

# User's Manual

# IE-784976-NS-EM1

## Emulation Board

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### Target Devices

**$\mu$ PD784976 Subseries**

**$\mu$ PD784976A Subseries**

[MEMO]

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# INTRODUCTION

## Product Overview

The IE-784976-NS-EM1 is designed to be used with the IE-78K4-NS to debug the following target devices that belong to the 78K/IV Series of 16-bit single-chip microcontrollers.

- $\mu$ PD784976 Subseries:  $\mu$ PD784975, 78F4976
- $\mu$ PD784976A Subseries:  $\mu$ PD784975A, 78F4976A

## Target Readers

This manual is intended for engineers who will use the IE-784976-NS-EM1 with the IE-78K4-NS 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-784976-NS-EM1, refer to not only this manual (supplied with the IE-784976-NS-EM1) but also the manual that is supplied with the IE-78K4-NS.

IE-78K4-NS User's Manual
-----------------------------

- Basic specifications
- System configuration
- External interface functions

IE-784976-NS-EM1 User's Manual
-----------------------------------

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

## Purpose

This manual's purpose is to explain various debugging functions that can be performed when using the IE-784976-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 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 in-circuit emulator (IE-78K4-NS) and the emulation board (IE-784976-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 No.
IE-78K4-NS In-Circuit Emulator		U13356E
IE-784976-NS-EM1 Emulation Board		This manual
ID78K Series Integrated Debugger Ver. 2.30 or Later Windows™ Based	Operation	U15185E
μPD784976 Subseries	Hardware	U14119E
μPD784976A Subseries	Hardware	U15017E

**Caution** The related documents listed above are subject to change without notice. Be sure to use the latest version of each document for designing.

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## CHAPTER 1 GENERAL

The IE-784976-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/IV Series of 16-bit single-chip microcontrollers.

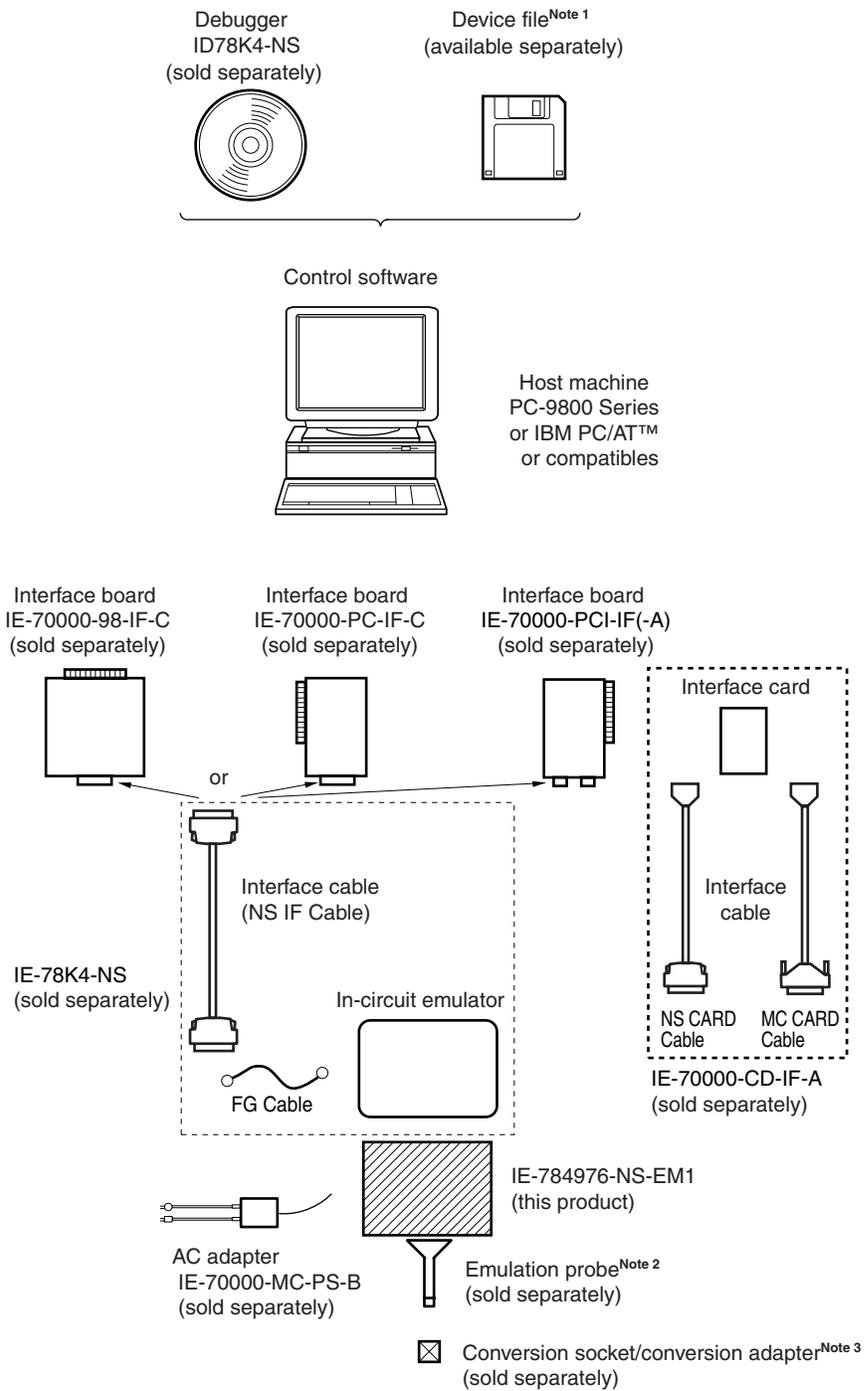
This chapter describes the IE-784976-NS-EM1's system configuration and basic specifications.

- Target devices
  - $\mu$ PD784976 Subseries
  - $\mu$ PD784976A Subseries

## 1.1 System Configuration

Figure 1-1 illustrates the IE-784976-NS-EM1's system configuration.

**Figure 1-1. System Configuration**



**Notes 1.** The device file is as follows.

$\mu$ SxxxxDF784976:  $\mu$ PD784976, 784976A Subseries

The device file can be downloaded from the website of NEC Electronics (<http://www.necel.com/micro/>).

