NEC

User's Manual

IE-789801-NS-EM1

Emulation Board

Target Devices
μPD789800 Subseries

[MEMO]

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- Device availability

- Ordering information

- Product release schedule

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- 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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Major Revisions in This Edition

Pages	Description
Throughout	• Addition of IE-78K0S-NS-A as supported main board • Addition of NP-H44GB-TQ as emulation probe • Addition of TGB-044SAP as conversion socket/adapter • Deletion of NP-42CU from supported emulation probes
pp.12, 13	**Figure 1-1 System Configuration** • Change of supply medium for debugger ID78K0S-NS to CD-ROM • Change of **Notes 1** to **3**.
p.15	Modification of a part of **Table 1-1 Basic Specifications**
pp.20 to 22	**3.2.1 Overview of clock settings** • Change from "internal clock" to "clock oscillator" • Addition of V_{SS} pin in **(a) Clock oscillator** in **Figure 3-2 External Circuit Used as System Clock Oscillator** • Change from "resonator" to "clock oscillator or external clock" on target system in **Figure 3-3 When Using Clock (6 MHz) That Is Already Mounted on Emulation Board** and **Figure 3-4 When Using User-Mounted Clock** • Change from "clock generator" to "external clock" in **Figure 3-5 When Using an External Clock**
p.29	Addition of **3.3 Setting Power Supply Voltage of Target Interface**
p.30	Addition of **3.4 External Trigger**
p.31	**3.5 Switch and Jumper Settings** • Addition of **(2) Switch and jumper settings on IE-78K0S-NS-A**
p.36	Addition of **APPENDIX B CAUTIONS ON DESIGNING TARGET SYSTEM**

The mark ★ shows major revised points.

INTRODUCTION

Product Overview The IE-789801-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.

- μPD789800 Subseries: μPD789800, 78F9801

Target Readers This manual is intended for engineers who will use the IE-789801-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 usage methods and to be knowledgeable about debugging.

Organization When using the IE-789801-NS-EM1, refer to not only this manual (supplied with the IE-789801-NS-EM1) but also the manual that is supplied with the IE-78K0S-NS or IE78K0S-NS-A.

IE-78K0S-NS
User's Manual

- Basic specifications
- System configuration
- External interface functions

IE-789801-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 is intended to give users an understanding of the various debugging functions that can be performed when using the IE-789801-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 (real chip) that is the target for emulation.
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 IE78K0S-NS-A and the IE-789801-NS-EM1.

Conventions   This document is described in accordance with the following notations.

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 No.
IE-78K0S-NS	U13549E
IE-78K0S-NS-A	U15207E
IE-789801-NS-EM1	This manual
ID78K0-NS, ID78K0S-NS Integrated Debugger Ver. 2.20 or Later Operation (Windows™ Based)	U14910E
μPD789800 Subseries	U12978E

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

CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1   GENERAL

The IE-789801-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-789801-NS-EM1's system configuration and basic specifications.

- Target device
  - μPD789800 Subseries

1.1   System Configuration

Figure 1-1 illustrates the IE-789801-NS-EM1's system configuration.

★ **Figure 1-1. System Configuration**
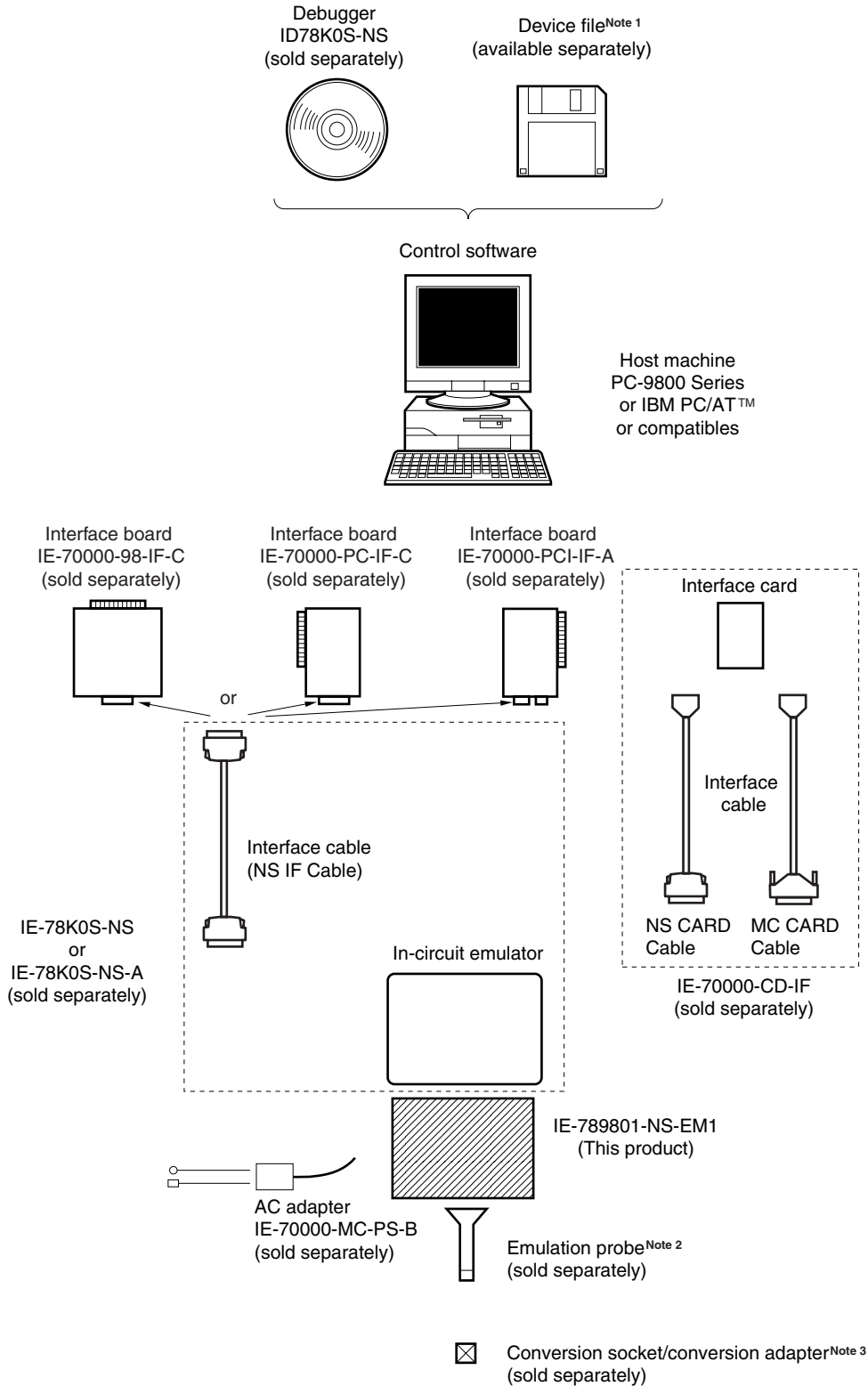
Notes 1. The device file is as follows.

μS$\times\times\times$DF789801

The device file can be downloaded from the NEC Electron Devices Web site

(URL: http://www.ic.nec.co.jp/micro).

