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User's Manual

IE-789088-NS-EM1

Emulation Board

Target Devices **μPD789088 Subseries**

Document No. U16398EJ1V0UM00 (1st edition)
Date Published December 2002 N CP(K)

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INTRODUCTION

Product Overview

The IE-789088-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.

- μ PD789088 Subseries: μ PD789086, 789088, 78F9088

Target Readers

This manual is intended for engineers who will use the IE-789088-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-789088-NS-EM1, refer to not only this manual (supplied with the IE-789088-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-78K0S-NS-A User's Manual

- Basic specifications
- System configuration
- External interface functions

IE-789088-NS-EM1 User's Manual

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

Purpose

This manual's purpose is to explain various debugging functions that can be performed when using the IE-789088-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 emulation board (IE-789088-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-789088-NS-EM1 Emulation Board	This manual
ID78K Series Integrated Debugger Ver. 2.30 or Later Operation Windows™ Based	U15185E
μPD789088 Subseries	U15332E

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

This chapter describes the IE-789088-NS-EM1's system configuration and basic specifications.

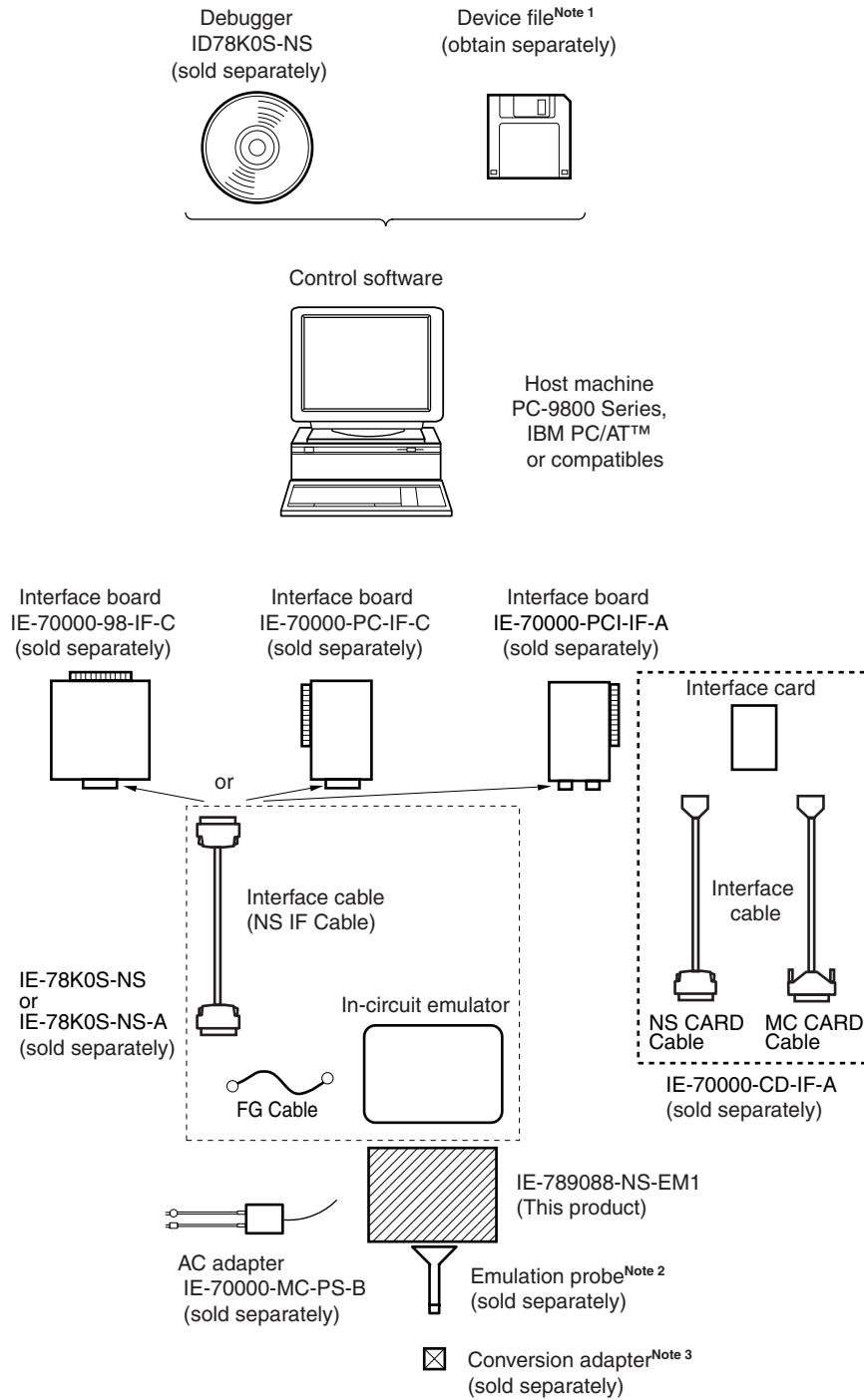
The IE-789088-NS-EM1 is a development tool for efficient debugging of hardware or software when using one of the following target devices that belong to the 78K/0S Series of 8-bit single-chip microcontrollers.

- Target devices
 - μ PD789088 Subseries

1.1 System Configuration

Figure 1-1 illustrates the IE-789088-NS-EM1's system configuration.

