which the IE-789026-NS-EM1's resonator is mounted or by the oscillator (encircled in the figure) is used.

**(3) Pulse input from target system**

An external clock connected to the target system can be used via an emulation probe.

★

**Figure 3-5. When Using an External Clock**



**Remark** The clock supplied by the target system’s external clock (encircled in the figure) is used.

**3.2.2 Main system clock settings**

**Table 3-1. Main System Clock Settings**

Frequency of Main System Clock		IE-789026-NS-EM1	CPU Clock Source Selection (ID)
		X1 Socket	
When using clock that is already mounted on emulation board	5.0 MHz	Oscillator used	Internal
When using clock mounted by user	Other than 5.0 MHz	Oscillator configured by user	External
When inputting pulse from target system		Oscillator (not used)	

**Caution** When inputting a pulse from the target system, open the configuration dialog box when starting the integrated debugger (ID78K0S-NS) and select “External” in the area (Clock) for selecting the CPU’s clock source (this selects the user’s clock).

**Remark** The IE-789026-NS-EM1’s factory settings are those listed above under “when using clock that is already mounted on emulation board”.

**(1) When using clock that is already mounted on emulation board**

When the IE-789026-NS-EM1 is shipped, a 5.0-MHz crystal oscillator is already mounted in the IE-789026-NS-EM1’s X1 socket. When using the factory-set mode settings, there is no need to make any other hardware settings.

When starting the integrated debugger (ID78K0S-NS), open the configuration dialog box and select “Internal” in the area (Clock) for selecting the CPU’s clock source (this selects the emulator’s internal clock).



**(2) When using clock mounted by user**

The settings described under either (a) or (b) are required, depending on the type of clock to be used. When starting the integrated debugger (ID78K0S-NS), open the configuration dialog box and select "Internal" in the area (Clock) for selecting the CPU's clock source (this selects the emulator's internal clock).

**(a) When using a ceramic resonator or crystal resonator**

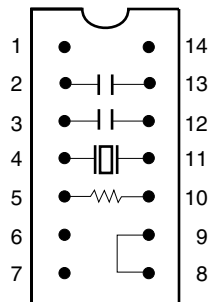
- Items to be prepared
  - Parts board
  - Ceramic resonator or crystal resonator
  - Resistor Rx
- Capacitor CA
- Capacitor CB
- Solder kit

<Steps>

- <1> Solder the target ceramic resonator or crystal resonator, resistor Rx, capacitor CA, and capacitor CB (all with suitable oscillation frequencies) onto the supplied parts board (as shown below).

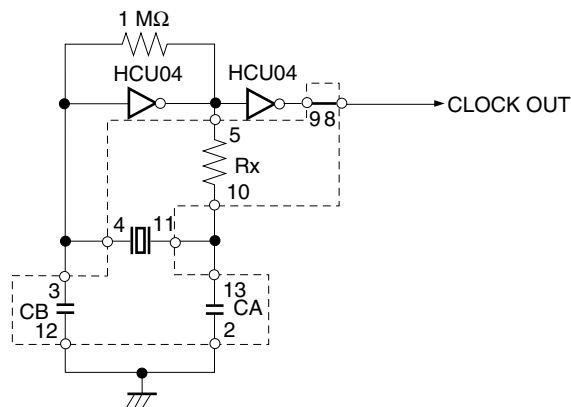
**Figure 3-6. Connections on Parts Board (When Using User-Mounted Clock)**

Parts board (X1)



Pin No.	Connection
2-13	Capacitor CA
3-12	Capacitor CB
4-11	Ceramic resonator or crystal resonator
5-10	Resistor Rx
8-9	Shorted

