User's Manual

NEC

IE-780018-NS-EM1

Emulation Board

Target device
μPD780018AY Subseries

[MEMO]

Windows is either a registered trademark or a trademark of Microsoft Corporation in the United States and/or other countries.
PC/AT is a trademark of International Business Machines Corporation.

M7A 98. 8

Regional Information

Some information contained in this document may vary from country to country. Before using any NEC product in your application, please contact the NEC office in your country to obtain a list of authorized representatives and distributors. They will verify:

• Device availability

• Ordering information

• Product release schedule

• Availability of related technical literature

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

• Network requirements

In addition, trademarks, registered trademarks, export restrictions, and other legal issues may also vary from country to country.

NEC Electronics Inc. (U.S.)
Santa Clara, California
Tel: 408-588-6000
    800-366-9782
Fax: 408-588-6130
    800-729-9288

NEC Electronics (Germany) GmbH
Duesseldorf, Germany
Tel: 0211-65 03 02
Fax: 0211-65 03 490

NEC Electronics (UK) Ltd.
Milton Keynes, UK
Tel: 01908-691-133
Fax: 01908-670-290

NEC Electronics Italiana s.r.l.
Milano, Italy
Tel: 02-66 75 41
Fax: 02-66 75 42 99

NEC Electronics (Germany) GmbH
Benelux Office
Eindhoven, The Netherlands
Tel: 040-2445845
Fax: 040-2444580

NEC Electronics (France) S.A.
Velizy-Villacoublay, France
Tel: 01-30-67 58 00
Fax: 01-30-67 58 99

NEC Electronics (France) S.A.
Spain Office
Madrid, Spain
Tel: 91-504-2787
Fax: 91-504-2860

NEC Electronics (Germany) GmbH
Scandinavia Office
Taeby, Sweden
Tel: 08-63 80 820
Fax: 08-63 80 388

NEC Electronics Hong Kong Ltd.
Hong Kong
Tel: 2886-9318
Fax: 2886-9022/9044

NEC Electronics Hong Kong Ltd.
Seoul Branch
Seoul, Korea
Tel: 02-528-0303
Fax: 02-528-4411

NEC Electronics Singapore Pte. Ltd.
United Square, Singapore 1130
Tel: 65-253-8311
Fax: 65-250-3583

NEC Electronics Taiwan Ltd.
Taipei, Taiwan
Tel: 02-2719-2377
Fax: 02-2719-5951

NEC do Brasil S.A.
Electron Devices Division
Rodovia Presidente Dutra, Km 214
07210-902-Guarulhos-SP Brasil
Tel: 55-11-6465-6810
Fax: 55-11-6465-6829

J99.1

INTRODUCTION

Product Overview   The IE-780018-NS-EM1 is designed to use with the IE-78K0-NS to debug the following target devices that belong to the 78K/0 Series of 8-bit single-chip microcontrollers.

- μPD780018AY Subseries : μPD780016AY, 780018AY, 78P0018AY

Target Readers   This manual is intended for engineers who will use the IE-780018-NS-EM1 with the IE-78K0-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-780018-NS-EM1, refer to not only this manual (supplied with the IE-780018-NS-EM1) but also the manual that is supplied with the IE-78K0-NS.

IE-78K0-NS User's Manual	IE-780018-NS-EM1 User's Manual
• Basic specifications • System configuration • External interface functions	• General • Parts 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-780018-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 a device (a μPD780018AY Subseries 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-78K0-NS and the IE-780018-NS-EM1.

Conventions

Data significance weight: 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 indicated in this publication may include preliminary versions. However, preliminary versions are not marked as such.

Document Name	Document Number	
	English	Japanese
IE-78K0-NS	To be prepared	U13731J
IE-780018-NS-EM1	This manual	U13303J
ID78K0-NS Integrated Debugger Reference Windows™ Based	U12900E	U12900J
μPD780018AY Subseries	To be prepared	To be prepared

Caution   **The 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

[MEMO]

CHAPTER 1 GENERAL

The IE-780018-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/0 Series of 8-bit single-chip microcontrollers.
This chapter describes the IE-780018-NS-EM1's system configuration and basic specifications.

- Target device
  - μPD780018AY Subseries

1.1 System Configuration

Figure 1-1 illustrates the IE-780018-NS-EM1's system configuration.