Figure 1-1. System Configuration



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

μ SxxxxDF789088: μ PD789088 Subseries

The device file can be downloaded from the web site of NEC Electronics

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

2. The emulation probe NP-30MC 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 adapters NSPACK30BK, YSPACK30BK, and YQGUIDE are products 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)

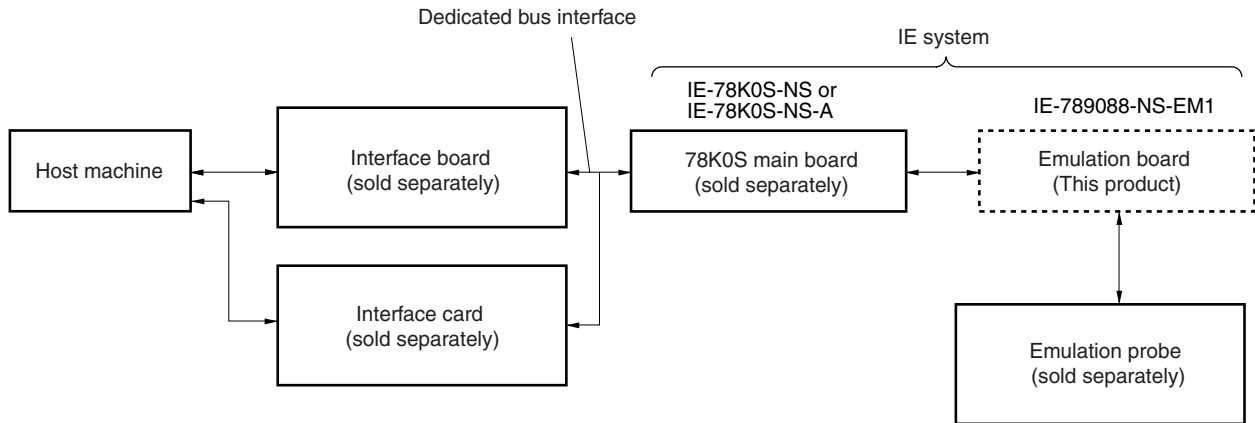
Table 1-1. Correspondence Between Emulation Probe and Conversion Adapter

Package	Emulation Probe	Conversion Socket/Conversion Adapter
30-pin plastic SSOP (MC type)	NP-30MC (probe length: 200 mm)	YSPACK30BK NSPACK30BK YQGUIDE (screw for fixing NSPACK30BK and YSPACK30BK)

1.2 Hardware Configuration

Figure 1-2 shows the IE-789088-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-789088-NS-EM1 are listed in Table 1-2.

Table 1-2. Basic Specifications

Parameter	Description
Target device	μ PD789088 Subseries
System clock	System clock: 1.0 to 5.0 MHz
System clock supply	External: Input pulse via an emulation probe from the target system Internal: Mounted on emulation board (5.0 MHz), or mounted on the parts 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-789088-NS-EM1 main unit.

The packing box contains the emulation board (IE-789088-NS-EM1), packing list, user's manual, and guarantee card.

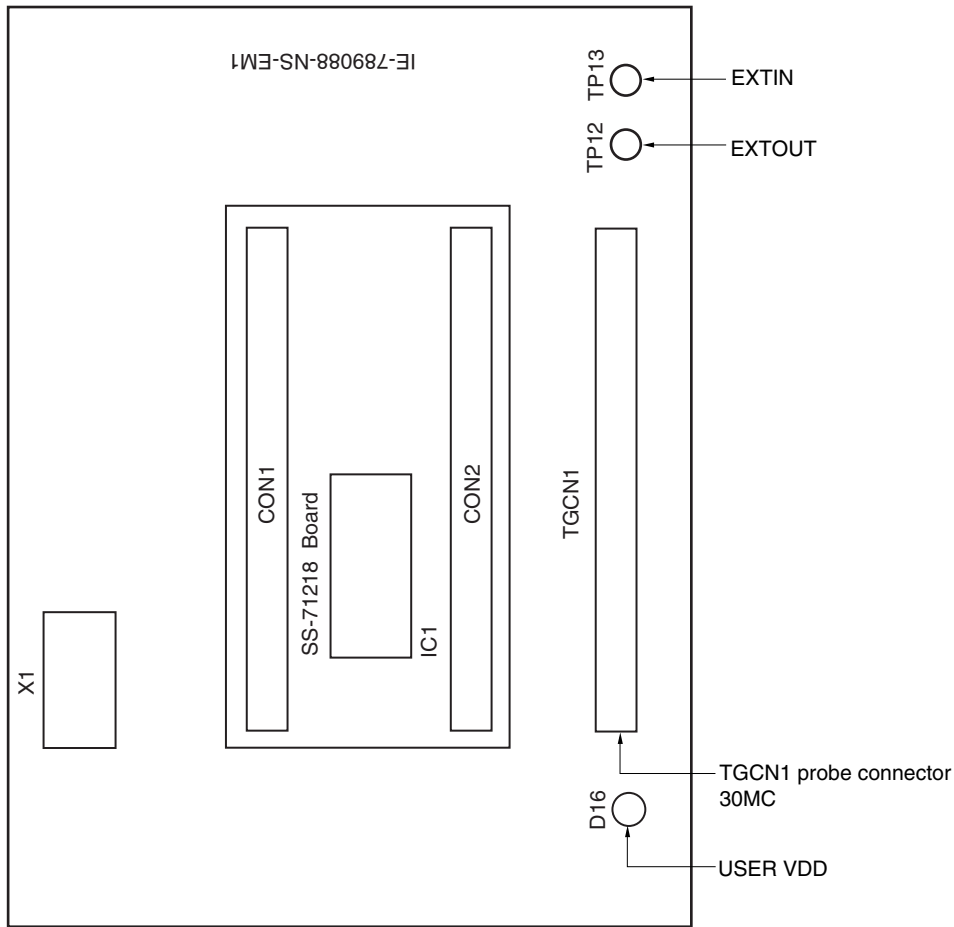
If there are any missing or damaged items, please contact an NEC Electronics sales representative.