Circuit diagram

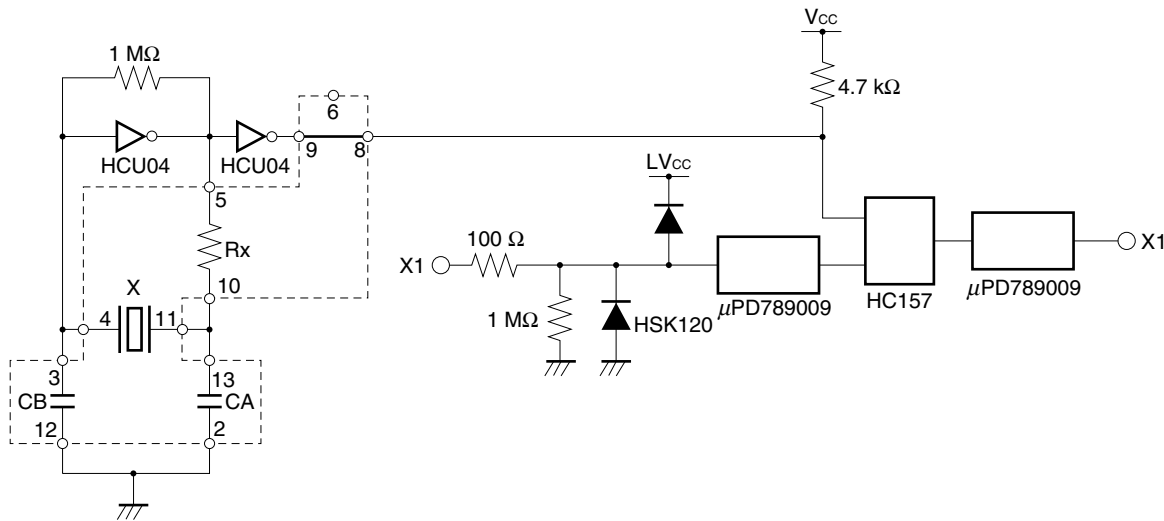


**Remark** The sections enclosed in broken lines indicate parts that are attached to the parts board.

- <2> Prepare the IE-789026-NS-EM1.
- <3> Remove the crystal oscillator that is mounted in the IE-789026-NS-EM1's X1 socket.
- <4> Connect the parts board (from <1> above) to the X1 socket from which the crystal oscillator was removed. Check the pin 1 mark to make sure the board is mounted in the correct direction.
- <5> Make sure that the parts board is wired as shown in Figure 3-6 above.
- <6> Install the IE-789026-NS-EM1 in the IE-78K0S-NS or IE-78K0S-NS-A.

The above steps configure the following circuit and enable supply of the clock from the mounted resonator to the emulation device.

**IE-78K0S-NS or IE-78K0S-NS-A side  
(Emulation device)**

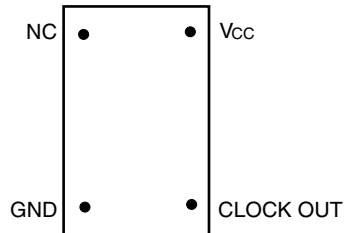


**Remark** The sections enclosed in broken lines indicate parts that are attached to the parts board.

(b) When using a crystal oscillator

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

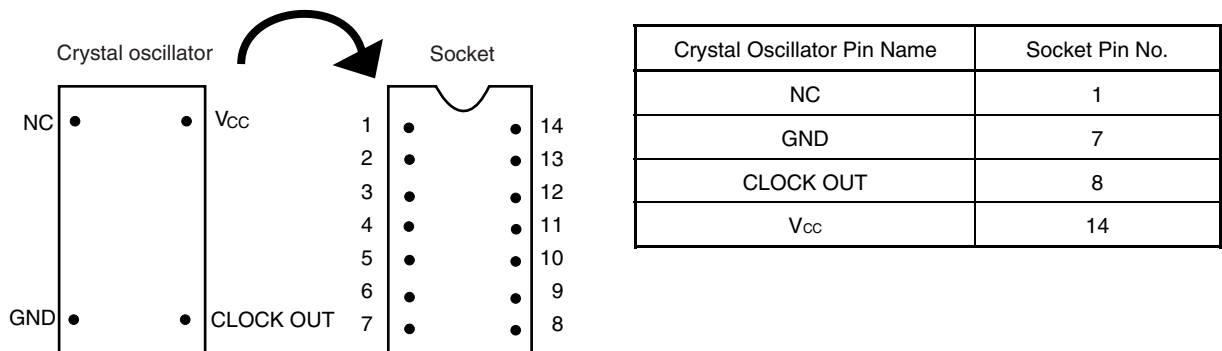
**Figure 3-7. Crystal Oscillator (When Using User-Mounted Clock)**



<Steps>

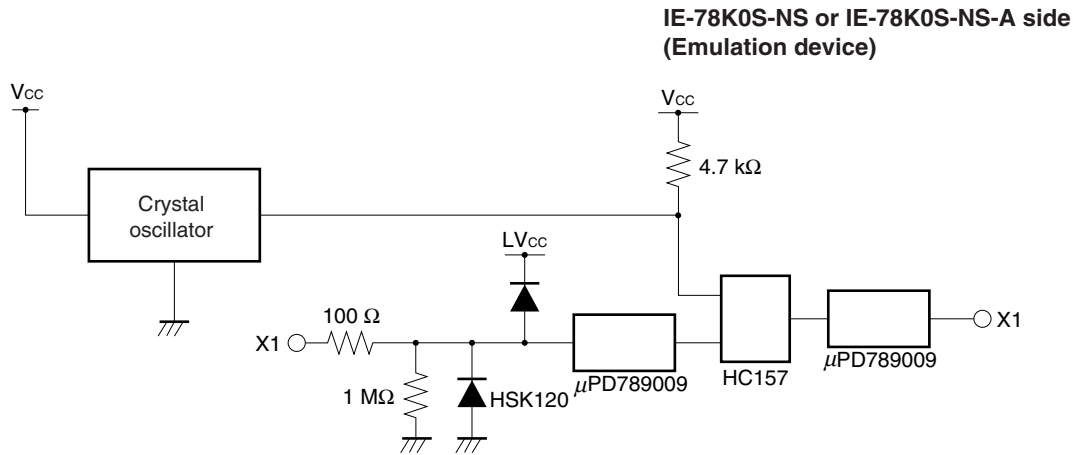
- <1> Prepare the IE-789026-NS-EM1.
- <2> Remove the crystal oscillator that is mounted in the IE-789026-NS-EM1's X1 socket.
- <3> Connect a crystal oscillator to the X1 socket from which the crystal oscillator was removed (in <2> above). Insert the crystal oscillator pin into the socket aligning the pins as shown in the figure below.