2. The emulation probes, NP-100GF, NP-100GF-TQ, and NP-H100GF-TQ are products of Naito Densai Machida Mfg. Co., Ltd.

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

3. The conversion adapter, TGF-100RBP 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)

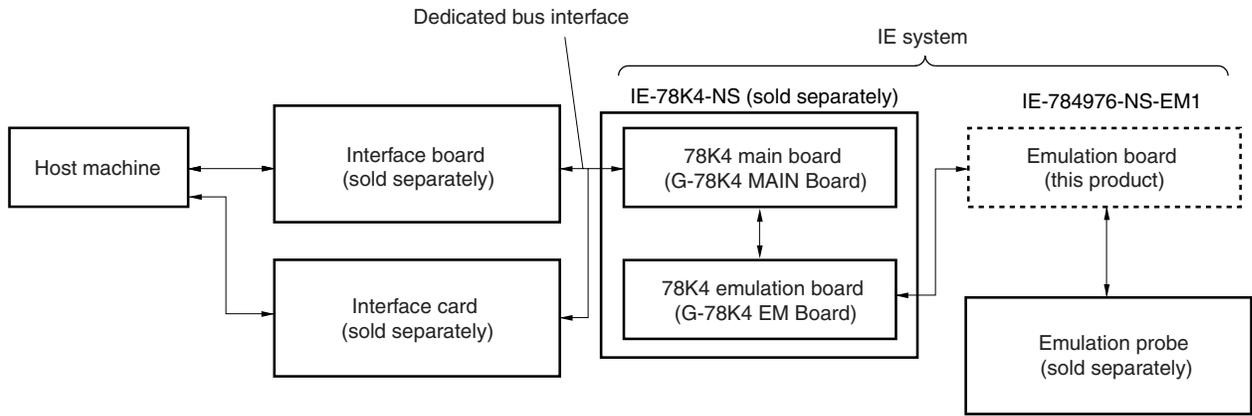
**Table 1-1. Correspondence Between Emulation Probes and Conversion Socket/Conversion Adapters**

Package	Emulation Probe	Conversion Socket/Conversion Adapter
100-pin plastic QFP (GF type)	NP-100GF (Probe length: 200 mm)	EV-9200GF-100
	NP-100GF-TQ (Probe length: 200 mm)	TGF-100RBP
	NP-H100GF-TQ (Probe length: 400 mm)	

## 1.2 Hardware Configuration

Figure 1-2 shows the IE-784976-NS-EM1's position in the basic hardware configuration.

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



### 1.3 Basic Specifications

The IE-784976-NS-EM1's basic specifications are listed in Table 1-2.

**Table 1-2. Basic Specifications**

Parameter	Description
Target device	$\mu$ PD784976, 784976A Subseries
System clock	12.5 MHz
Main system clock supply	External: Input via an emulation probe from the target system Internal: Mounted on the emulation board (25 MHz), or mounted on the board by the user
Low-voltage support	4.5 to 5.25 V (same as target device)

## CHAPTER 2 PART NAMES

This chapter introduces the parts of the IE-784976-NS-EM1 main unit.

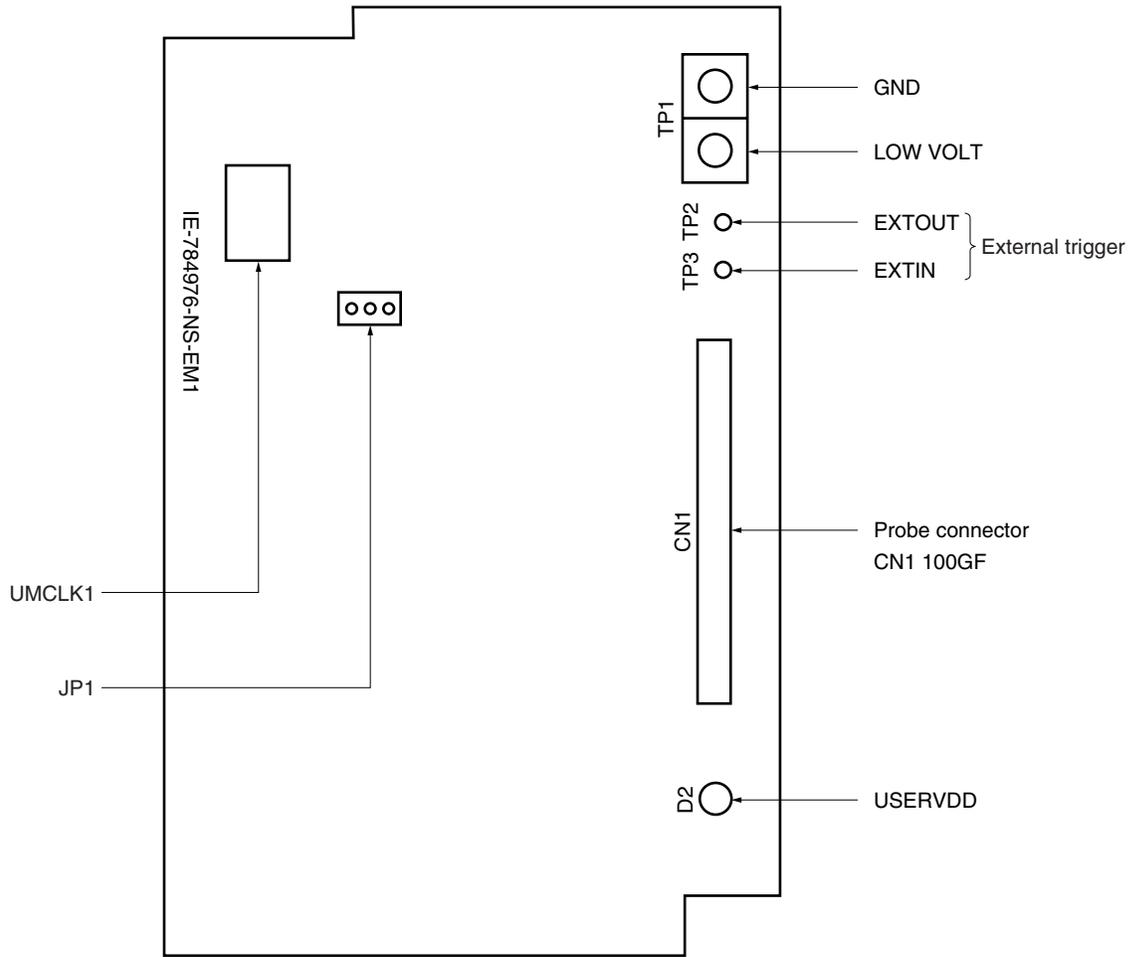
The packing box contains the emulation board (IE-784976-NS-EM1).