2. The emulation probes are as follows.

NP-44GB: For 44-pin plastic QFP (GB type: EV-9200G-44 supported)

NP-44GB-TQ: For 44-pin plastic QFP (GB type: TGB-044)

NP-H44GB-TQ: Long type for 44-pin plastic QFP (GB type: TGB-044)

3. The conversion socket/conversion adapters are as follows.

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

TGB-044SAP: For 44-pin plastic QFP (GB-8ES type)

Remark NP-44GB, NP-44GB-TQ, and NP-H44GB-TQ are products of Naito Densei Machida Mfg. Co., Ltd.

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

TGB-044SAP is a product of TOKYO ELETECH CORPORATION.

For further information, contact Daimaru Kogyo, Ltd.

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

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

1.2 Hardware Configuration

Figure 1-2 shows the IE-789801-NS-EM1's position in the basic hardware configuration.

Figure 1-2. Basic Hardware Configuration
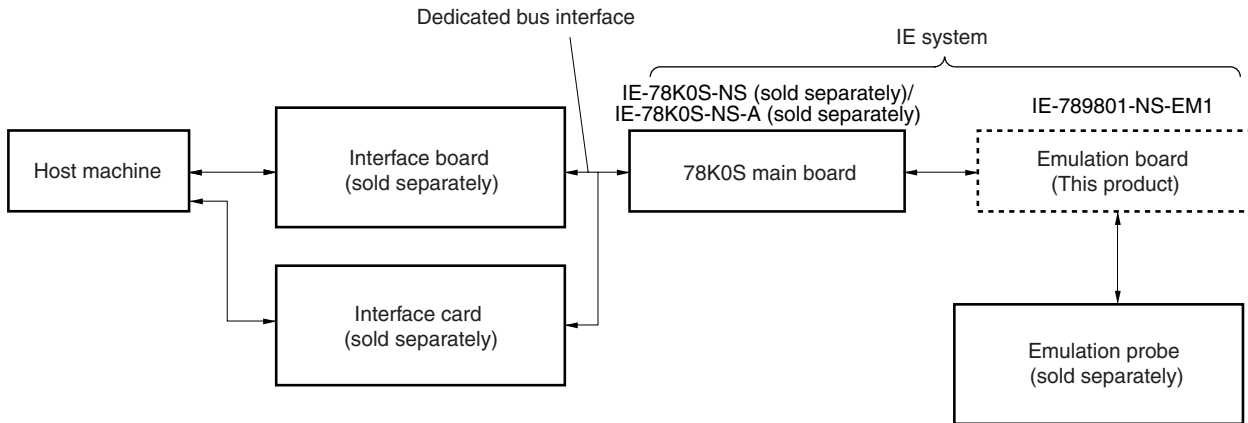
1.3   Basic Specifications

The IE-789801-NS-EM1's basic specifications are listed in Table 1-1.

★   **Table 1-1. Basic Specifications**

Parameter	Description
Target device	μPD789800 Subseries
System clock	6 MHz
Clock supply	External: Pulse input from the target system via an emulation probe Internal: Clock mounted on emulation board (6 MHz), or clock mounted on parts board by user
Target interface voltage	V_{DD} = 4.0 to 5.5 V (same as the target device) Operates with internal power supply (5 V) when not connected to the target system.

CHAPTER 2   PART NAMES

This chapter introduces the parts of the IE-789801-NS-EM1 main unit.

The packing box contains the emulation board (IE-789801-NS-EM1).

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-789801-NS-EM1 Part Names
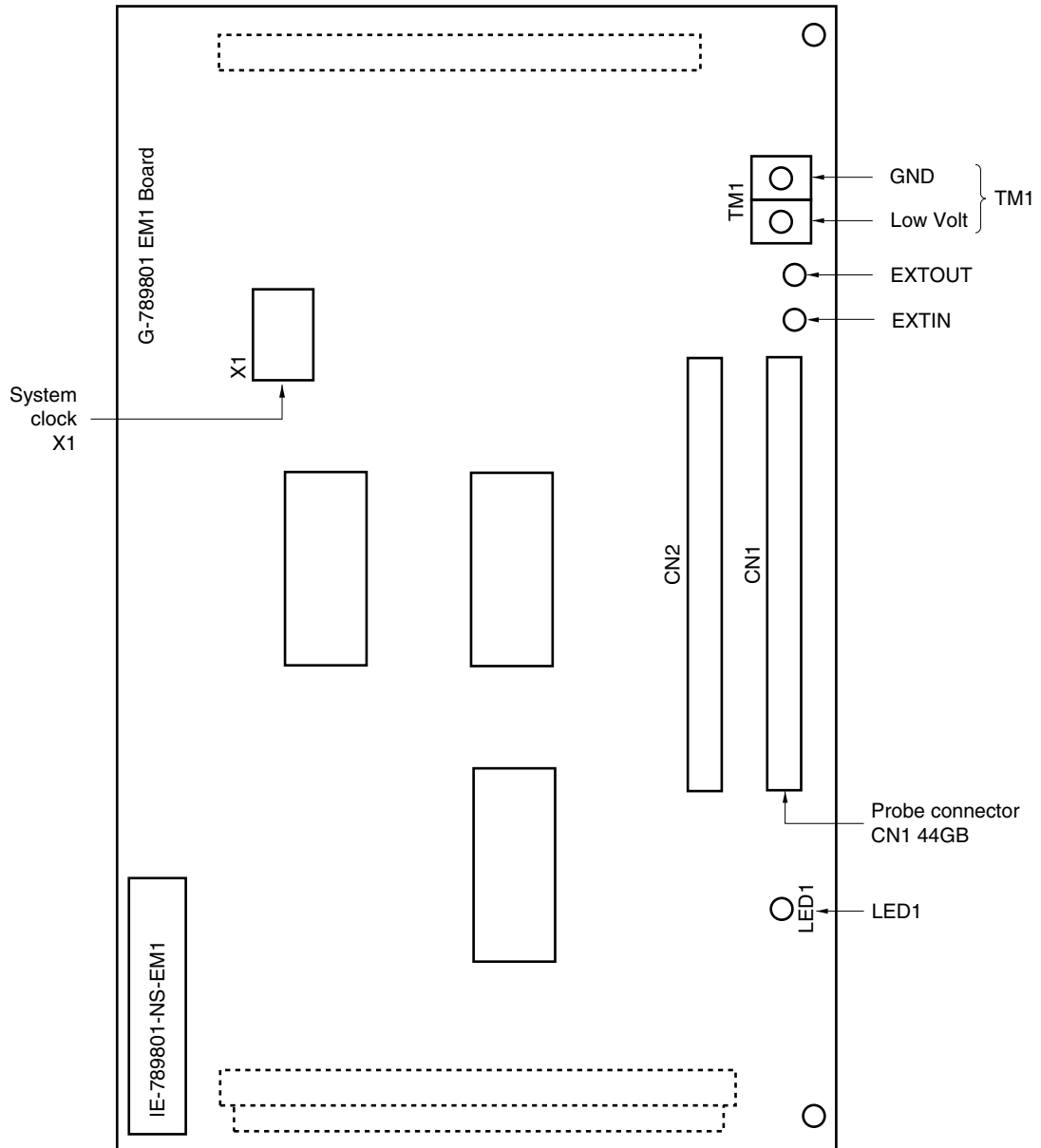
CHAPTER 3   INSTALLATION

This chapter describes methods for connecting the IE-789801-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-789801-NS-EM1 to the IE-78K0S-NS or IE-78K0S-NS-A**Note**.

Note   When using the IE-78K0S-NS-A, refer to 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-789801-NS-EM1**Note**.