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-789088-NS-EM1.

Figure 2-1. IE-789088-NS-EM1 Part Names



Caution Do not remove the SS-71218 Board when using the IE-789088-NS-EM1.

2.2 Initial Settings of Switches and Jumpers

There are no switches or jumpers to be set.

CHAPTER 3 INSTALLATION

This chapter describes methods for connecting the IE-789088-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-789088-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-789088-NS-EM1^{Note}.

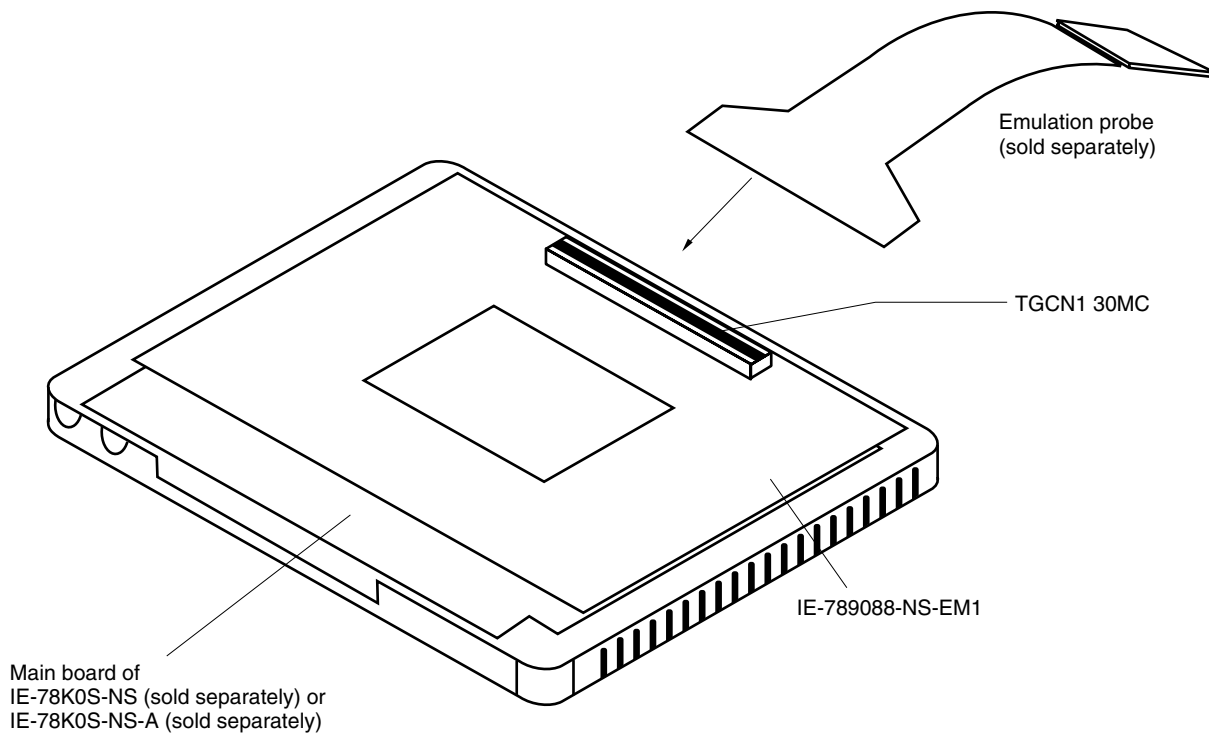
On this board, connect the emulation probe to TGCN1.

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



3.2 Switch and Jumper Settings on Main Unit

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

When using the IE-789088-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)	2 and 3 shorted	1 and 2 shorted

Caution Incorrect connection may damage the IE-789088-NS-EM1.

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

When using the IE-789088-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	1 and 2 shorted (fixed)	Shorted (fixed)

Caution Incorrect connection may damage the IE-789088-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 (5 V).

When debugging with a voltage that is the same level as that of the target system, the IE-789088-NS-EM1 is supplied with the same voltage as that of the target system from the V_{DD} pin via the emulation probe, and that voltage is used as the reference voltage for generating the target interface power supply.

Set the target voltage to between 1.8 and 5.5 V.