**Figure 3-8. Pin Alignment of Crystal Oscillator and Socket**



- <4> Install the IE-789026-NS-EM1 in the IE-78K0S-NS or IE-78K0S-NS-A.

The above steps configure the following circuit and enable supply of the clock from the mounted resonator to the emulation device.



**(3) When inputting pulse from target system**

No hardware settings are required for this situation.

When starting the integrated debugger (ID78K0S-NS), open the configuration dialog box and select "External" in the area (Clock) for selecting the CPU's clock source (this selects the user's clock).

### ★ 3.3 Power Supply Voltage Setting of Target Interface

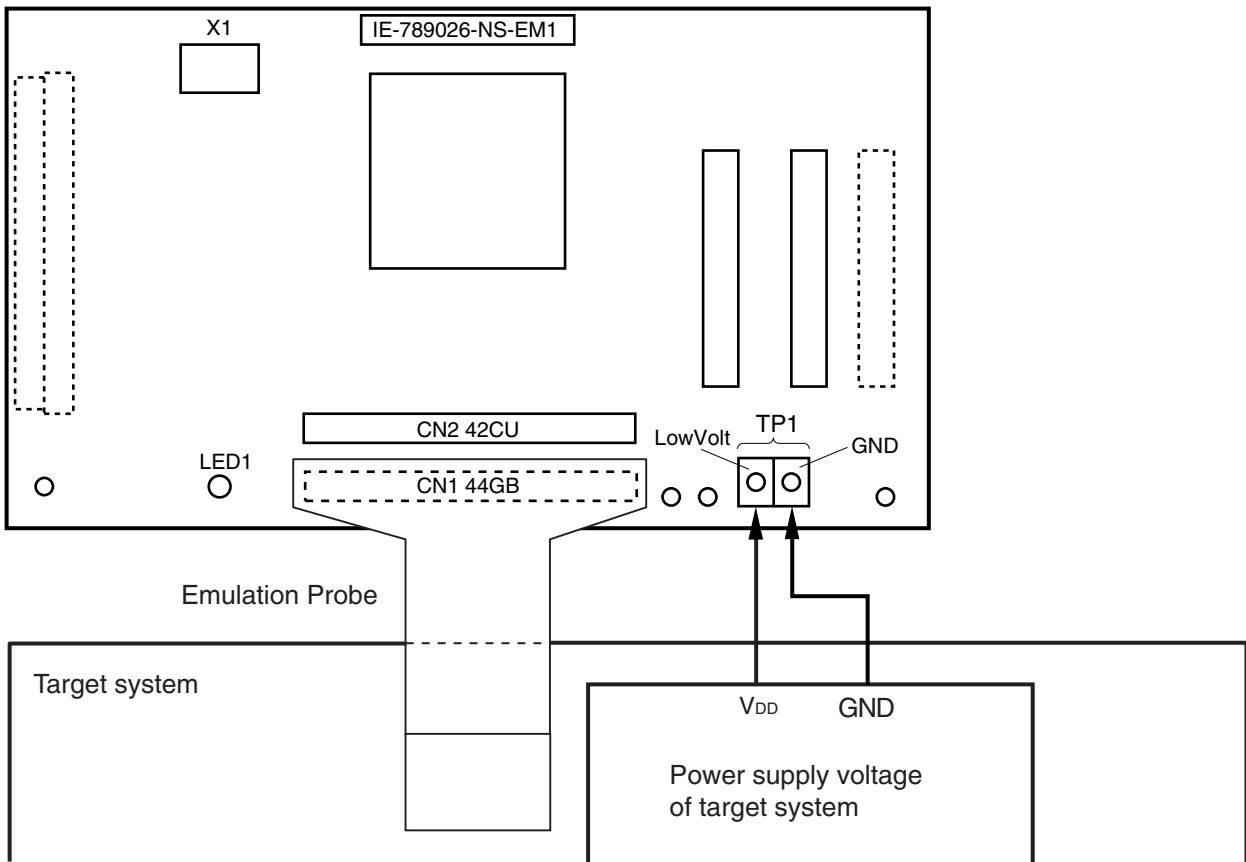
In the IE system, emulation is possible with a voltage of the same level as the power supply voltage of the target system.