On this board, connect the emulation probe to CN1.

Note   When using the IE-78K0S-NS-A, refer to 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
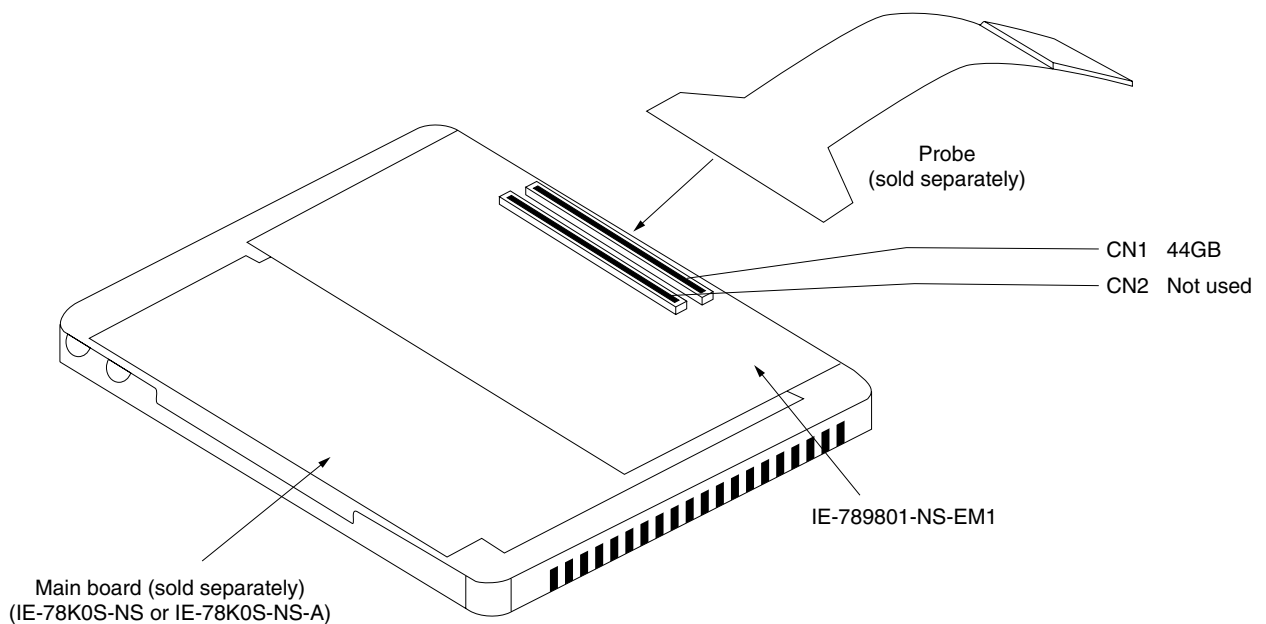
3.2   Clock Settings

3.2.1   Overview of clock settings

The system clocks 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 a clock oscillator, the target device is connected to a resonator 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 which is installed for 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 an 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 system clock is not supplied normally. Moreover, be sure to input a rectangular wave as the clock from the target. However, it is not necessary to supply a clock to the X2 pin.

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

★   (a) Clock oscillator   (b) External clock
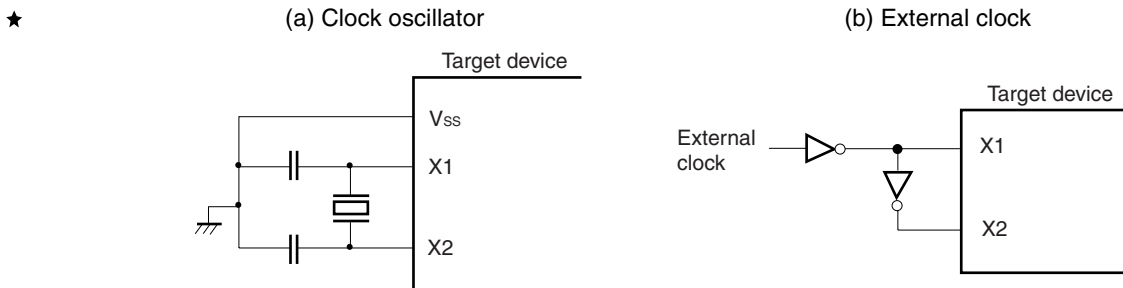
(1) Clock that is already mounted on emulation board

A crystal oscillator is already mounted in the socket of X1 on the emulation board. Its frequency is 6 MHz.

★ **Figure 3-3. When Using Clock (6 MHz) That Is Already Mounted on Emulation Board**
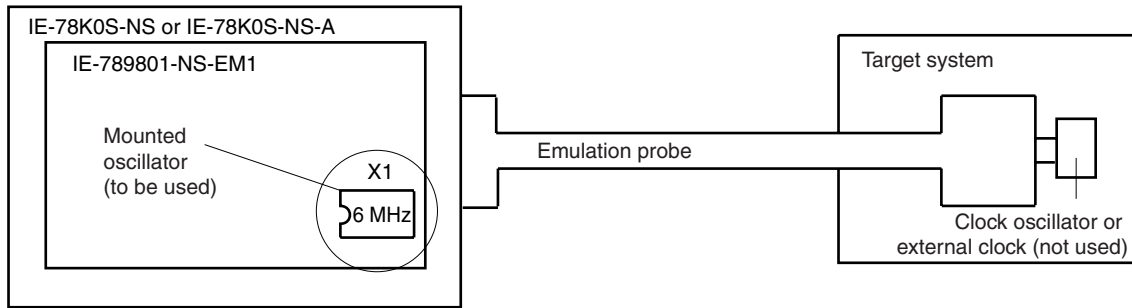
Remark The clock that is supplied by the IE-789801-NS-EM1's oscillator (encircled in the figure) is used.

(2) Clock that is mounted by user

The user is able to mount any clock supported by the set specifications on the IE-789801-NS-EM1. First mount the resonator on the parts board, then attach the parts board to the IE-789801-NS-EM1. This method is useful when using a different frequency from that of the pre-mounted clock.

★ **Figure 3-4. When Using User-Mounted Clock**
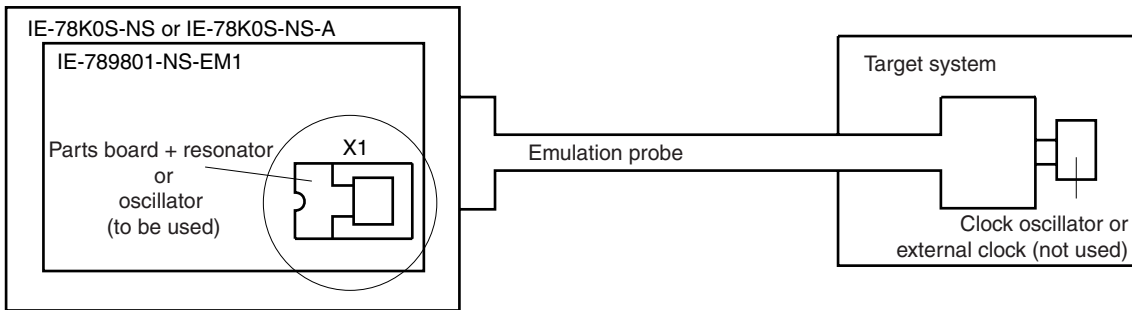
Remark The clock that is supplied by the parts board with the IE-789801-NS-EM1's resonator (encircled in the figure) or the oscillator is used.