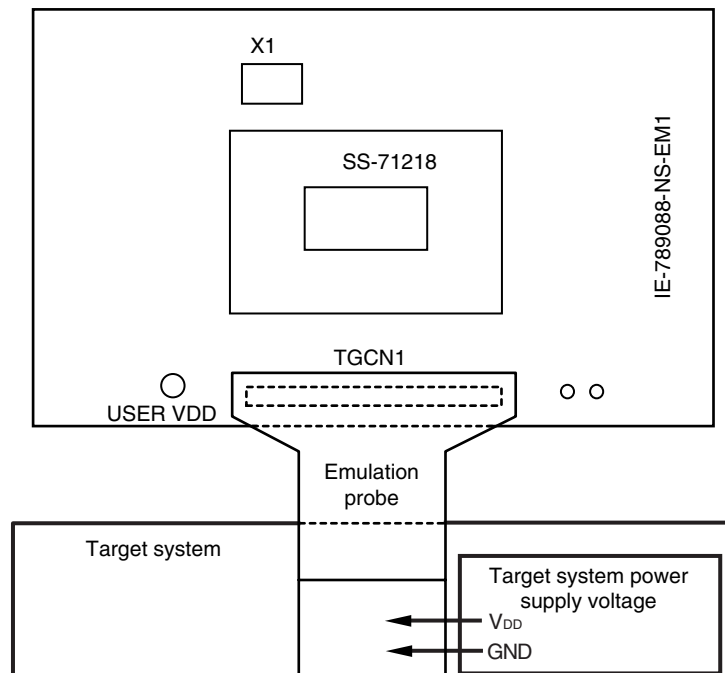
For how to select the operating power supply, refer to the **ID78K Series Ver.2.30 or Later Operation Windows-Based User's Manual (U15185E)**.

- Maximum current consumption of V_{DD} pin
1.8 to 5.5 V: 20 mA

Table 3-3. Setting Power Supply of Target Interface

Power Supply of Target Interface (LVcc)		Integrated Debugger (ID78K0S-NS)
		Operating Power Supply Selection
When connecting target system	1.8 to 5.5 V	Target
When not connecting target system	5 V	Internal

Figure 3-2. Connecting Target System and Power Supply Voltage



Caution Before connecting or disconnecting the target system, turn off the power to the IE-78K0S-NS or IE-78K0S-NS-A and the target system.

3.4 Clock Settings

3.4.1 Overview of clock settings

The 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

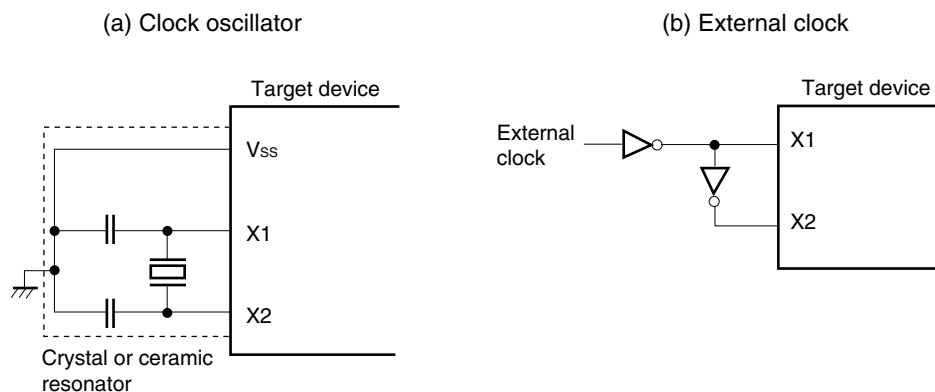
If the target system includes a clock oscillator, select either **(1) Clock that is already mounted on emulation board** or **(2) Clock that is mounted by user**. For the clock oscillator, a resonator is connected to the target device and the target device's internal oscillator is used. An example of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

If the target system includes an external clock, select either **(1) Clock that is already mounted on emulation board**, **(2) Clock that is mounted by user**, or **(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 3-3.

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 pulse from the target system. There is no need to supply a clock to the X2 pin. Also, even if a crystal resonator is connected directly to X1, the target device will not operate.

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

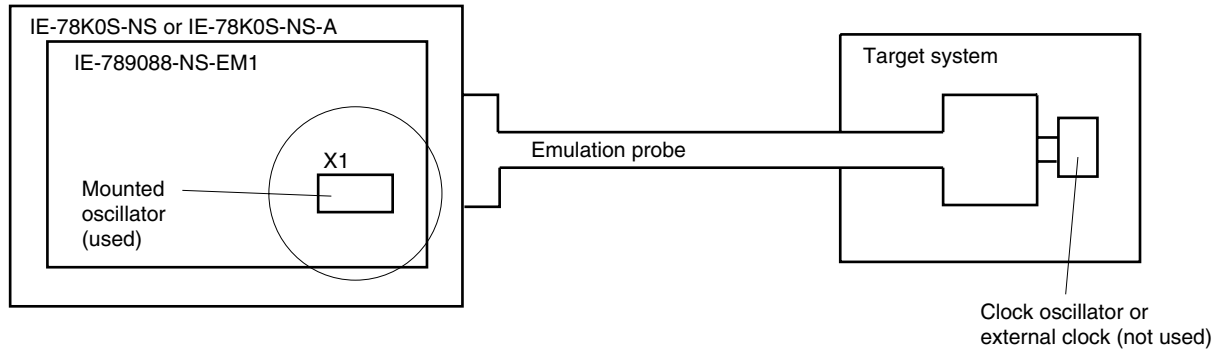


(1) Clock that is already mounted on emulation board

The crystal oscillator mounted on the IE-789088-NS-EM1 can be used.