Figure 1-1. System Configuration
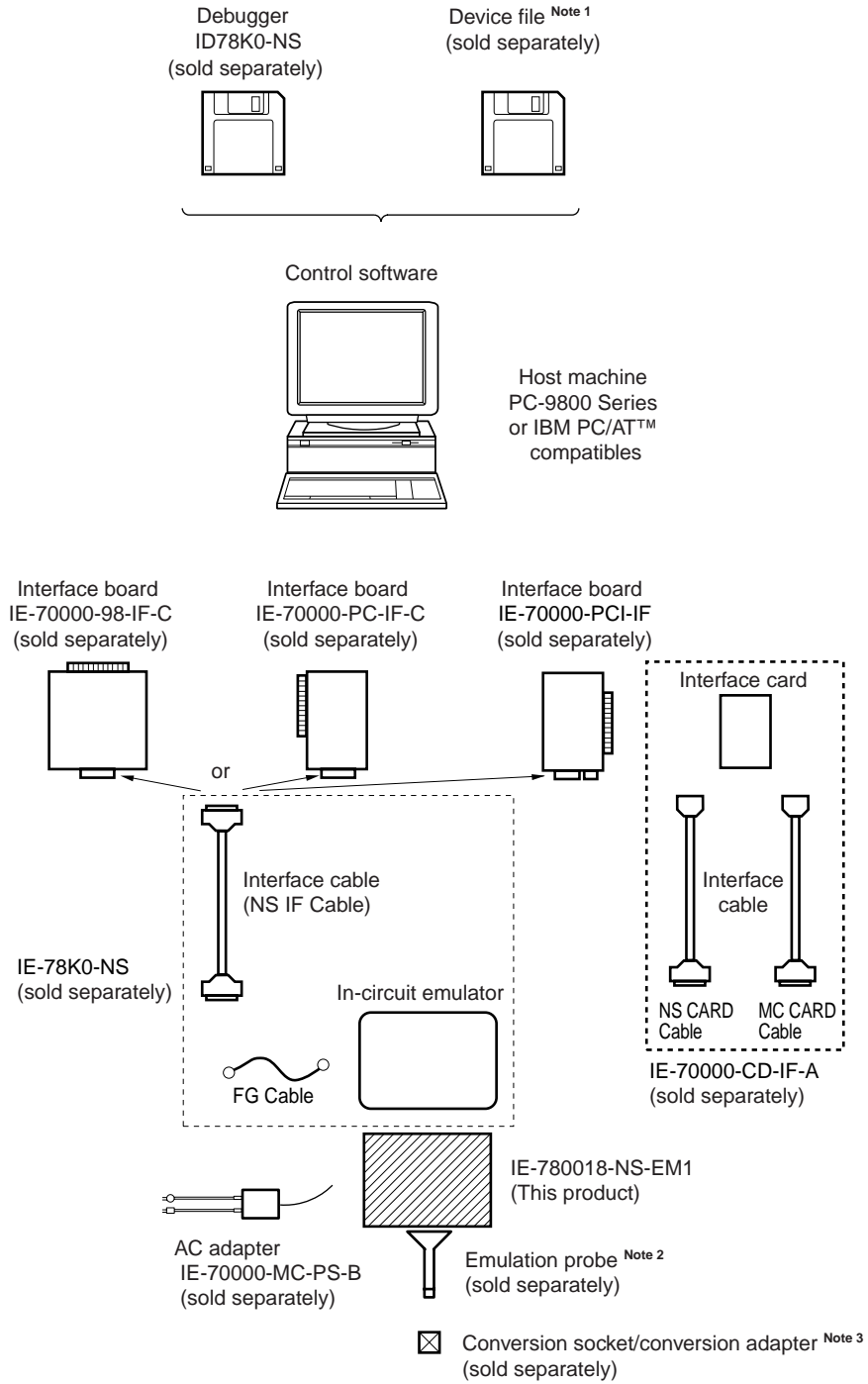
Notes 1. The device file is as follows, in accordance with the subseries.

μ SxxxxDF780018: μ PD780018AY Subseries

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

NP-100GF: 100-pin plastic QFP (GF-3BA type)

The NP-100GF is a product of Naito Densei Machidaseisakusho Co., Ltd.

For further information, contact Naito Densei Machidaseisakusho Co., Ltd. (TEL: +81-44-822-3813)

3. The conversion socket is as follows, in accordance with the package.

EV-9200GF-100: 100-pin plastic QFP (GF-3BA type)

1.2 Hardware Configuration

Figure 1-2 shows the IE-780018-NS-EM1's position in the basic hardware configuration.