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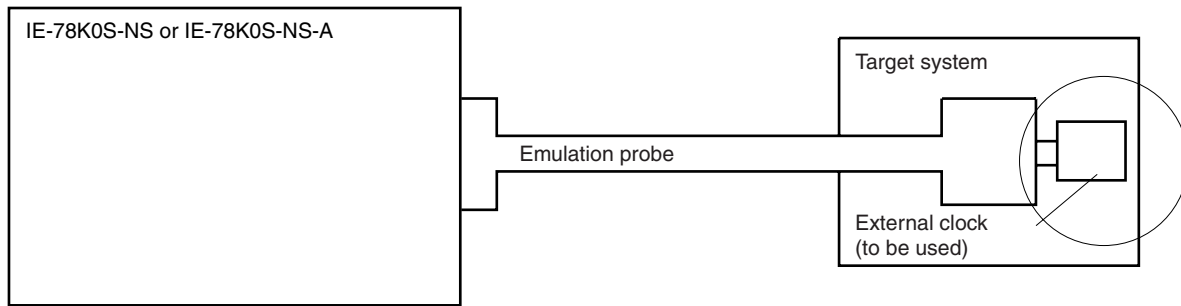
Remark   The clock supplied by the target system's external clock (encircled in the figure) is used.

3.2.2 System clock settings

Table 3-1. System Clock Settings

Frequency of System Clock		IE-789801-NS-EM1	CPU Clock Source Selection (ID)
		Parts Board (X1)	
When using clock that is already mounted on emulation board	6 MHz	Oscillator used	Internal
When using clock mounted by user	Other than 6 MHz	Oscillator assembled by user	
When pulse is input from target system		Oscillator not used	External

Caution   **When a pulse is input from 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-789801-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-789801-NS-EM1 is shipped, a 6 MHz crystal oscillator is already mounted in the IE-789801-NS-EM1's X1 socket. If the IE-789801-NS-EM1 is in the same state as when shipped, no hardware settings are required.

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 frequency) onto the parts board (as shown below).

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

Parts board

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-789801-NS-EM1.

<3> Remove the crystal oscillator that is mounted in the IE-789801-NS-EM1's socket (the socket marked as X1).

<4> Connect the parts board (from <1> above) to the socket (X1) 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 mounted in the X1 socket on the emulation board is wired as shown in Figure 3-6 above.

<6> Install the IE-789801-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.
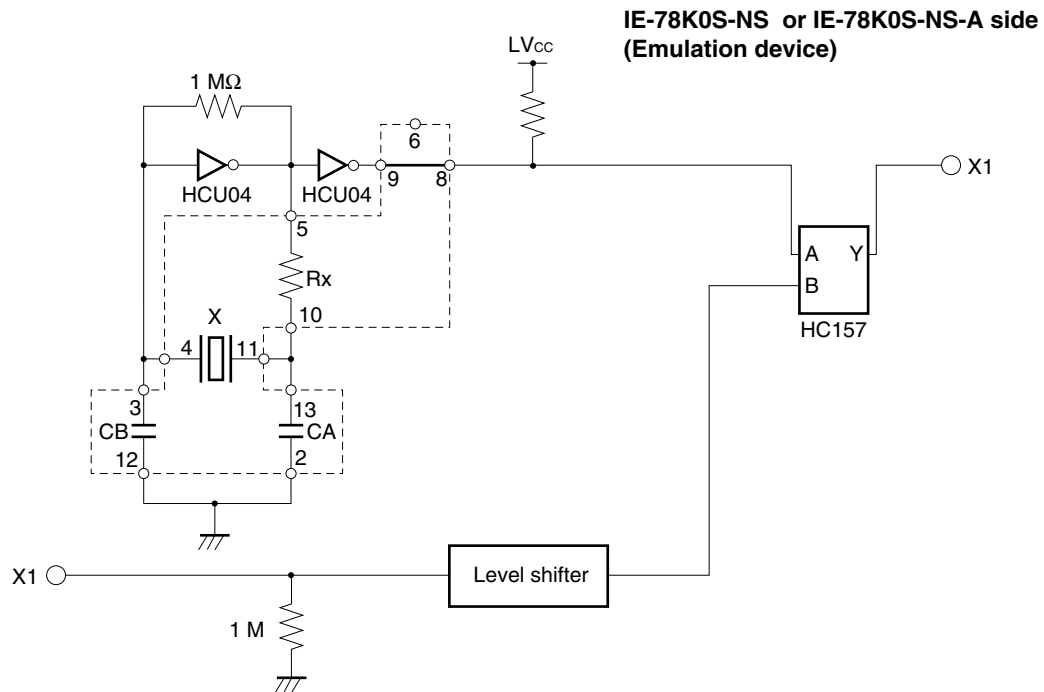
Remark   The sections enclosed in broken lines indicate parts that are attached to the parts board.

(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-789801-NS-EM1.
 <2> Remove the crystal oscillator that is mounted in the IE-789801-NS-EM1's socket (the socket marked as X1).
 <3> Connect the crystal oscillator (from <2> above) to the socket (X1) from which the parts board for external clock was removed. 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

Crystal Oscillator Pin Name	Socket Pin No.
NC	1
GND	7
CLOCK OUT	8
Vcc	14
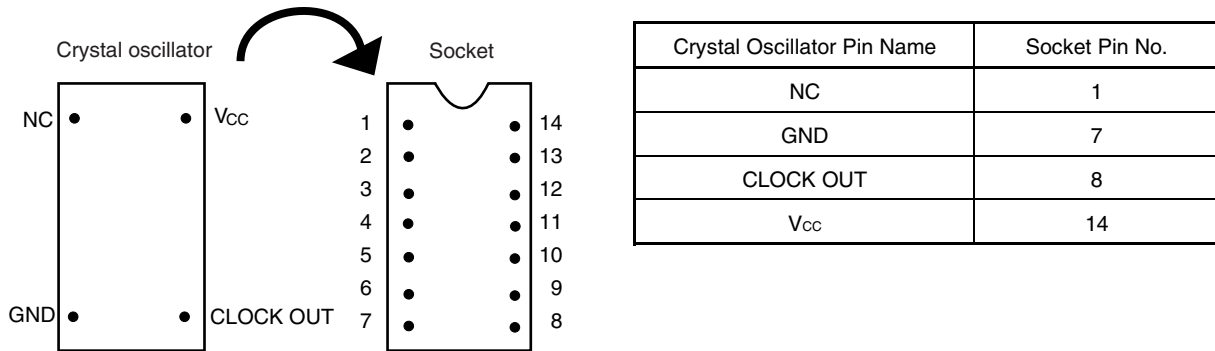
 <4> Install the IE-789801-NS-EM1 in the IE-78K0S-NS or IE-78K0S-NS-A.