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

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

2.1 Parts of Main Unit

Figure 2-1. IE-784976-NS-EM1 Part Names



## CHAPTER 3 INSTALLATION

This chapter describes methods for connecting the IE-784976-NS-EM1 to the IE-78K4-NS, 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-78K4-NS main unit

See the **IE-78K4-NS User's Manual (U13356E)** for a description of how to connect the IE-784976-NS-EM1 to the IE-78K4-NS.

#### (2) Connection with emulation probe

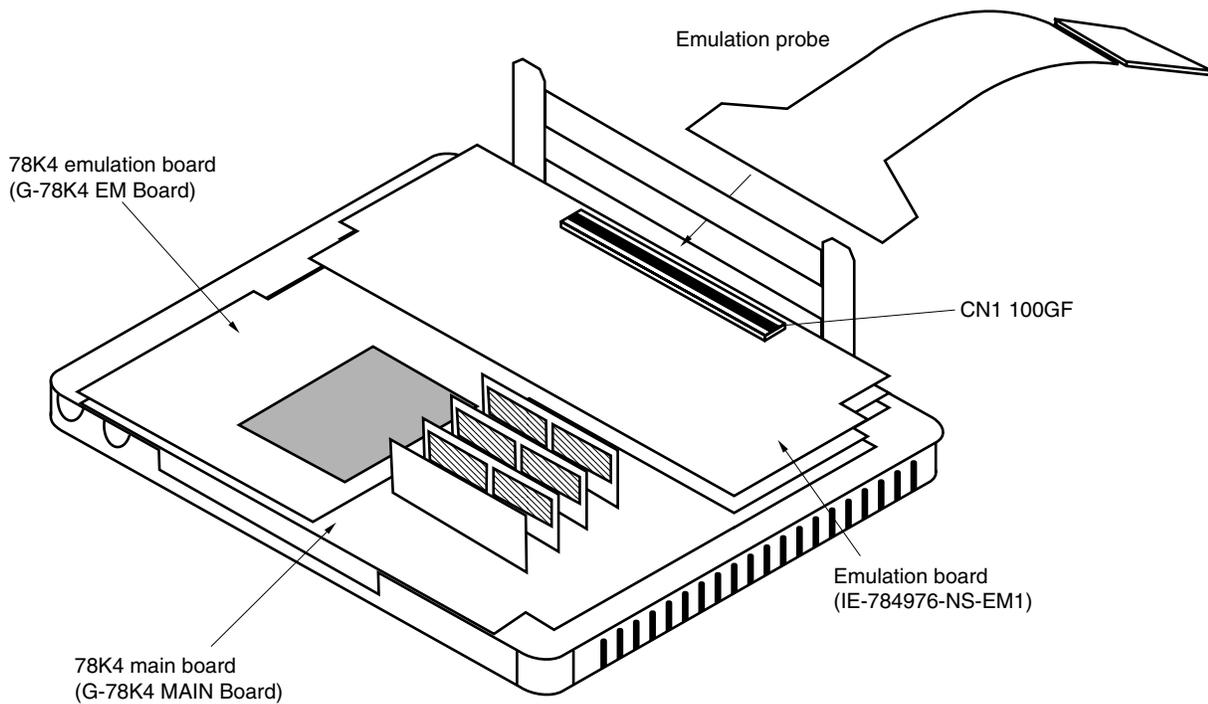
See the **IE-78K4-NS User's Manual (U13356E)** for a description of how to connect an emulation probe to the IE-784976-NS-EM1.

On this board, connect the emulation probe to CN1.

**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**

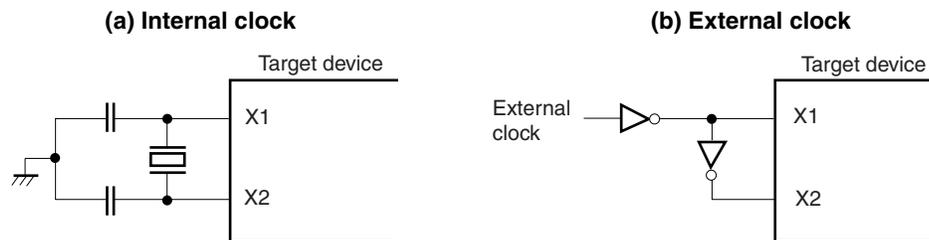
**(3) External clock**

If the target system includes an internal clock, select either **(1) Clock that is already mounted on emulation board** or **(2) Clock that is mounted by user**. For an internal clock, 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 resonator that is mounted on the target system is not used. Instead, the clock that is mounted on the emulation board installed in the IE-78K4-NS is used.

If the target system includes an external clock, select **(3) External clock**.

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.

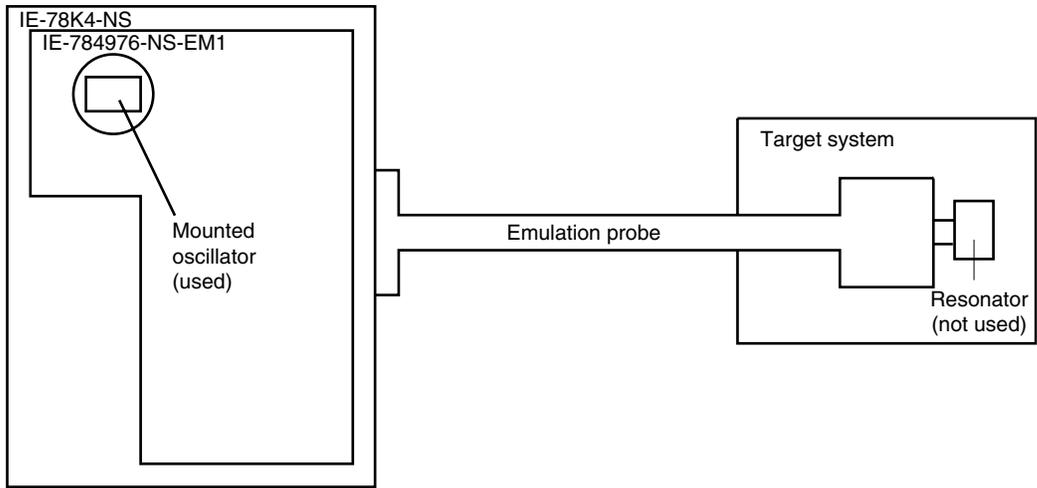
**Figure 3-2. External Circuits Used as System Clock Oscillator**



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

A crystal oscillator is already mounted on the emulation board. Its frequency is 25 MHz.