When the target system is not connected, the IE system automatically operates with the emulator's internal power supply (5 V). When debugging with a voltage that is the same level as that of the target system, supply the same voltage as that of the target system to the TP1 terminal pin of the IE-789026-NS-EM1 (the same applies when the voltage is 5 V).

Set the target voltage to between 1.8 and 5.0 V.

- Maximum current consumption of TP1  
1.8 to 5.0 V: Approximately 100 mA

**Figure 3-9. Connection of TP1 and Power Supply Voltage of Target System**



**Caution** Connect TP1 on the board and the power supply voltage of the target system after turning off the power of the IE-78K0S-NS or IE-78K0S-NS-A.

**Remark** The V<sub>DD</sub> pin of the target system is only used for controlling LED1 (TV<sub>CC</sub>), which monitors whether the power supply of the target system is connected in the IE-789026-NS-EM1.

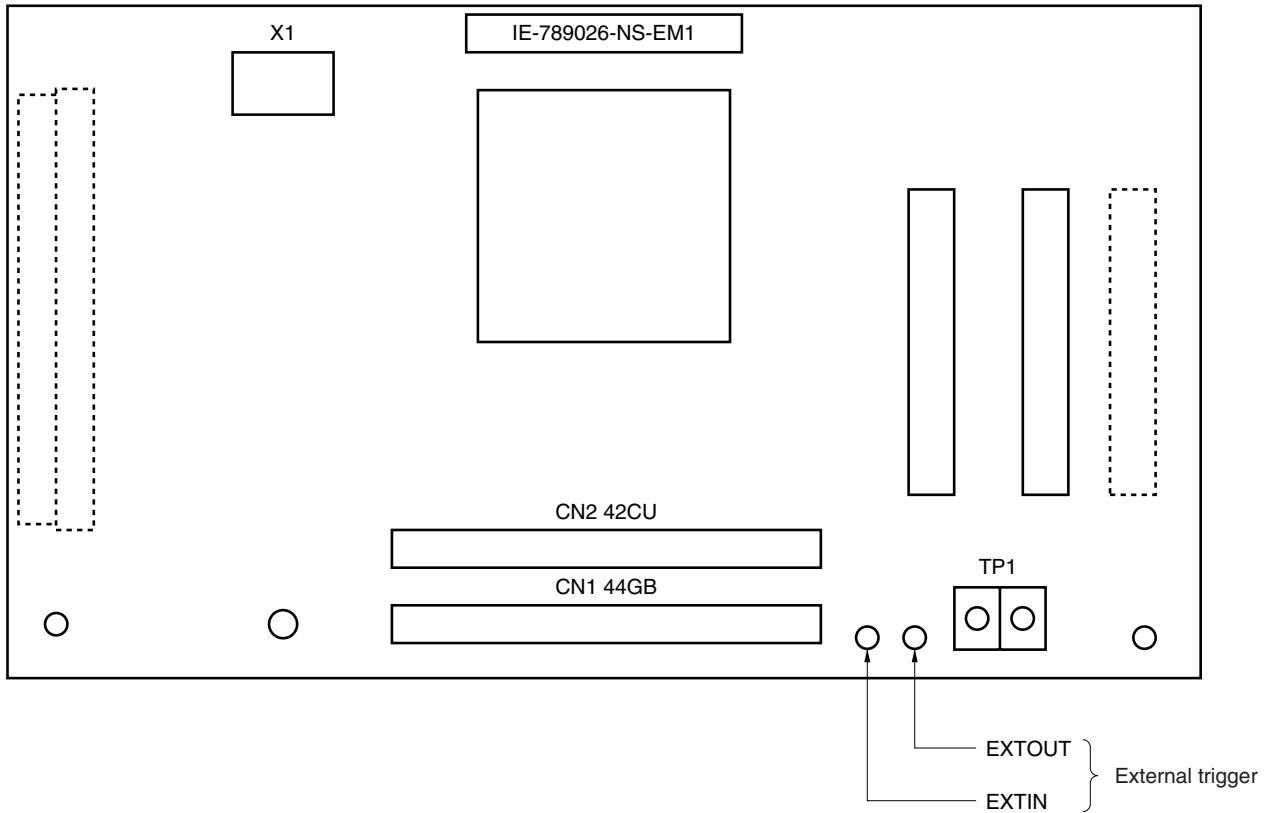
### 3.4 External Trigger

To set up an external trigger, connect the IE-789026-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 **ID78K0-NS, ID78K0S-NS Integrated Debugger Ver.2.20 or Later Operation (Windows Based) User's Manual (U14910E)**.