The above steps configure the following circuit and enable supply of the clock from the mounted resonator to the emulation device.
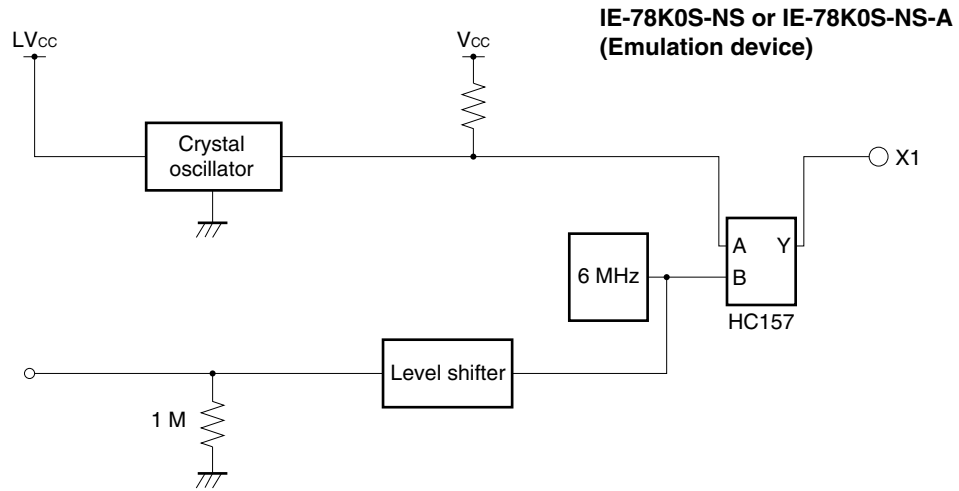
(3) When inputting pulse from target system

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).
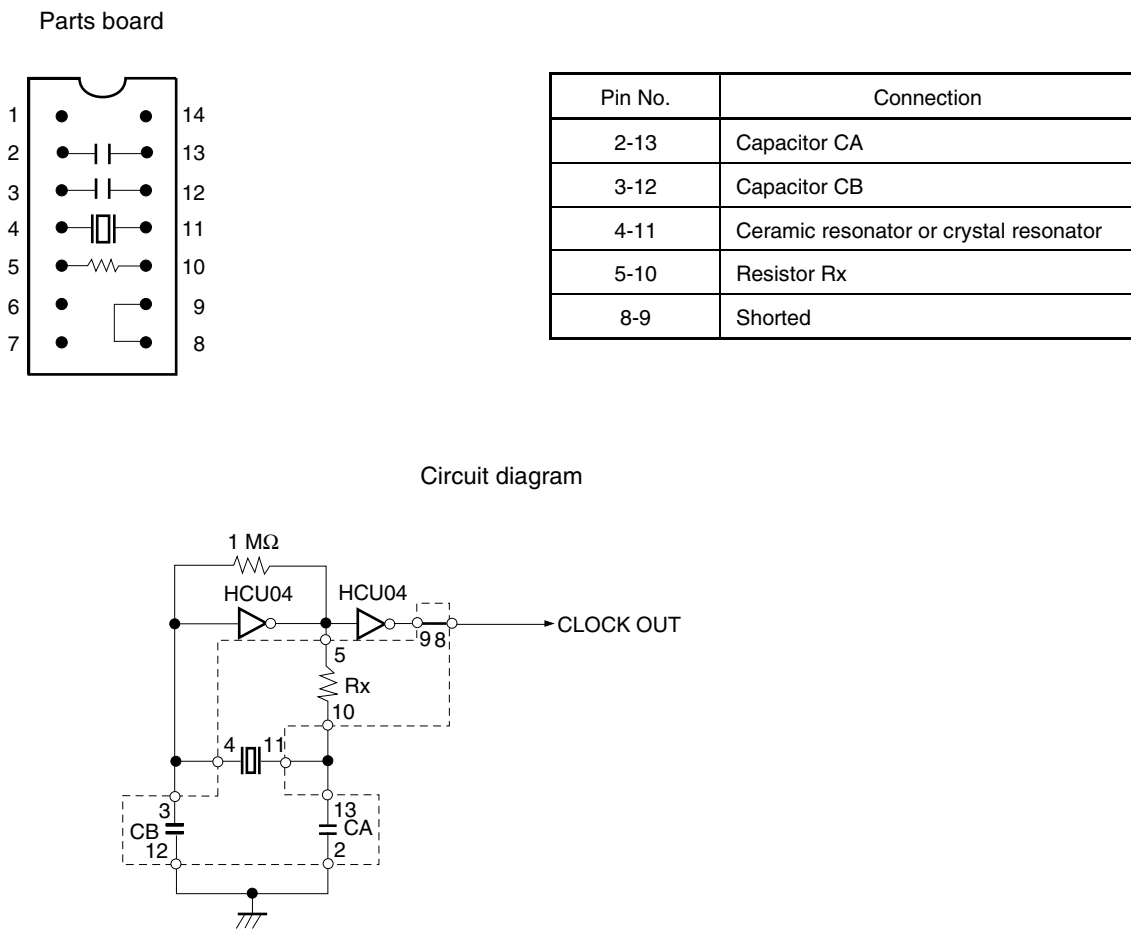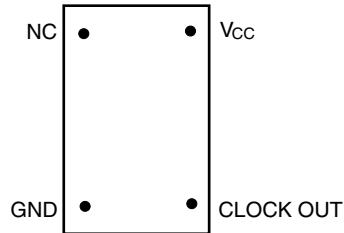
The above steps configure the following circuit and enable supply of the clock on the target device to the emulation device.

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

V_{CC}

X1

A

Y

B

HC157

X1 pin of emulation probe[Note]

Level shifter

1 M

X1
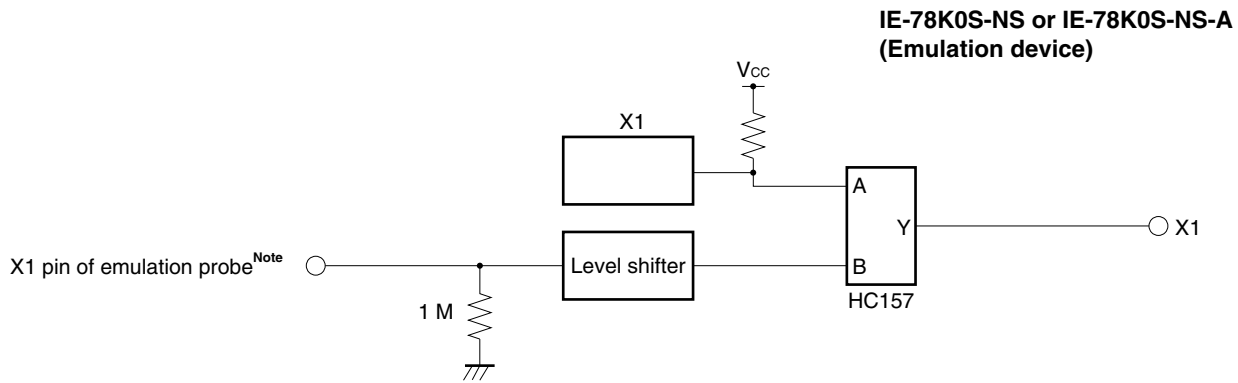
Note   Indicates the pin name of the target device.

★ ## 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 (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 TM1 terminal pin of the IE-789801-NS-EM1 (the same applies when the voltage is 5 V).

Set the target voltage to between 4.0 and 5.0 V.