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

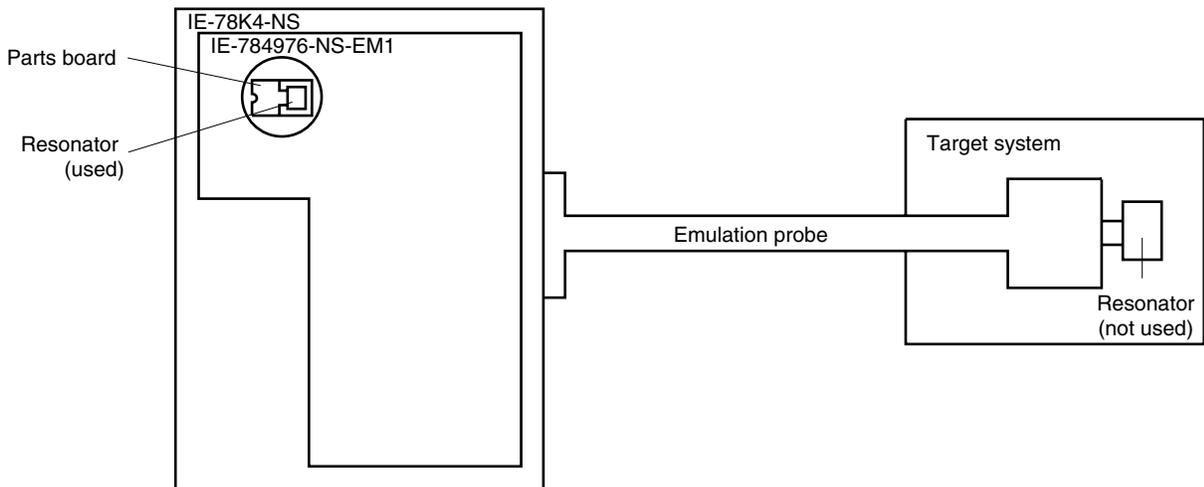


**Remark** The clock that is supplied by the IE-784976-NS-EM1's oscillator (encircled in the figure) is used.

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

The user is able to mount any clock supported by the set specifications on the IE-784976-NS-EM1. First mount the resonator on the parts board, then attach the parts board to the IE-784976-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**

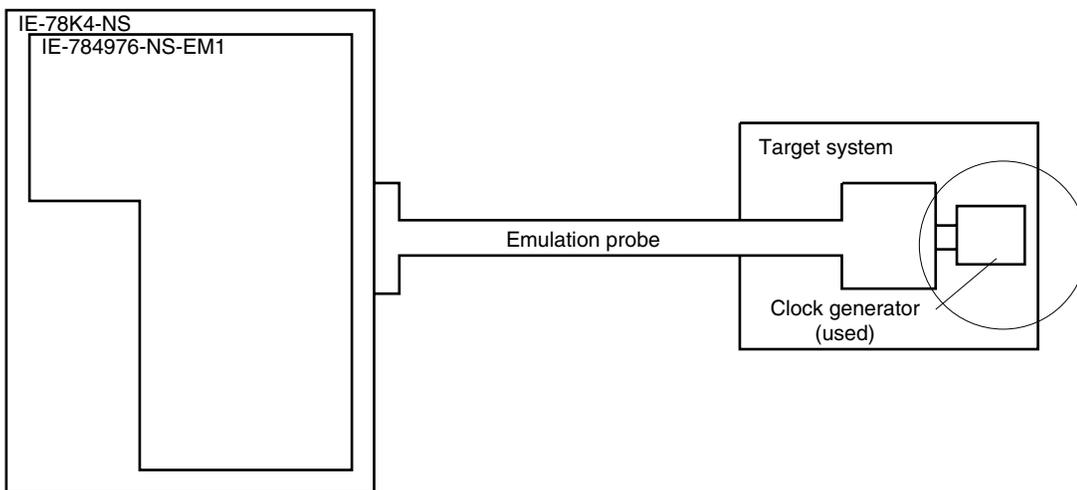


**Remark** The clock that is supplied by the IE-784976-NS-EM1's resonator (encircled in the figure) is used.

**(3) External clock**

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

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



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

**3.2.2 Main system clock settings**

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

Clock Supply Method	Frequency of Supply Clock	Frequency of Main System Clock	IE-784976-NS-EM1		CPU Clock Source Selection (ID78K4-NS)
			JP1	Parts Board (UMCLK1)	
When using clock that is already mounted on emulation board	25 MHz	12.5 MHz	1 and 2 shorted (not used)	Oscillator	Internal
When using clock mounted by user	25 MHz or lower	12.5 MHz or lower	1 and 2 shorted (not used)	Oscillator assembled by user	
When using external clock		Clock-through mode $f_x$	1 and 2 shorted	Oscillator (not used)	External
		Division mode $f_x/2$	2 and 3 shorted		

**Caution** When using an external clock, open the configuration dialog box when starting the integrated debugger (ID78K4-NS) and select “External” in the area (Clock) for selecting the CPU’s clock source (this selects the user’s clock).

**Remark** The IE-784976-NS-EM1’s factory settings are those listed above under “when using clock that is already mounted on emulation board” (JP1 = 1 and 2 shorted).

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

When the IE-784976-NS-EM1 is shipped, a 25 MHz crystal oscillator is already mounted in the IE-784976-NS-EM1's UMCLK1 socket. When using the factory-set mode settings, there is no need to make any other hardware settings.

When starting the integrated debugger (ID78K4-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 (ID78K4-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

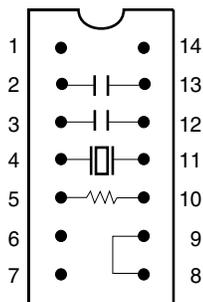
- Parts board
- Ceramic resonator or crystal resonator
- Resistor Rx
- Capacitor CA
- Capacitor CB
- Solder kit

## &lt;Steps&gt;

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

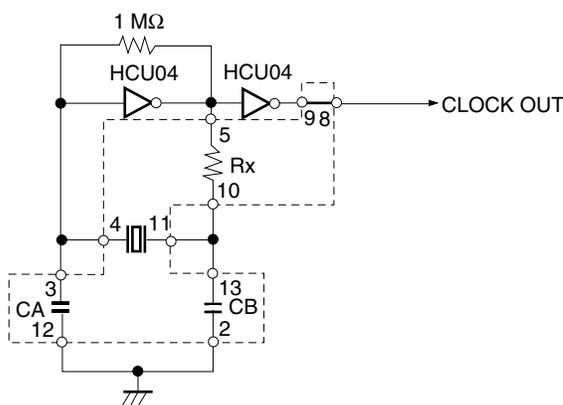
Figure 3-6. Connections on Parts Board (When Using Main System Clock or User-Mounted Clock)