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

Figure 3-4. When Using Clock That Is Already Mounted on Emulation Board



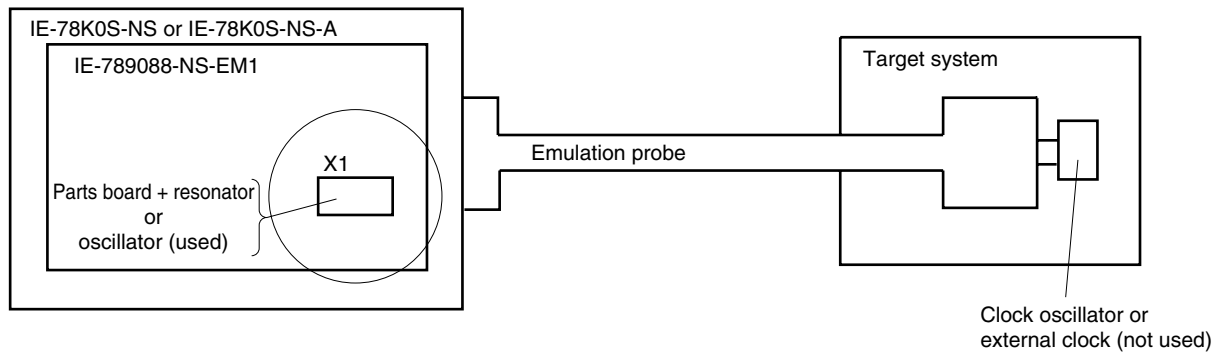
Remark The clock that is supplied by the oscillator of the IE-789088-NS-EM1 (encircled in the figure) is used.

(2) Clock that is mounted by user

The user can mount any clock supported by the set specifications on the IE-789088-NS-EM1. This feature is effective when debugging at a different frequency than the clock already mounted.

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 mount the oscillator to be used.

Figure 3-5. When Using User-Mounted Clock

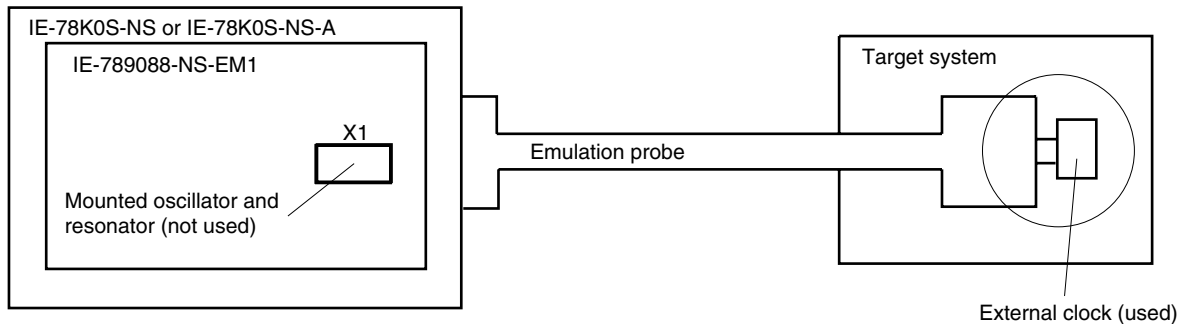


Remark The clock that is supplied by the resonator of the IE-789088-NS-EM1 (encircled in the figure) or the oscillator is used.

(3) Pulse input from target system

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

Figure 3-6. When Supplying Pulse from Target System



Remark The pulse that is supplied by the external clock on the target system (encircled in the figure) or the oscillator is used.

3.4.2 System clock settings

Table 3-4 shows the settings of the IE-789088-NS-EM1 when the system clocks in (1) to (3) are used.

Table 3-4. System Clock Settings

Frequency of System Clock		IE-789088-NS-EM1	CPU Clock Source Selection (ID78K0S-NS)
		X1 Socket	
(1) When using clock that is already mounted on emulation board	5.0 MHz	Oscillator	Internal
(2) When using clock mounted by user	Other than 5.0 MHz	Oscillator configured by user	
(3) When inputting pulse from target system		Oscillator (not used)	External

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 factory settings of the IE-789088-NS-EM1 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-789088-NS-EM1 is shipped, a 5.0 MHz crystal oscillator is already mounted in the IE-789088-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

Perform the settings described under either (a) or (b), 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

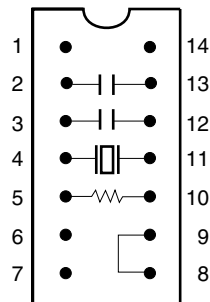
- Parts board
- Ceramic resonator or crystal resonator
- Resistor Rx
- Capacitor CA
- Capacitor CB
- Solder kit

<Steps>

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

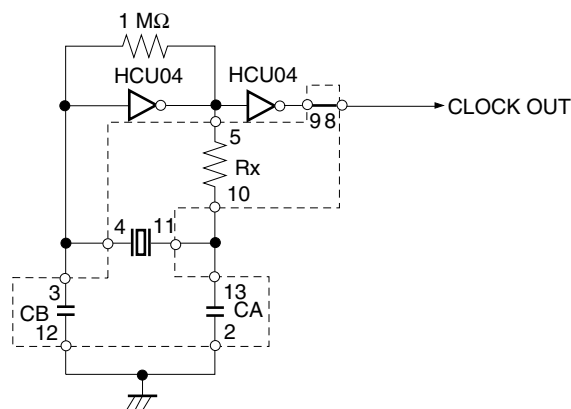
Figure 3-7. Connections on Parts Board

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.

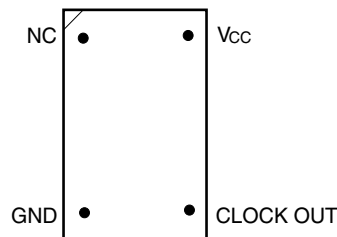
- <2> Prepare the IE-789088-NS-EM1.
- <3> Remove the crystal oscillator that is mounted in the IE-789088-NS-EM1's X1 socket.
- <4> Connect the parts board (from <1> above) to the X1 socket from which the crystal oscillator was removed. Check the pin 1 mark to make sure the board is mounted in the correct direction.
- <5> Make sure that the parts board is wired as shown in Figure 3-7 above.
- <6> Install the IE-789088-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.