Figure 1-2. Basic Hardware Configuration
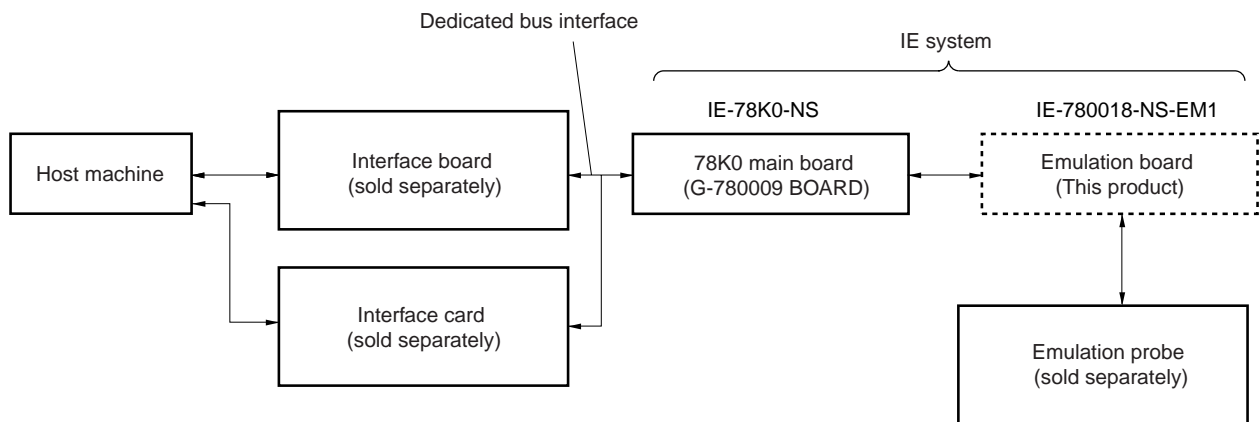
1.3 Basic Specifications

The IE-780018-NS-EM1's basic specifications are listed in Table 1-1.

Table 1-1. Basic Specifications

Parameter	Description
Target device	μPD780018AY Subseries
System clock	Main system clock: 5 MHz
	Subsystem clock: 32.768 kHz
Clock supply	External: Input via an emulation probe from the target system
	Internal: Mounted on emulation board, or mounted on the board by the user
Low-voltage support	2.7 to 5.5 V (same as target device)

[MEMO]

User's Manual U13303EJ1V1UM00

CHAPTER 2   PART NAMES

This chapter introduces the parts of the IE-780018-NS-EM1 main unit.

The packing box contains the emulation board (IE-780018-NS-EM1).