Parts board (UMCLK1)



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

Circuit diagram



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

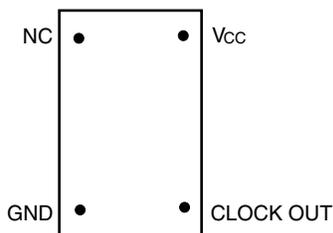
- <2> Prepare the IE-784976-NS-EM1.
- <3> Remove the crystal oscillator that is mounted in the IE-784976-NS-EM1's socket (the socket marked as UMCLK1).
- <4> Connect the parts board (from <1> above) to the socket (UMCLK1) from which the crystal oscillator was removed (see <3> above). Check the pin 1 mark to make sure the board is mounted in the correct direction.
- <5> Make sure that the parts board mounted in the UMCLK1 socket on the emulation board is wired as shown in Figure 3-6 above.
- <6> Connect the IE-784976-NS-EM1 to the IE-78K4-NS.

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 3-7)

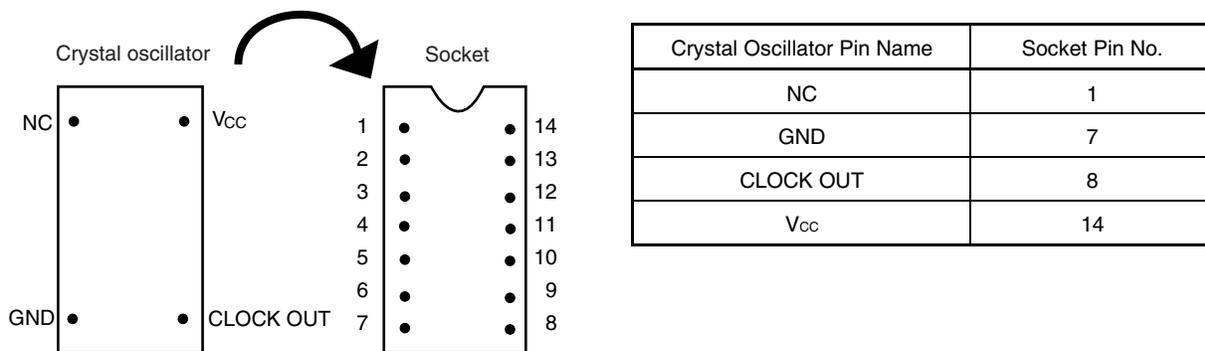
**Figure 3-7. Crystal Oscillator (When Using Main System Clock or User-Mounted Clock)**



<Steps>

- <1> Prepare the IE-784976-NS-EM1.
- <2> Remove the crystal oscillator that is mounted in the IE-784976-NS-EM1's socket (the socket marked as UMCLK1).
- <3> Connect the crystal oscillator (from <2> above) to the socket (UMCLK1) from which the crystal oscillator was removed. 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**



- <4> Connect the IE-784976-NS-EM1 to the IE-78K4-NS.

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

**(3) When using external clock**

Set JP1 of the IE-784976-NS-EM1 as shown in Table 3-1.

When starting the integrated debugger (ID78K4-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 Low-Voltage Emulation Setting

Low-voltage emulation is possible in the IE system.

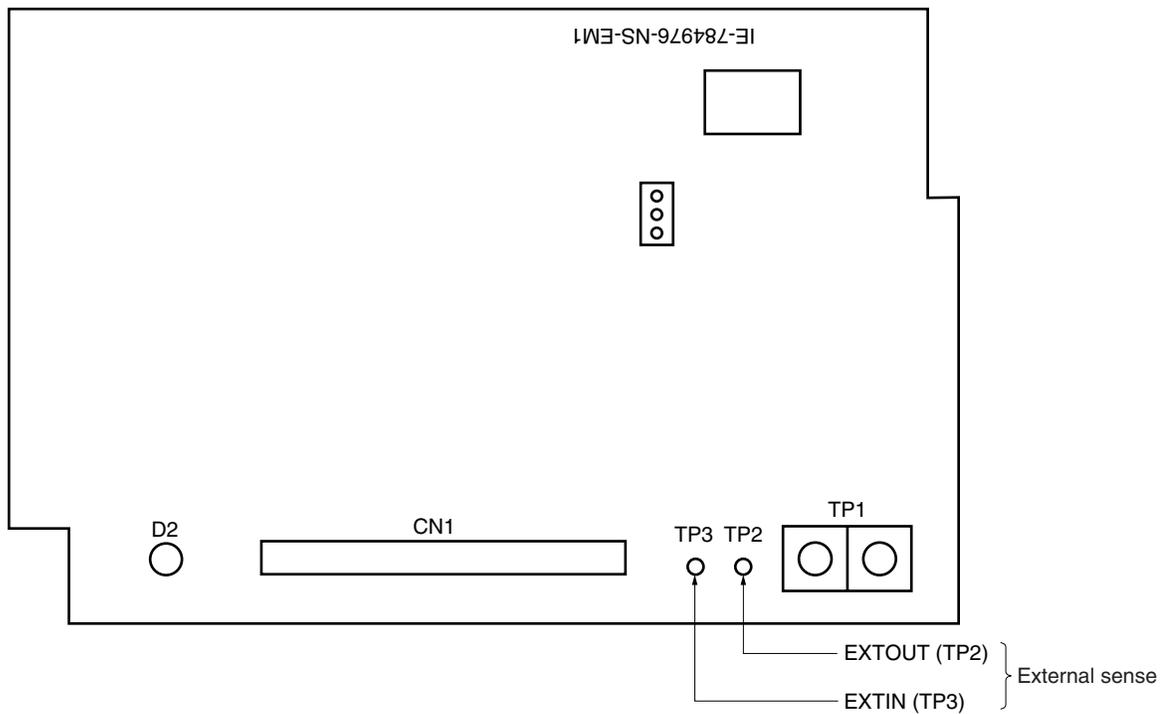
When the target system is operating on low voltage, supply the same voltage as the target system to the TP1 terminal pin of the IE-784976-NS-EM1. Set the target voltage between 4.5 and 5.25 V. The maximum current consumption is 300 mA.