Figure 3-10. External Trigger Input Position



### 3.5 Switch and Jumper Settings on IE-78K0S-NS or IE-78K0S-NS-A

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

When using the IE-789026-NS-EM1, set the switches and jumpers on the IE-78K0S-NS as shown in Table 3-2. For details of these switch and jumper settings, refer to the **IE-78K0S-NS User's Manual (U13549E)**.

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

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

★ **Caution** Incorrect connection may damage the IE-789026-NS-EM1.

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

When using the IE-789026-NS-EM1, set the switches and jumpers on the IE-78K0S-NS-A as shown in Table 3-3. For details of these switch and jumper settings, refer to the **IE-78K0S-NS-A User's Manual (U15207E)**.

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

	SW1	JP1	JP3
Setting	OFF	1 and 2 shorted	Shorted (fixed)

**Caution** Incorrect connection may damage the IE-789026-NS-EM1.

## 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 IE-789026-NS-EM1's target interface circuit.

Although the target device is a CMOS circuit, the IE-789026-NS-EM1's target interface circuit consists of an emulation CPU, TTL, CMOS-IC, and other components.

When the IE system is connected with the target system for debugging, the IE system performs emulation so as to operate as the actual target device would operate in the target system.

However, some minor differences exist since the operations are performed via the IE system's emulation.

- (1) Signals input to or output from the evaluation chip and peripheral evaluation chip
- (2) Signals input from the target system via a gate
- (3) Other signals

The IE-789026-NS-EM1's circuit is used as follows for signals listed in (1) to (3) above.

### (1) Signals input to or output from the evaluation chip and peripheral evaluation chip

The following signals perform the same operations as in the  $\mu$ PD789026 Subseries. However, a 1 M $\Omega$  pull-down resistor and 100  $\Omega$  resistor are inserted in series for the signals related to ports. Refer to **Figure 4-1 Equivalent Circuit 1 of Emulation Circuit**.

- Signals related to port 0
- Signals related to port 1
- Signals related to port 2
- Signals related to port 3
- Signals related to port 4
- Signals related to port 5

### (2) Signals input from the target system via a gate

Since the following signals are input via a gate, their timing shows a delay compared to the  $\mu$ PD789026 Subseries.

- $\overline{\text{RESET}}$  signal
- X1 signal

Refer to **Figure 4-3 Equivalent Circuit 3 of Emulation Circuit**.



**(3) Other signals**

- $V_{DD}$  pin

When the target system is not connected, the internal power supply voltage (5 V) of the IE-789026-NS-EM1 is supplied to the emulation CPU. When the target system is connected, power is supplied via the voltage supply pin (TP1). The  $V_{DD}$  pin of the target system is only used to control the LED ( $TV_{CC}$ ) in the IE-789026-NS-EM1 that monitors the input of the target system's power supply.

- $V_{SS}$  pin

The  $V_{SS}$  pin is connected to GND in the IE-789026-NS-EM1.

- $V_{PP}/IC$  pin

The  $V_{PP}$  and IC pins are not used in the IE-789026-NS-EM1.

- X2 pin

The X2 pin is not used in the IE-789026-NS-EM1.