- Maximum current consumption of TM1
    4.0 to 5.0 V: Approximately 100 mA

Figure 3-9. Connection of TM1 and Power Supply Voltage of Target System
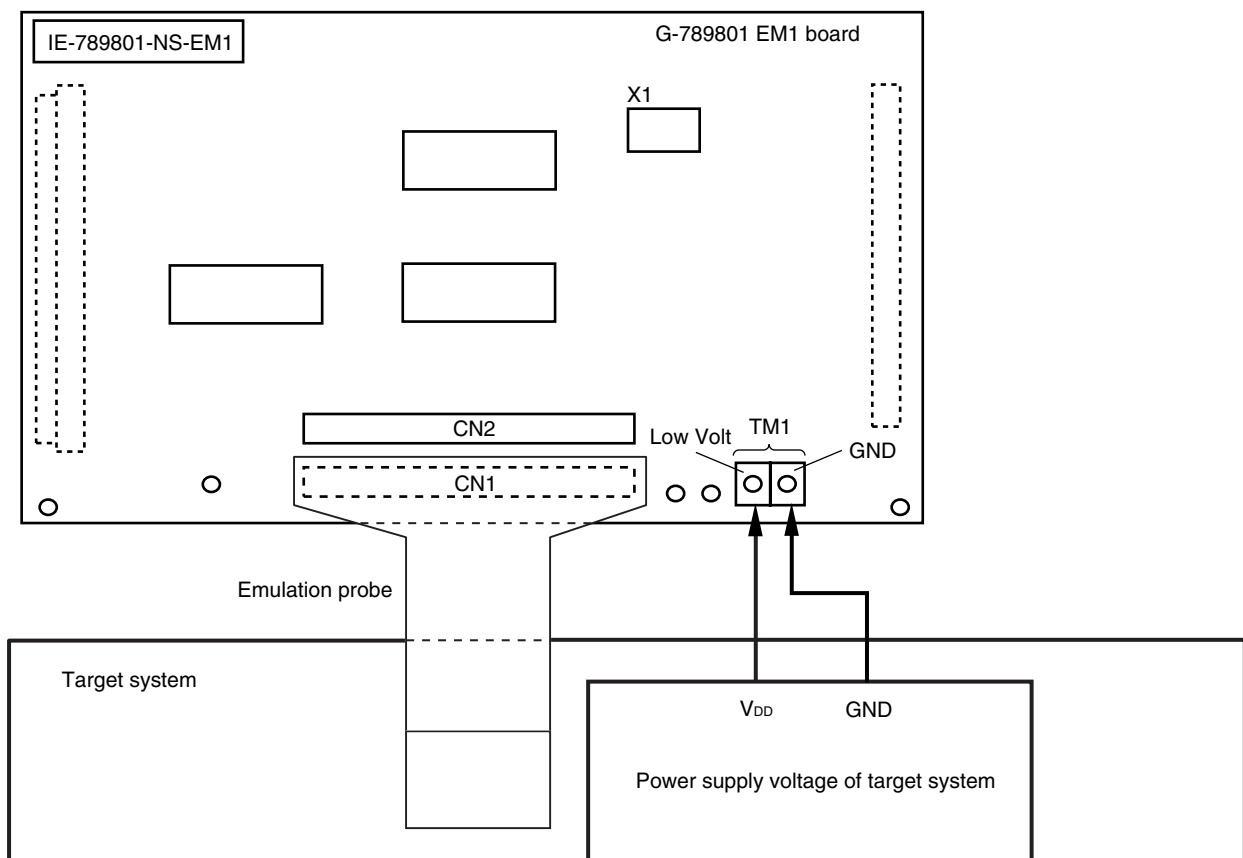
Caution   Connect TM1 on the board and the power supply voltage of the target system after turning off the power of the IE-78K0S-NS or IE-78K0S-NS-A.

Remark   The V_{DD} pin of the target system is only used for controlling LED1 (TV$_{CC}$), which monitors whether the power supply of the target system is connected in the IE-789801-NS-EM1.

★ 3.4   External Trigger

To set up an external trigger, connect it to the IE-789801-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, and the **ID78K0-NS, ID78K0S-NS Integrated Debugger Ver. 2.20 or Later Operation User's Manual (Windows Based) (U14910E)** for usage methods.

(**1**) **EXTOUT**

Output a low level from the EXTOUT pin on the IE-789801-NS-EM1 for 1.3 μs upon the occurrence of a break event.

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

(2) **EXTIN**

An event signal can be input from the EXTIN pin on the IE-789801-NS-EM1. Use a high-level pulse signal of 2 CPU operation clocks or more for the event signal.

Figure 3-10. External Trigger Input Position
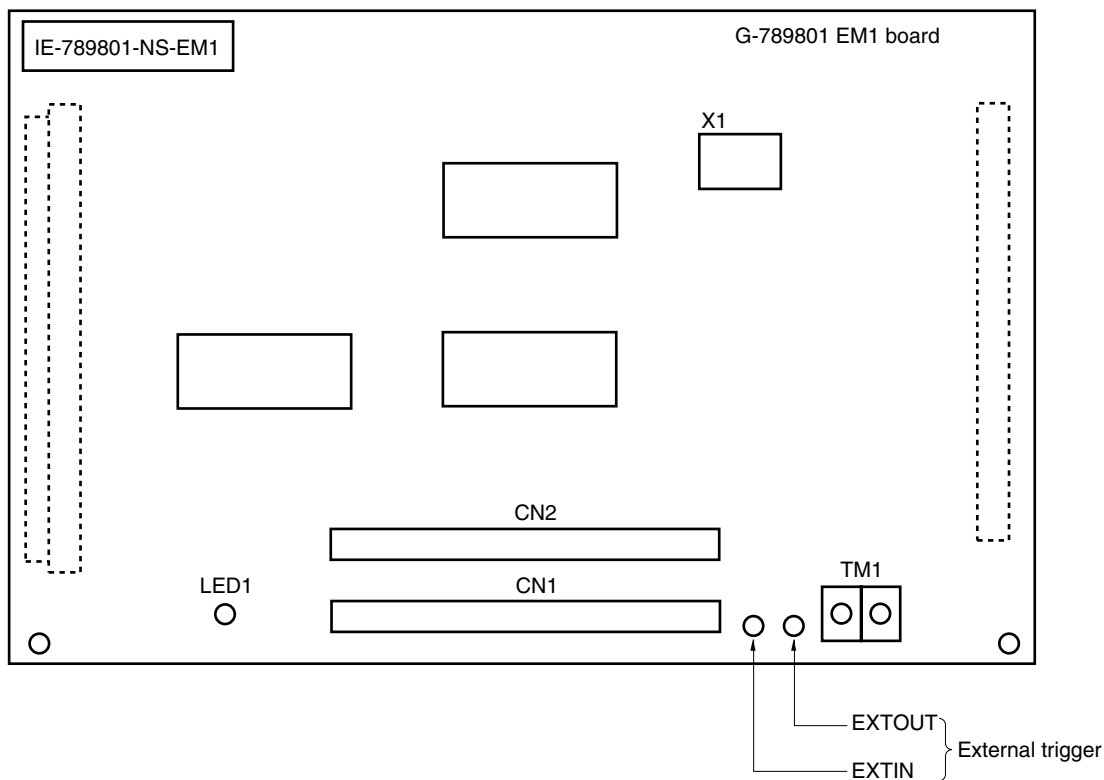
3.5   Switch and Jumper Settings

(1) Switch and jumper setting on IE-78K0S-NS

When using the IE-789801-NS-EM1, set the switches and jumpers on the IE-78K0S-NS as shown in Table 3-2. For the position of the switches and jumpers, refer to the **IE-78K0S-NS User's Manual (U13549E)**.

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

	JP1	JP4	SW1	SW3	SW4
Setting	Short 2-3	Short 1-2	OFF	All switches ON	All switches ON

Caution   If the jumpers and switches are set incorrectly, the board may be damaged.