If there are any missing or damaged items, please contact an NEC 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-780018-NS-EM1 Part Names
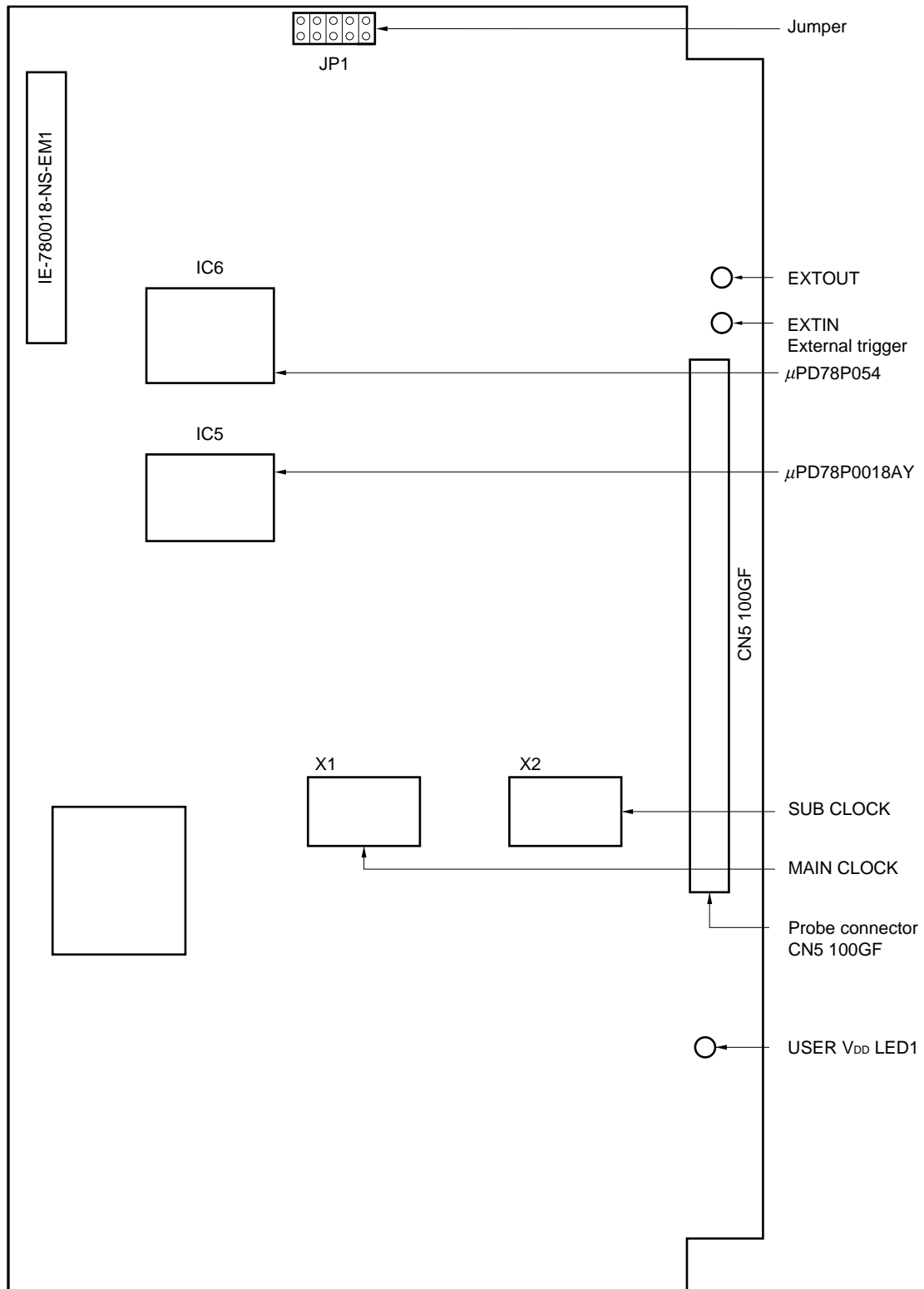
CHAPTER 3   INSTALLATION

This chapter describes methods for connecting the IE-780018-NS-EM1 to the IE-78K0-NS, emulation probe, etc. Mode setting methods are also described.

3.1 Connection

(1) Connection with IE-78K0-NS main unit
See the IE-78K0-NS User's Manual for a description of how to connect the IE-780018-NS-EM1 to the IE-78K0-NS.

(2) Connection with emulation probe
Connect the emulation probe NP-100GF to CN5.
See the IE-78K0-NS User's Manual for a description of how to connect an emulation probe to the IE-780018-NS-EM1.

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

Figure 3-1. Connection of Emulation Probe

Emulation probe
(sold separately)

CN5 100GF

IE-780018-NS-EM1

Main board
(IE-78K0-NS)
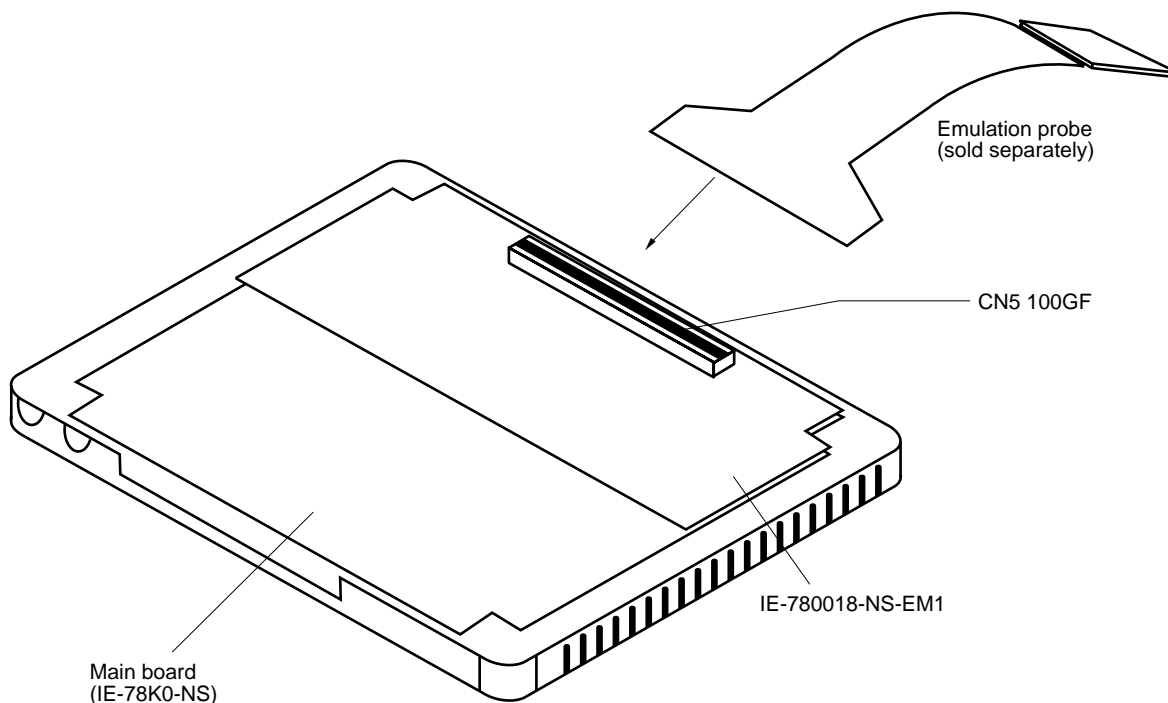
3.2 Clock Settings