(b) When using a crystal oscillator

- Items to be prepared
 - Crystal oscillator (see pinouts shown in Figure 3-8)

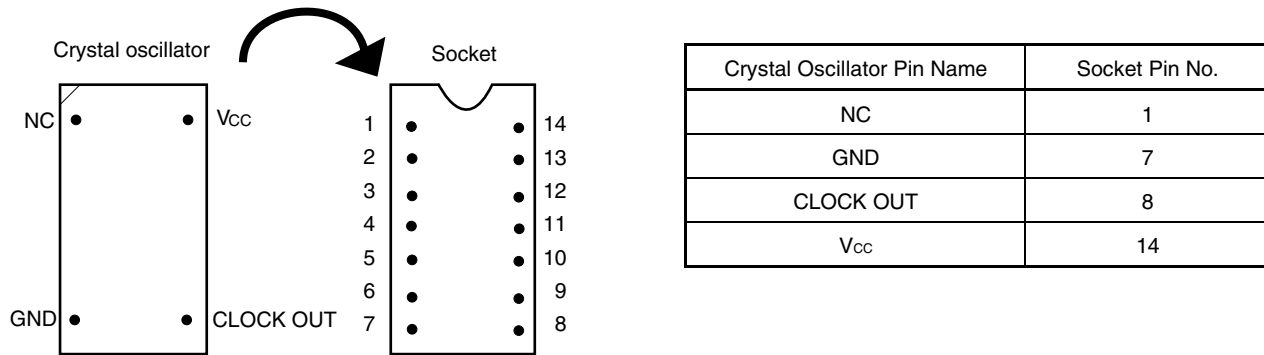
Figure 3-8. Crystal Oscillator



<Steps>

- <1> Prepare the IE-789088-NS-EM1.
- <2> Remove the crystal oscillator that is mounted in the IE-789088-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 into the socket aligning the pins as shown in the figure below.

Figure 3-9. Pin Alignment of Crystal Oscillator and Socket



<4> Install the IE-789088-NS-EM1 in the IE-78K0S-NS or IE-78K0S-NS-A.

(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).

3.5 External Trigger

To set an external trigger, connect the IE-789088-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

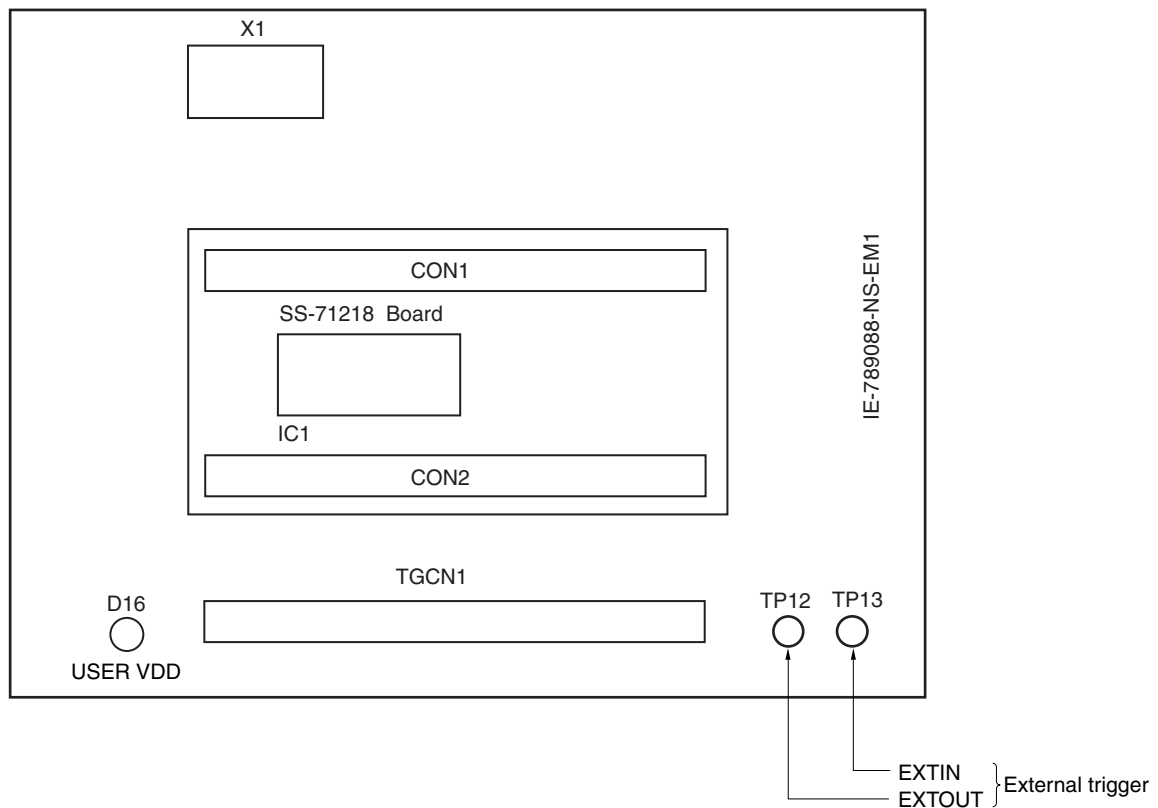
The EXTOUT pin on the IE-789088-NS-EM1 outputs a low level for 1.3 μ s when a break event occurs.