Figure 4-1. Equivalent Circuit 1 of Emulation Circuit

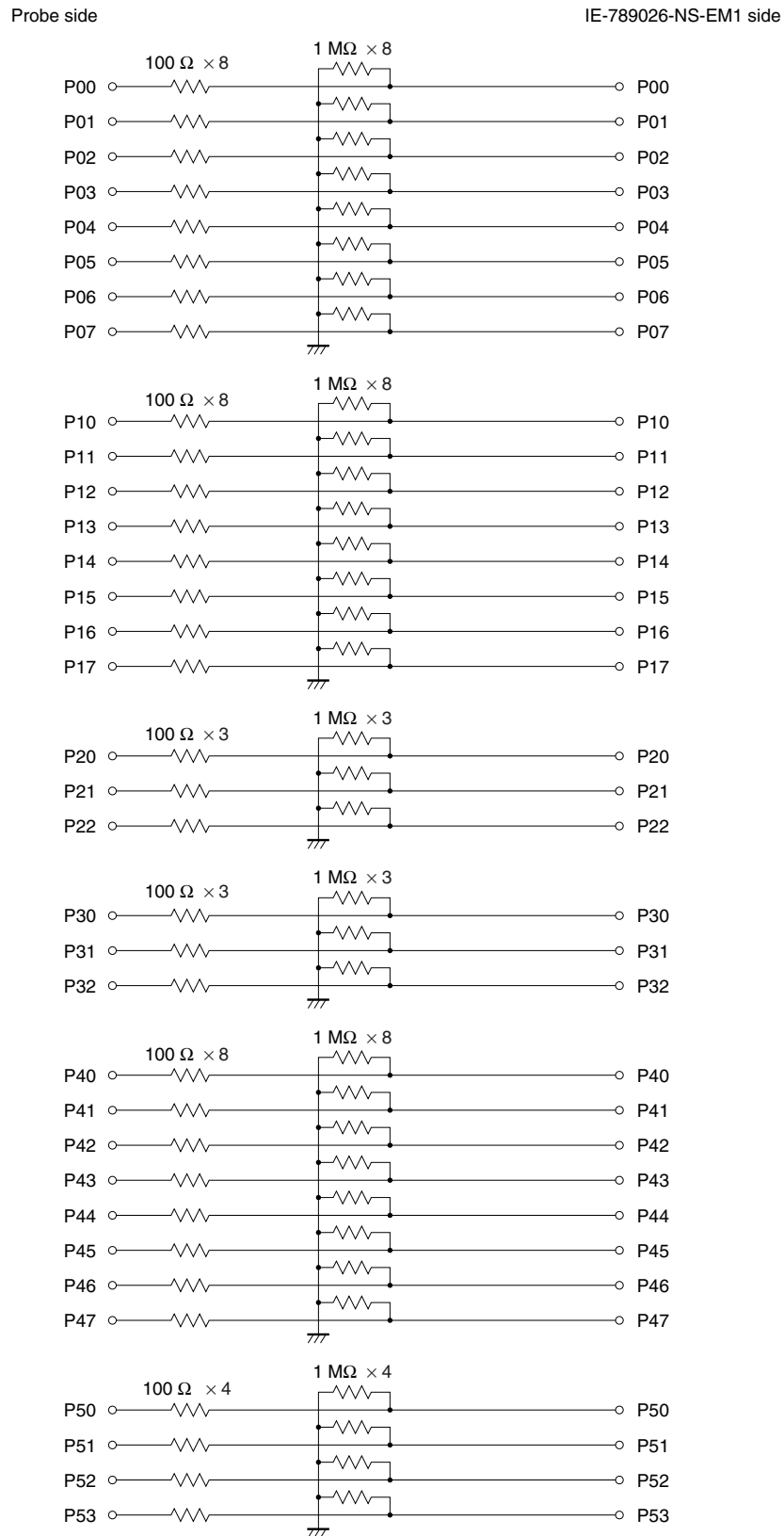


Figure 4-2. Equivalent Circuit 2 of Emulation Circuit

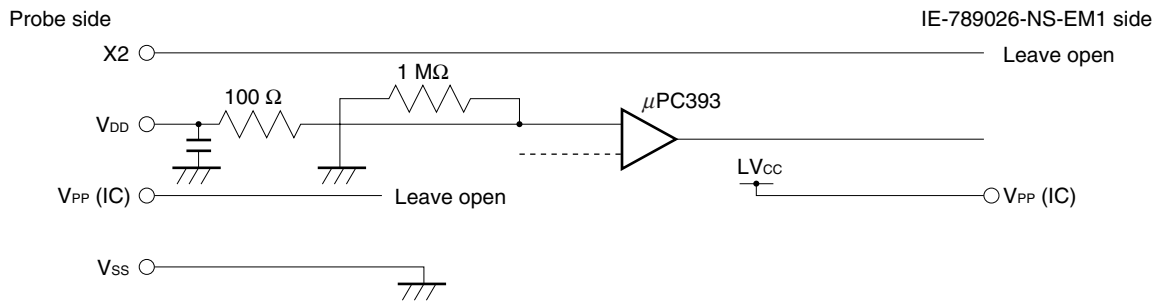
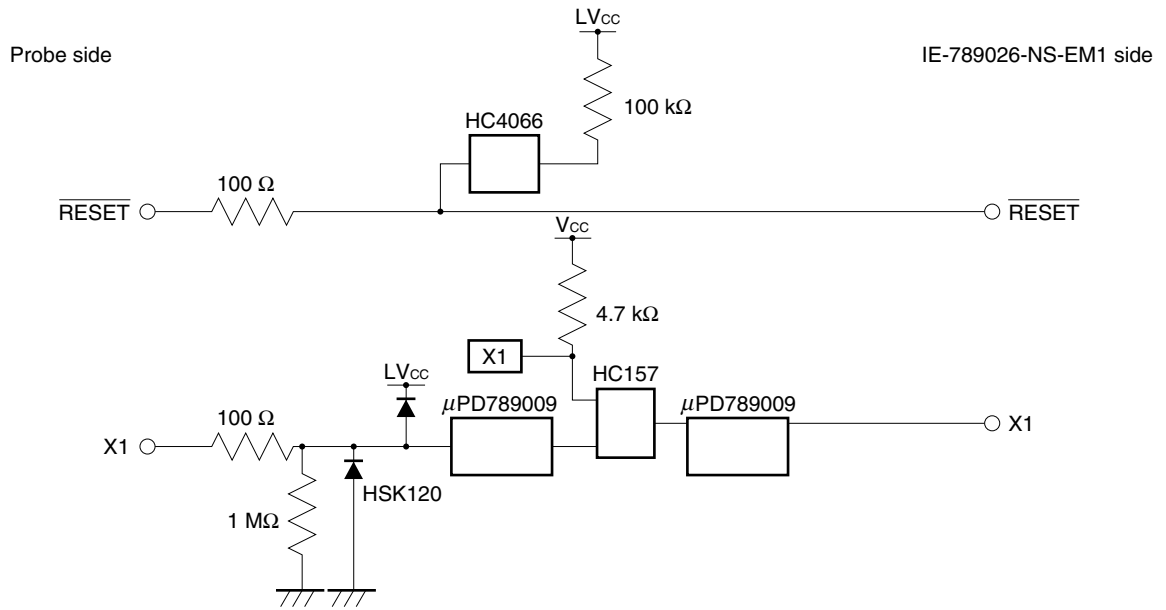