3.2.1 Overview of clock settings

Select from (1) to (3) below as the main system clock and subsystem clock to be used during debugging.

(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". An internal clock connects the target device to an oscillator and uses the target device's internal oscillation circuit. An example of an 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, it uses the clock that is mounted on the emulation board which is installed for the IE-78K0-NS.

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

An external clock supplies a clock signal from outside of the target device and does not use the target device's internal oscillation circuit. An example of an external circuit is shown in part (b) of Figure 3-2.

Figure 3-2. External Circuits Used as System Clock Oscillation Circuit

(a) Internal clock

(b) External clock
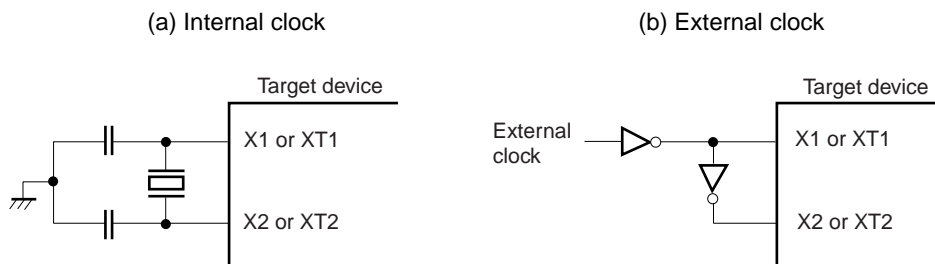
(1) Clock that is already mounted on emulation board
A crystal resonator is already mounted on the emulation board. Its frequency is 5 MHz.

Figure 3-3. When Using Clock That Is Already Mounted on Emulation Board
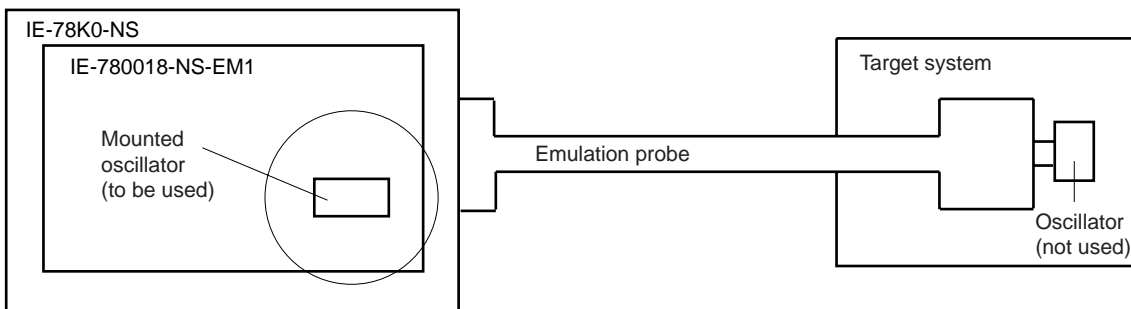
Remark The clock that is supplied by the IE-780018-NS-EM1's oscillator (encircled in the figure) is used.