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-789088-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 directly input to or output from the emulation CPU**
- (2) Signals input from the target system via a gate**
- (3) Other signals**

The circuits of the IE-789088-NS-EM1 are used as follows for signals listed in (1) to (3) above. The same applies to handling alternate-function pins, for which no circuit is provided in the IE system.

(1) Signals directly input to or output from the emulation CPU

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

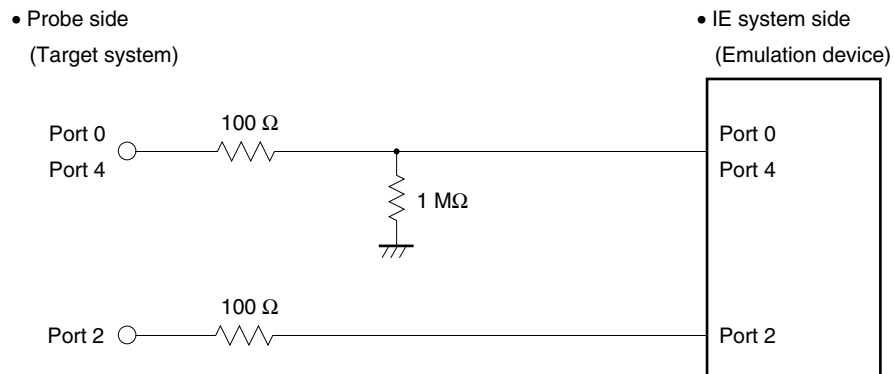
Note that for the following signals, a 1 M Ω pull-down resistor and a 100 Ω resistor are connected in series.

- Signals related to port 0
- Signals related to port 4

For the following signals, a 100 Ω resistor is connected in series.

- Signals related to port 2

Figure 4-1. Equivalent Circuit 1 of Emulation Circuit

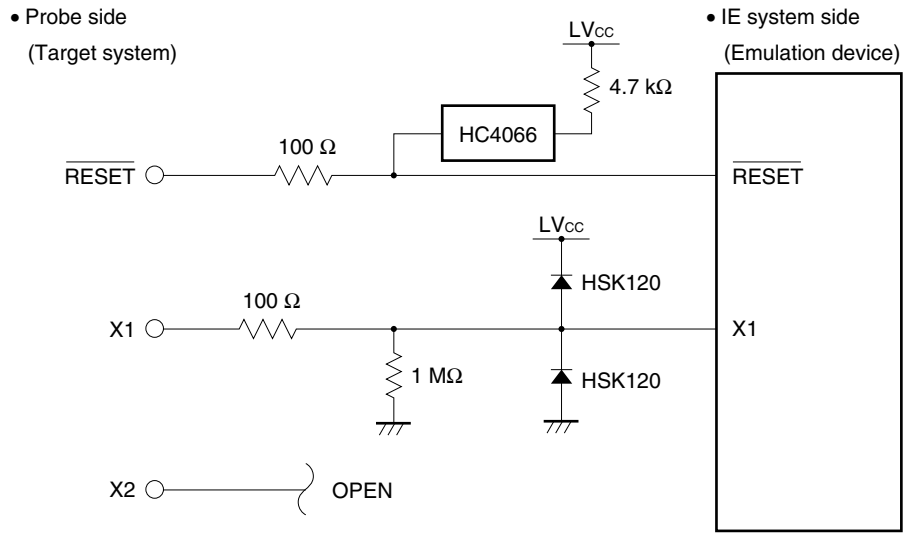


(2) Signals input from the target system via a gate

Since the following signals are input via a gate, their timing shows a delay compared to the μ PD789088 Subseries. Refer to **Figure 4-2 Equivalent Circuit 2 of Emulation Circuit**.

- $\overline{\text{RESET}}$ signal
- Signals related to clock input
The X2 pin is not used in the IE-789088-NS-EM1.