### 3.4 External Trigger

To set an external trigger, connect the IE-784976-NS-EM1's check pins EXTOUT and EXTIN as shown below.

For pin characteristics, refer to the **IE-78K4-NS User's Manual (U13356E)**, and for usage methods, refer to the **ID78K Series Ver.2.30 or Later Operation User's Manual (Windows Based) (U15185E)**.

Figure 3-9. External Trigger Input Position



### 3.5 Jumper Setting of IE-784976-NS-EM1

The following shows the jumper setting of JP1 on the IE-784976-NS-EM1.

JP1 is an alternate function in place of SFR register CC (oscillation mode selection register), which cannot be emulated.

**Table 3-2. Jumper Setting of IE-784976-NS-EM1**

	Setting	Description	Factory Setting
JP1	1 and 2 shorted	External clock not divided (clock-through)	1 and 2 shorted
	2 and 3 shorted	External clock divided by 1/2	

## 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-784976-NS-EM1's target interface circuit.

Although the target device is a CMOS circuit, the IE-784976-NS-EM1's target interface circuit consists of an emulation CPU, TTL, CMOS-IC, and other emulation circuits.

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

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

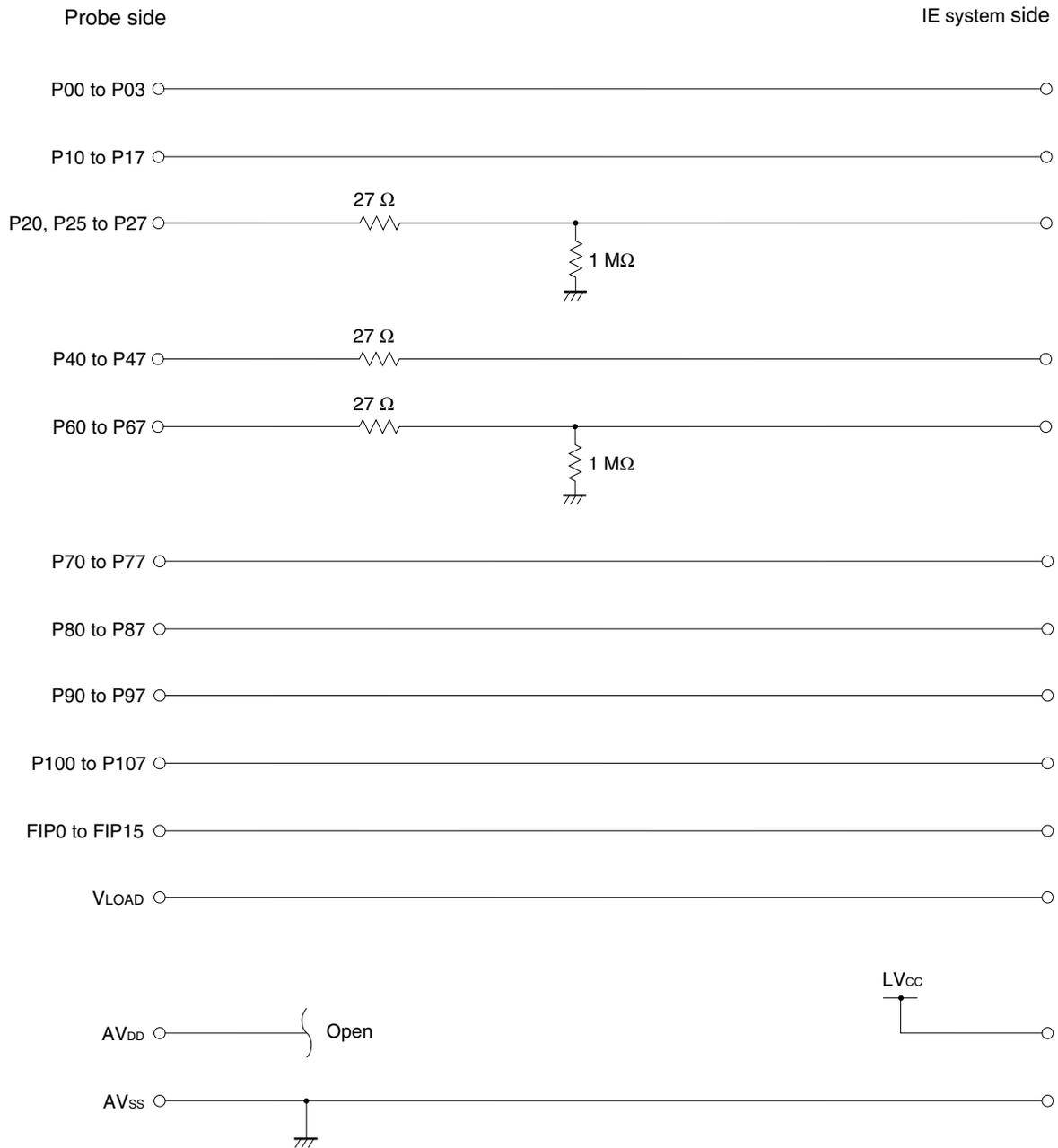
### (1) Signals directly input/output to/from the emulation CPU

The following signals perform the same operations as in the  $\mu$ PD784976 and 784976A Subseries. For the signals related to ports, excluding ports 0, 1, 7, 8, 9, and 10 (having alternate functions as pins for the A/D converter and FIP), however, a 1 M $\Omega$  pull-down resistor and 27  $\Omega$  resistor are inserted in series.

- Signals related to port 0 (A/D converter input)
- Signals related to port 1 (A/D converter input)
- Signals related to port 2
- Signals related to port 4
- Signals related to port 6
- Signals related to port 7 (FIP output)
- Signals related to port 8 (FIP output)
- Signals related to port 9 (FIP output)
- Signals related to port 10 (FIP output)
- Signals related to A/D converter
  - AV<sub>SS</sub>
  - AV<sub>DD</sub><sup>Note</sup>
- Signals related to FIP

**Note** The AV<sub>DD</sub> pin on the target system is not connected to the IE system. Either the power supply of the IE system or the power supply supplied to TP1 is supplied to the AV<sub>DD</sub> pin of the emulation CPU.