(2) Clock that is mounted by user
The user is able to mount any clock supported by the set specifications on the IE-780018-NS-EM1. First mount the oscillator on the parts board, then attach the parts board to the IE-780018-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
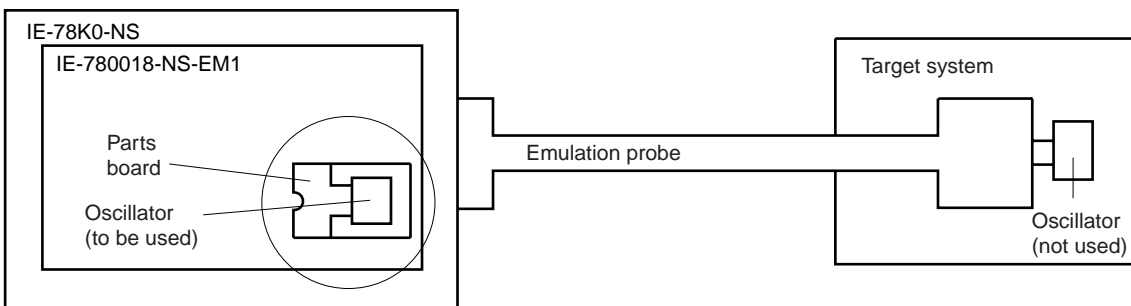
Remark The clock that is supplied by the IE-780018-NS-EM1's oscillator (encircled in the figure) is used.

(3) External clock

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

Figure 3-5. When Using an 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

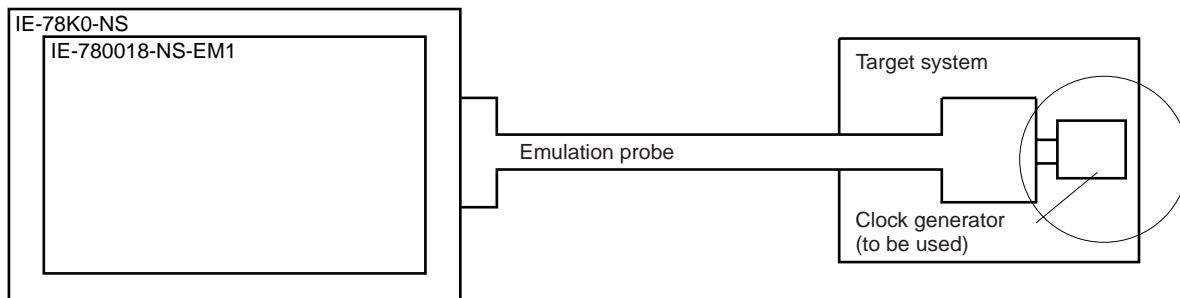| Frequency of Main System Clock		IE-780018-NS-EM1	CPU Clock Source
		Parts board (X1)	Selection (ID)
When using clock that is already mounted on emulation board	5 MHz	Oscillator	Internal
When using clock mounted by user	Other than 5 MHz	Includes oscillation circuit	
When using external clock		Oscillator (not used)	External

Caution   When using an external clock, open the configuration dialog when starting the integrated debugger (ID78K0-NS) and select "External" in the area (Clock) for selecting the CPU's clock source (this selects the user's clock).

Remark   The IE-780018-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-780018-NS-EM1 is shipped, a 5-MHz crystal resonator is already mounted in the IE-780018-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 (ID78K0-NS), open the configuration dialog 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 (ID78K0-NS), open the configuration dialog 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 oscillator or crystal resonator

- Items to be prepared
  - Parts board (supplied with IE-78K0-NS)
  - Ceramic oscillator or crystal resonator
  - Resistor Rx
  - Capacitor CA
  - Capacitor CB
  - Solder kit

<Steps>

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

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

Parts board (X1)
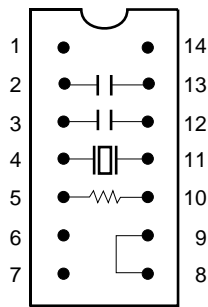
Pin No.	Connection
2-13	Capacitor CB
3-12	Capacitor CA
4-11	Ceramic oscillator or crystal resonator
5-10	Resistor Rx
8-9	Short

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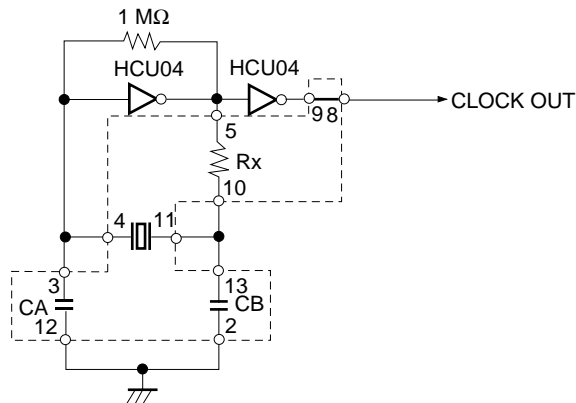
Remark The sections enclosed in broken lines indicate parts that are attached to the parts board.