★   **(2) Switch and jumper setting on IE-78K0S-NS-A**

When using the IE-789801-NS-EM1, set the switches and jumpers on the IE-78K0S-NS-A as shown in Table 3-3. For the position of the switches and jumpers, 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	1-2	Shorted (fixed)

Caution   If the jumpers and switches are set incorrectly, the board may be damaged.

CHAPTER 4   DIFFERENCES BETWEEN TARGET DEVICES AND TARGET INTERFACE CIRCUITS

This chapter describes differences between the target device's signal lines and the signal lines of the IE-789801-NS-EM1's target interface circuit.

Although the target device is a CMOS circuit, the IE-789801-NS-EM1's target interface circuit consists of an emulation chip, 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 EVA chip and the peripheral EVA chip

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

(3) Other signals

The IE-789801-NS- EM1's circuit is used as follows for signals listed in (1) to (3) above.

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

The following signals perform the same operations as in the μPD789800 Subseries.

- Signals related to port 0
- Signals related to port 1
- Signals related to port 2
- Signals related to port 4
- Signals related to USB

(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 μPD789800 Subseries.

- RESET signal
- Signals related to clock input

(3) Other signals

- V_{DD} pin

  The emulation CPU operates with the internal power supply of the IE system (5 V) when not connected to the target system, and operates with the voltage (LV_{CC}) supplied from the voltage supply pin (TM1) when connected to the target system.

  The V_{DD} pin of the target system is used only for control of LED1 (USER V_{DD}), which indicates whether the target system's power is on or off.

- V_{SS} pin

  The V_{SS} pin is internally connected to GND in the IE-789801-NS-EM1.

- V_{PP}/IC pins

  These are not used for the IE-789801-NS-EM1

- X2 pin

  This is not used for the IE-789801-NS-EM1.

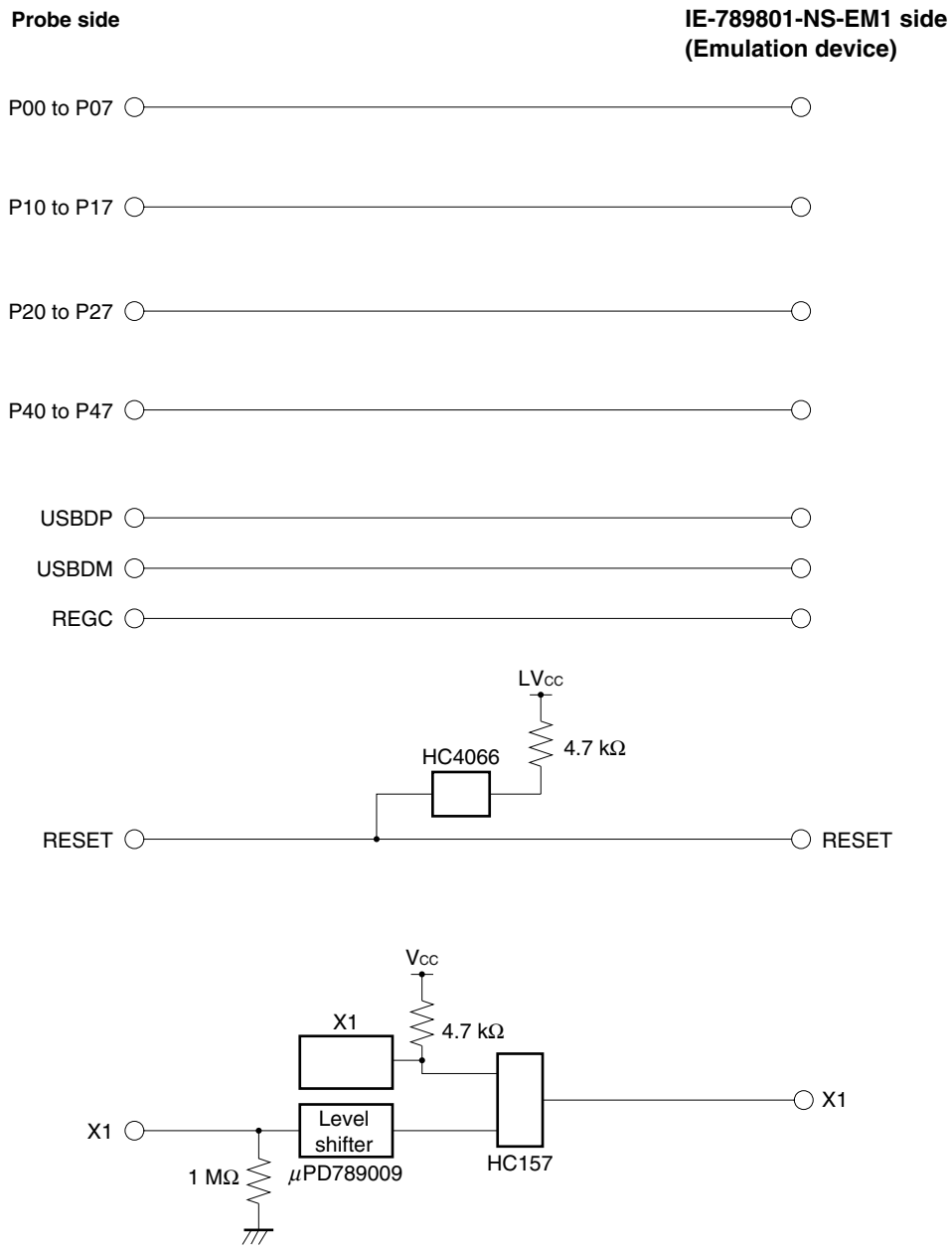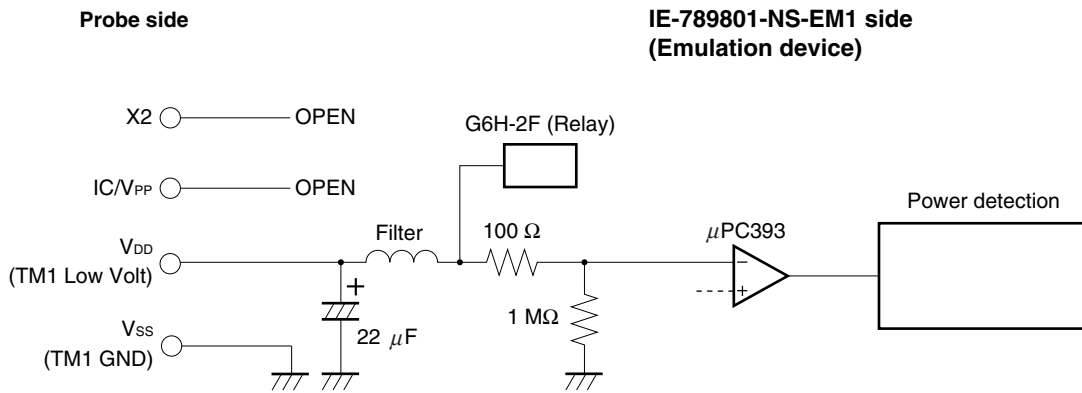**Figure 4-1. Equivalent Circuit 1 of Emulation Circuit**