Figure 4-1. Equivalent Circuit 1 of Emulation Circuit

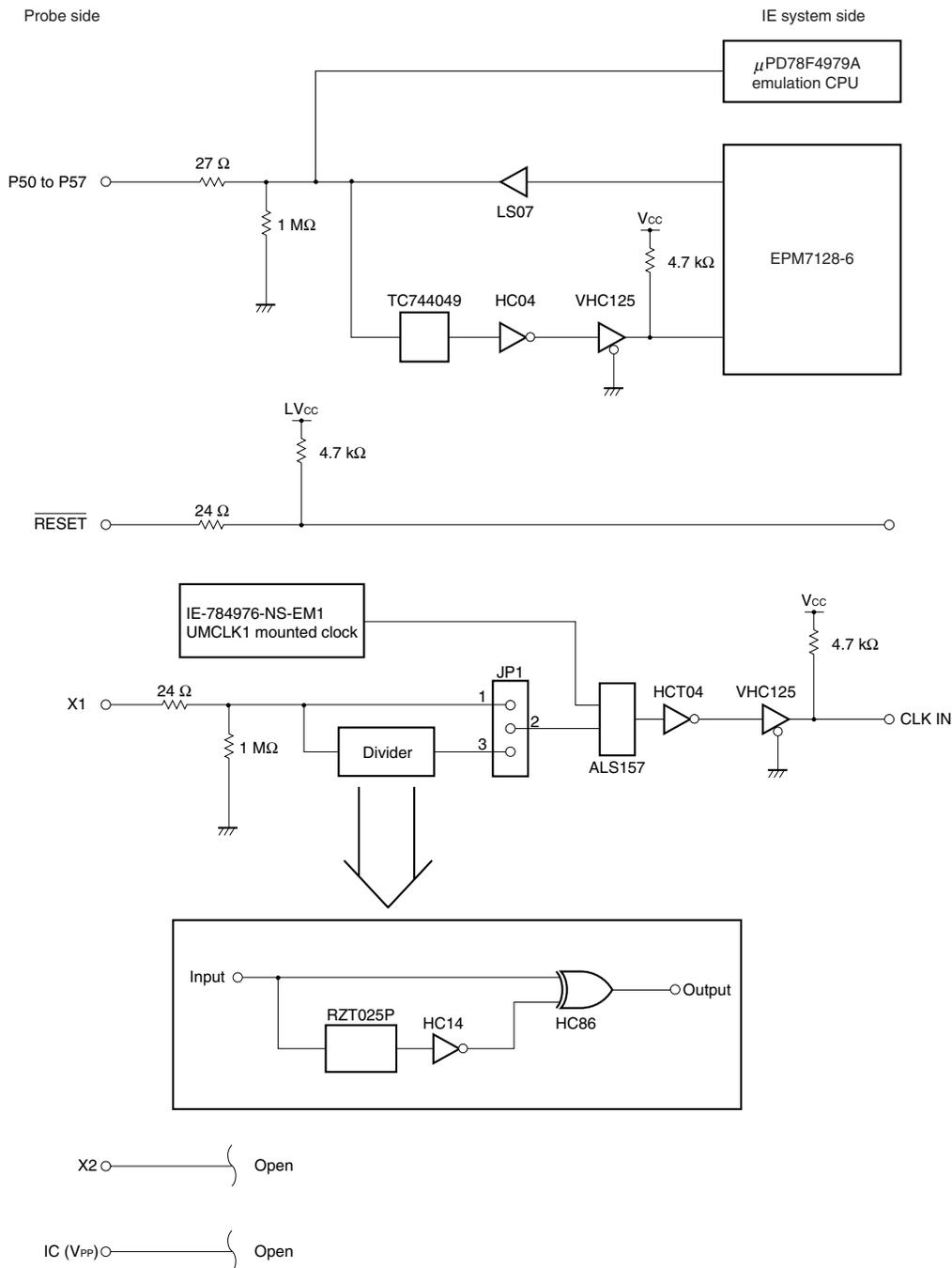


(2) Signals input from the target system via a gate

Since the following signals are input via a gate, their timing shows a delay compared to that of the  $\mu$ PD784976 and 784976A Subseries. Their AC characteristics and DC characteristics are therefore different from  $\mu$ PD784976 and 784976A Subseries, making it necessary to observe a stricter timing design than in the case of  $\mu$ PD784976 and 784976A Subseries.

- Signals related to port 5
- $\overline{\text{RESET}}$  signal
- Signals related to clock input

Figure 4-2. Equivalent Circuit 2 of Emulation Circuit



**(3) Other signals**

- **V<sub>DD</sub> pin**

When the emulation CPU is operating at 5 V, its power is supplied from the internal IE system, but when operating at low voltage, its power is supplied from the low-voltage pin (TP1). The V<sub>DD</sub> pin of the target system is only used to control the LED (USERV<sub>DD</sub>) in the IE system that monitors the input of the target system's power supply.

- **V<sub>SS</sub> pin**

The V<sub>SS</sub> pin is connected to GND inside the IE system.

## CHAPTER 5 RESTRICTIONS

The IE-784976-NS-EM1 has the following restrictions.

- SFR register CC (oscillation mode selection register) cannot be emulated.  
Preventive measures: Mode selection is possible by setting JP1 on the IE-784976-NS-EM1.
- Mask option functions of ports 5, 7, 8, 9, and 10 are not supported.

## APPENDIX A EMULATION PROBE PIN ASSIGNMENT TABLE

**Table A-1. NP-100GF, NP-100GF-TQ, NP-H100GF-TQ Pin Assignments (1/2)**

Emulation Probe	CN1 Pin No.	Emulation Probe	CN1 Pin No.
1	116	34	107
2	115	35	104
3	87	36	103
4	88	37	100
5	83	38	99
6	84	39	94
7	77	40	93
8	78	41	30
9	73	42	29
10	74	43	24
11	69	44	23
12	70	45	20
13	63	46	19
14	64	47	16
15	61	48	15
16	62	49	10
17	65	50	9
18	66	51	6
19	71	52	5
20	72	53	33
21	75	54	34
22	76	55	37
23	79	56	38
24	80	57	43
25	85	58	44
26	86	59	47
27	89	60	48
28	90	61	51
29	118	62	52
30	117	63	57
31	114	64	58
32	113	65	59
33	108	66	60

- Remarks**
1. The NP-100GF, NP-100GF-TQ, and NP-H100GF-TQ products 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.