<2> Prepare the IE-780018-NS-EM1.

<3> Remove the crystal oscillator that is mounted in the IE-780018-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-780018-NS-EM1 in the IE-78K0-NS.

The above steps configure a circuit and enable clock output to be supplied from the mounted oscillator to the emulation device.

**IE-78K0-NS side
(Emulation device)**
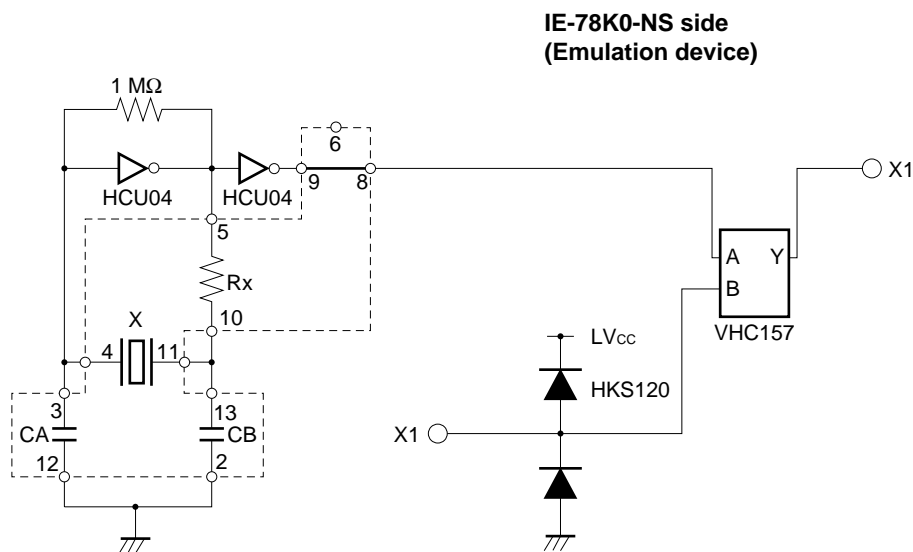
Remark   The sections enclosed in broken lines indicate parts that are attached to the parts board.

(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 Main System Clock or User-mounted Clock)
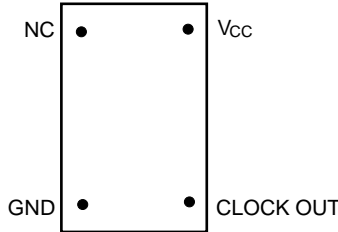
<Steps>

<1> Prepare the IE-780018-NS-EM1.

<2> Remove the crystal oscillator that is mounted in the IE-780018-NS-EM1's socket (the socket marked as "X1").

<3> Connect the parts board (from <2> above) to the socket (X1) from which the crystal oscillator was removed. Insert the crystal oscillator into the socket so as to align the pins as shown in the figure below.

Figure 3-8. Pin Alignment of Crystal Oscillator and Socket
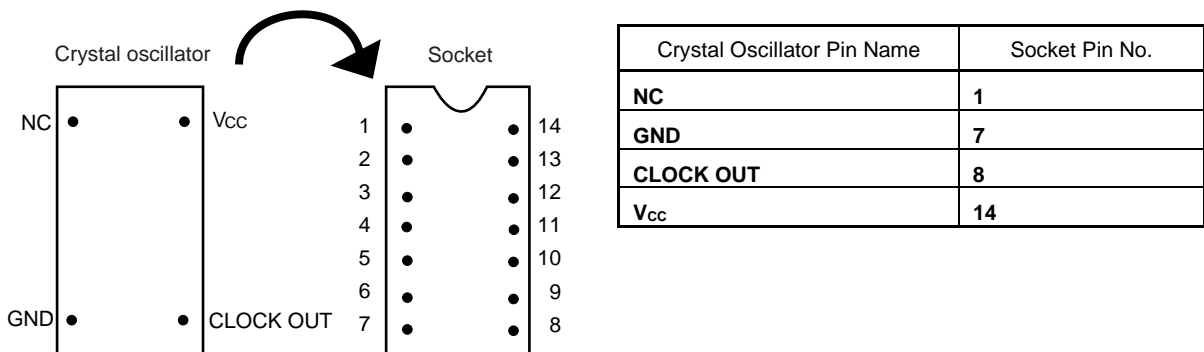
Crystal Oscillator Pin Name	Socket Pin No.
NC	**1**
GND	**7**
CLOCK OUT	**8**
V_{CC}	**14**