Figure 4-2. Equivalent Circuit 2 of Emulation Circuit

APPENDIX A   EMULATION PROBE PIN ASSIGNMENT TABLE

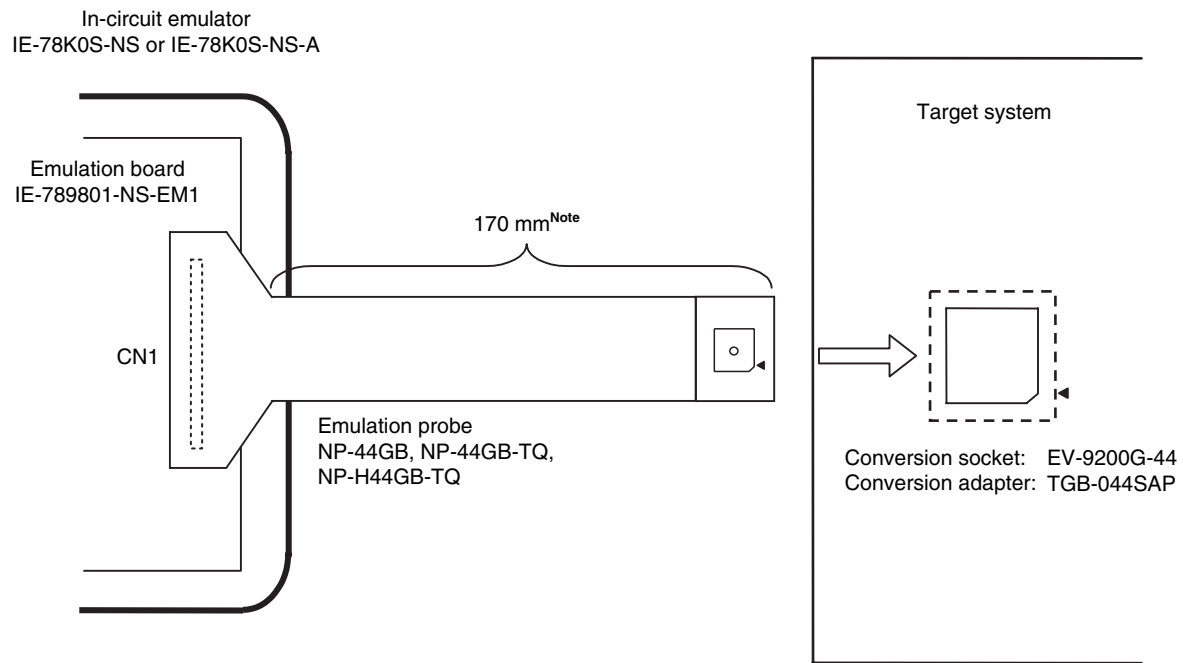**Table A-1. NP-44GB, NP-44GB-TQ, and NP-H44GB-TQ Pin Assignments**

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. The NP-44GB, NP-44GB-TQ, and NP-H44GB-TQ are products 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.

Figures B-1 and B-2 show the conditions when connecting the emulation probe to the conversion adapter or conversion socket. Follow the configuration below and consider the shape of parts to be mounted on the target system when designing a system.
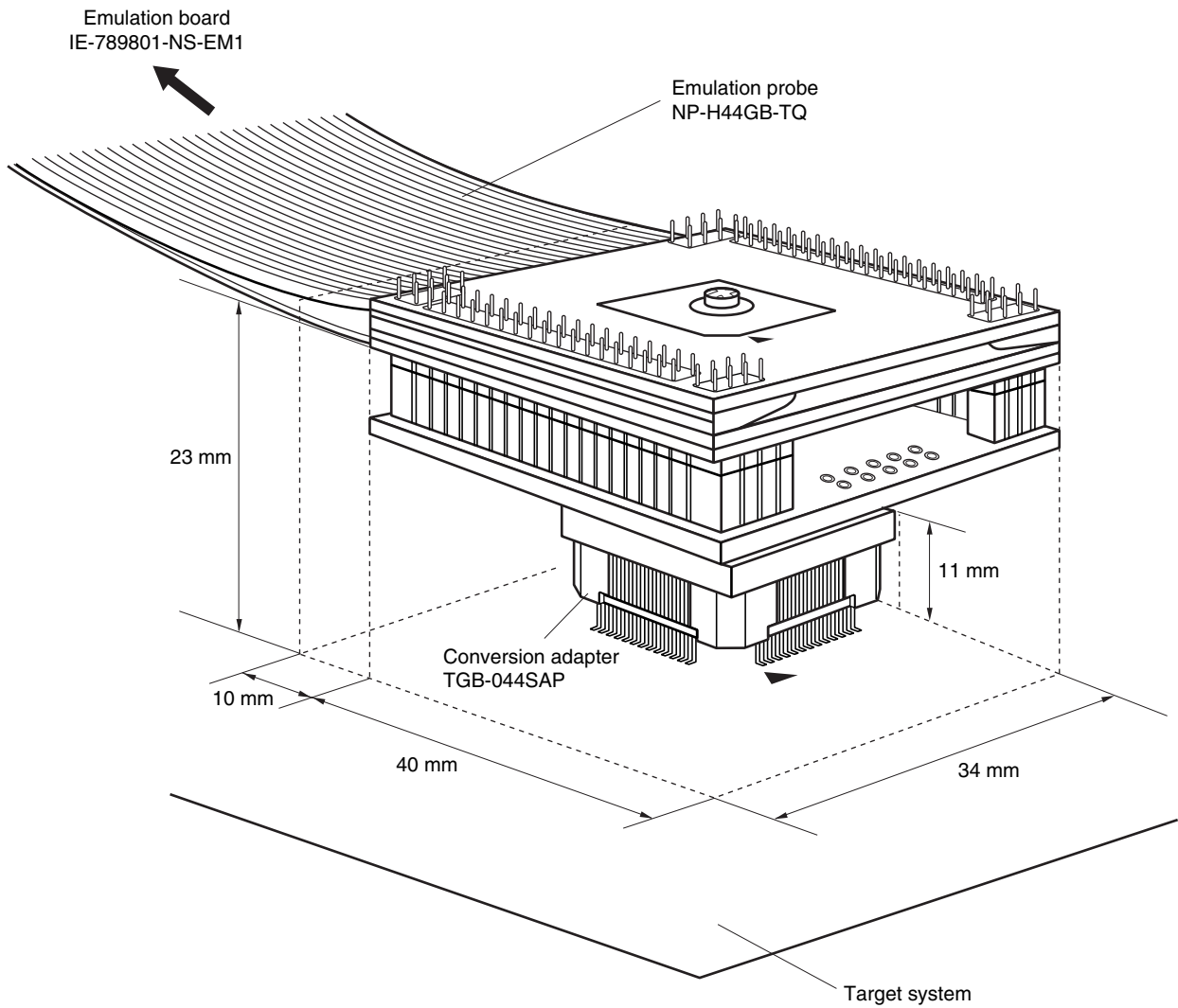
Figure B-1. Distance Between In-Circuit Emulator and Conversion Socket

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 Densei Machida Mfg. Co., Ltd.
      2.   TGB-044SAP is a product of TOKYO ELETECH CORPORATION.

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

Emulation board
IE-789801-NS-EM1

Emulation probe
NP-H44GB-TQ

23 mm

11 mm

Conversion adapter
TGB-044SAP

10 mm

40 mm

34 mm

Target system

Remarks 1. NP-H44GB-TQ is a product of Naito Densei Machida Mfg. Co., Ltd.
　　　　2. TGB-044SAP is a product of TOKYO ELETECH CORPORATION.

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