**Table A-1. NP-100GF, NP-100GF-TQ, NP-H100GF-TQ Pin Assignments (2/2)**

Emulation Probe	CN1 Pin No.	Emulation Probe	CN1 Pin No.
67	55	84	13
68	56	85	18
69	49	86	17
70	50	87	22
71	45	88	21
72	46	89	28
73	41	90	27
74	42	91	92
75	35	92	91
76	36	93	98
77	31	94	97
78	32	95	102
79	4	96	101
80	3	97	106
81	8	98	105
82	7	99	112
83	14	100	111

- Remarks**
1. The NP-100GF, NP-100GF-TQ, and NP-H100GF-TQ 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 NOTES ON TARGET SYSTEM DESIGN

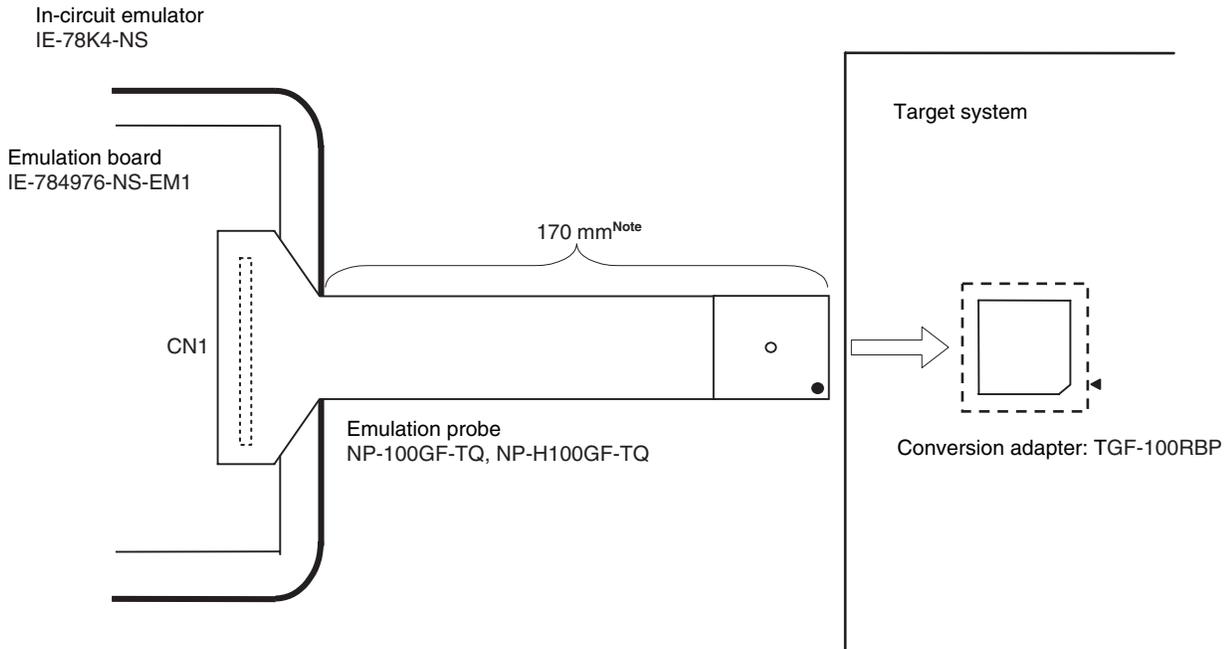
The following shows the conditions when connecting the emulation probe to the conversion adapter. Follow the configuration below and consider the shape of parts to be mounted on the target system when designing a system.

Among the products described in this appendix, NP-100GF-TQ and NP-H100GF-TQ are products of Naito Densai Machida Mfg. Co., Ltd, and TGF-100RBP 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-100GF-TQ	TGF-100RBP	170 mm
NP-H100GF-TQ		370 mm

**Figure B-1. Distance Between IE System and Conversion Adapter**



**Note** Distance when NP-100GF-TQ is used. When NP-H100GF-TQ is used, the distance is 370 mm.

Figure B-2. Connection Conditions of Target System (When NP-100GF-TQ Is Used)

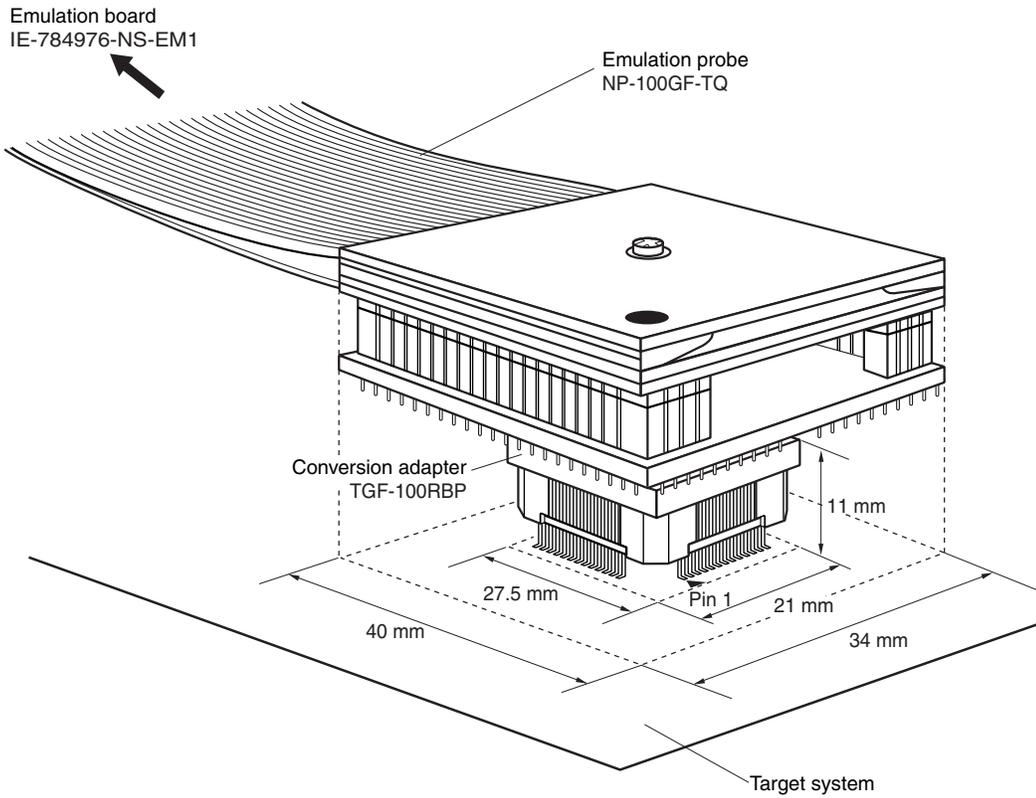


Figure B-3. Connection Conditions of Target System (When NP-H100GF-TQ Is Used)