Figure 4-3. Equivalent Circuit 3 of Emulation Circuit



## APPENDIX A EMULATION PROBE PIN ASSIGNMENT TABLE

**Table A-1. NP-44GB, NP-44GB-TQ, NP-H44GB-TQ Pin Assignments**

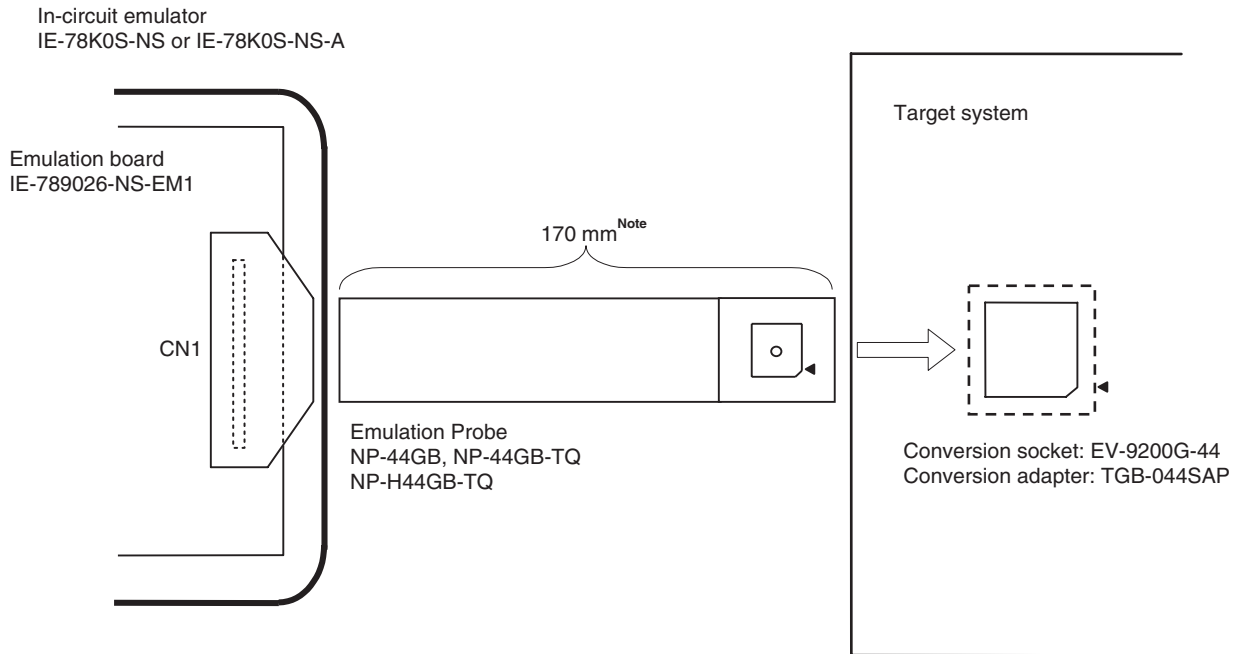
Emulation Probe	CN1 Pin No.	Emulation Probe	CN1 Pin No.
1	104	23	18
2	103	24	17
3	100	25	22
4	99	26	21
5	94	27	28
6	93	28	27
7	30	29	92
8	29	30	91
9	24	31	98
10	23	32	97
11	20	33	102
12	47	34	73
13	48	35	72
14	51	36	69
15	52	37	70
16	57	38	63
17	58	39	64
18	59	40	61
19	60	41	62
20	55	42	65
21	56	43	66
22	49	44	71

- Remarks**
1. NP-44GB, NP-44GB-TQ, and NP-H44GB-TQ are products of Naito Densai Machida Mfg. Co., Ltd.
  2. The numbers in the “Emulation probe” column indicate the corresponding pin number on the emulation probe tip.