Figure 4-2. Equivalent Circuit 2 of Emulation Circuit

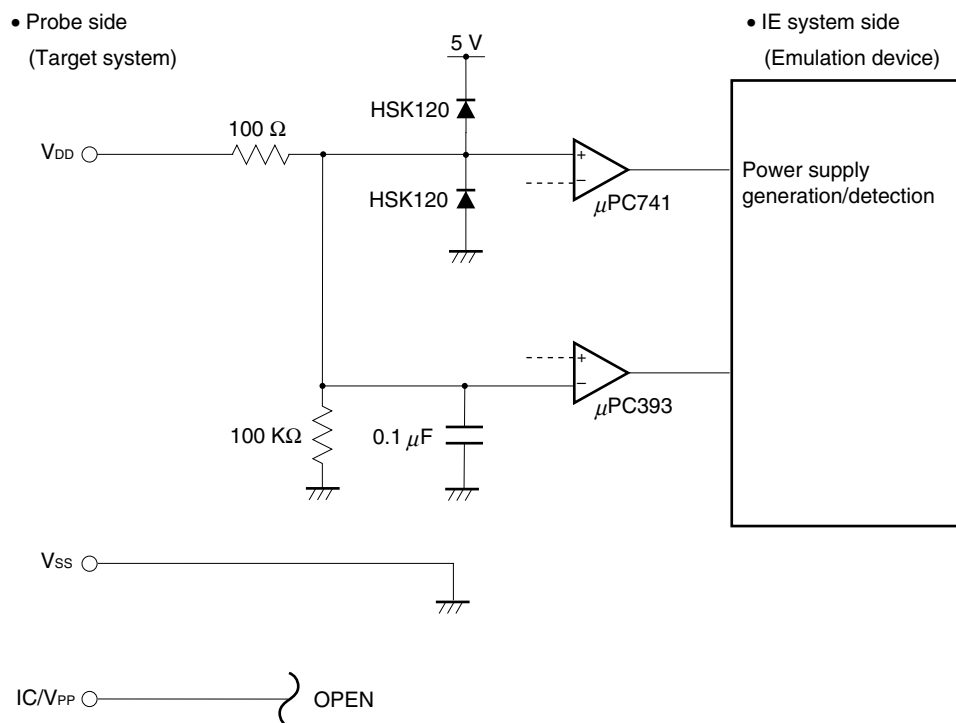


(3) Other signals

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

- VDD pin
The power supply of the emulation CPU operates on the internal power supply voltage (5 V) when the target system is not connected, and on the voltage supplied from the power voltage supply pin (LVcc) when the target system is connected.
- Vss pin
The Vss pin is connected to GND in the IE-789088-NS-EM1.
- IC/VPP pin
The IC/VPP pin is not used in the IE-789088-NS-EM1.

Figure 4-3. Equivalent Circuit 3 of Emulation Circuit



APPENDIX A EMULATION PROBE PIN ASSIGNMENT TABLE

Table A-1. NP-30MC Pin Assignments

Emulation Probe	TGCN1 Pin No.	Emulation Probe	TGCN1 Pin No.
1	58	16	99
2	56	17	63
3	49	18	64
4	55	19	70
5	19	20	69
6	18	21	72
7	22	22	102
8	62	23	71
9	65	24	94
10	66	25	93
11	92	26	30
12	91	27	29
13	98	28	24
14	97	29	23
15	21	30	20

- Remarks**
1. NP-30MC is a product of Naito Densetsu Machida Mfg. Co., Ltd.
 2. The numbers in the “Emulation probe” column indicate the corresponding pin number on the emulation probe tip.

APPENDIX B NOTES ON DESIGNING TARGET SYSTEM

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-30MC is a product of Naito Densai Machida Mfg. Co., Ltd, and YSPACK30BK, NSPACK30BK, and YQGUIDE are products 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-30MC	YSPACK30BK NSPACK30BK YQGUIDE	150 mm

**Figure B-1. Distance Between In-Circuit Emulator and Conversion Socket/Conversion Adapter
(When 30MC Is Used)**

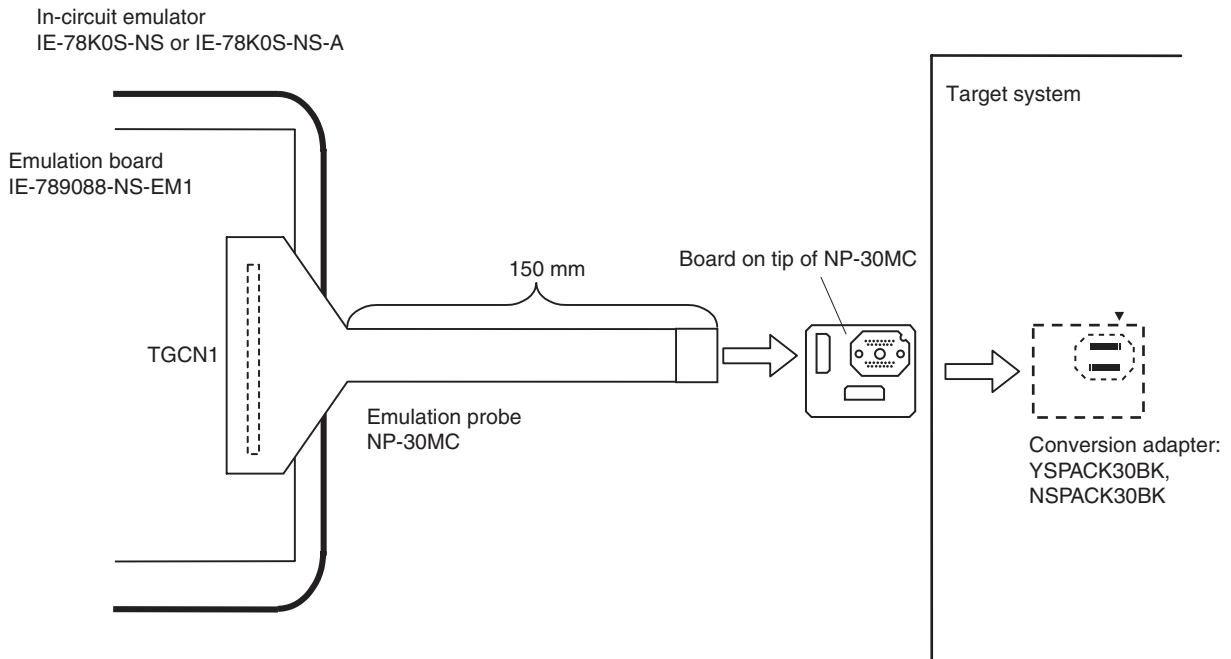


Figure B-2. Connection Conditions of Target System (When NP-30MC Is Used)