## APPENDIX B CAUTIONS ON DESIGNING TARGET SYSTEM

Figures B-1 and B-2 show the conditions when connecting the emulation probe to the conversion connector or conversion socket. Follow the configuration below and consider the shape of parts to be mounted on the target system when designing a system.

**Figure B-1. Distance Between In-Circuit Emulator and Conversion Socket/Conversion Adapter**

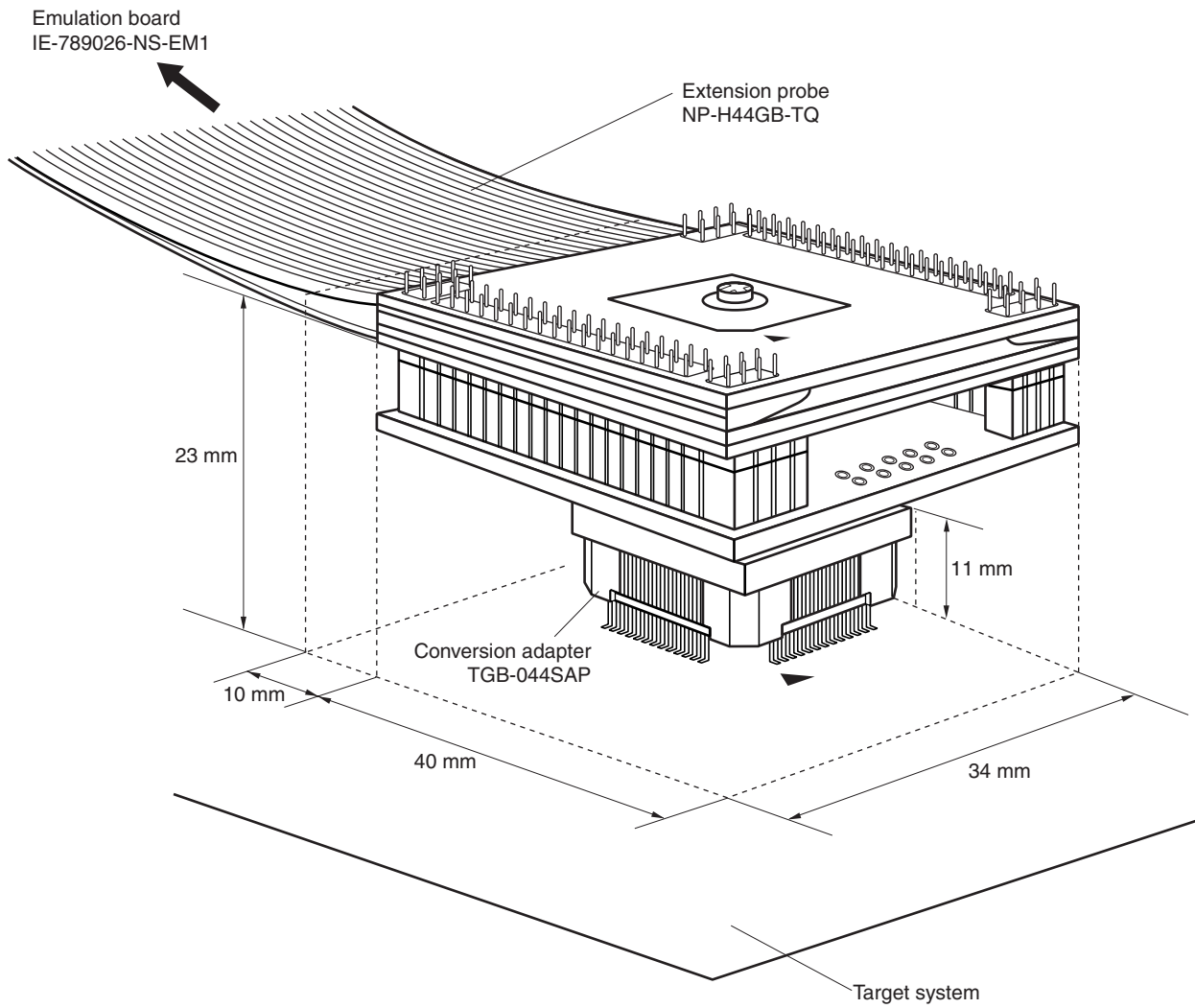


**Note** Distance when NP-44GB and NP-44GB-TQ are used. When NP-H44GB-TQ is used, the distance is 370 mm.

**Remarks**

1. NP-44GB, NP-44GB-TQ, and NP-H44GB-TQ are products of Naito Densai Machida Mfg. Co., Ltd.
2. TGB-044SAP is a product of TOKYO ELETECH CORPORATION.

Figure B-2. Connection Condition of Target System (When NP-H44GB-TQ Is Used)



**Remark** NP-H44GB-TQ is a product of Naito Densai Machida Mfg. Co., Ltd.  
 TGB-044SAP is a product of TKYO ELETECH CORPORATION.

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