<4> Install the IE-780018-NS-EM1 in the IE-78K0-NS.

The above steps configure a circuit and enable clock output to be supplied from the mounted oscillator to the emulation device.
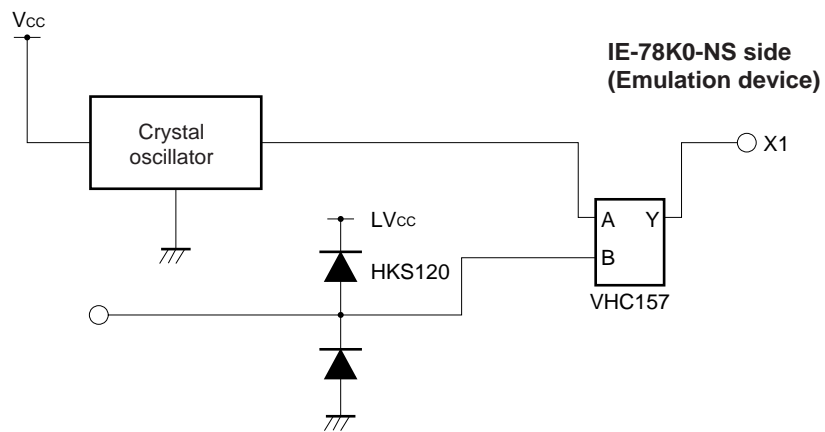

(3) When using an external clock

No hardware settings are required for this situation.

When starting the integrated debugger (ID78K0-NS), open the configuration dialog and select "External" in the area (Clock) for selecting the CPU's clock source (this selects the user's clock).

3.2.3 Subsystem clock settings

Table 3-2. Subsystem Clock Settings

Subsystem Clock Frequency to be Used		IE-780018-NS-EM1	IE-78K0-NS
		Parts board (X2)	JP8
When using clock that is already mounted on emulation board	32.768 kHz	Short 6 and 8	Short 1 and 2
When using user-mounted clock	Other than 32.768 kHz	Includes oscillator	
When using external clock		Not used	Short 3 and 4

Caution   Jumper JP8, which is used to select the board's clock or an external clock, should be set only after turning off the IE-78K0-NS's power.

Remark   When the IE-780018-NS-EM1 is shipped, the settings for "when using clock that is already mounted on emulation board" are pre-set.

(1)   When using clock that is already mounted on emulation board
When the IE-780018-NS-EM1 is shipped, a 32.768-kHz crystal oscillator is already mounted in the IE-780018-NS-EM1. Pins 6 and 8 on the parts board (X2) are shorted. Short pins 1 and 2 on the IE-78K0-NS's jumper (JP8). There is no need to make any other settings via the integrated debugger (ID78K0-NS).

(2)   When using the user-mounted clock
The settings described under either (a) or (b) are required, depending on the type of clock to be used. Short pins 1 and 2 on the IE-78K0-NS's jumper (JP8).
There is no need to make any other settings via the integrated debugger (ID78K0-NS).

(a)   When using a ceramic oscillator or crystal resonator

- Items to be prepared
  - Parts board (supplied with IE-78K0-NS)
  - Ceramic oscillator or crystal resonator
  - Resistor Rx
  - Capacitor CA
  - Capacitor CB
  - Solder kit

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

Figure 3-9. Connections on Parts Board (When Using Subsystem Clock or User-Mounted Clock)

Parts board (X2)
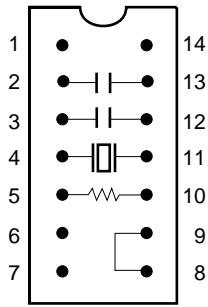
Pin No.	Connection
2-13	Capacitor CB
3-12	Capacitor CA
4-11	Ceramic oscillator or crystal resonator
5-10	Resistor Rx
8-9	Short

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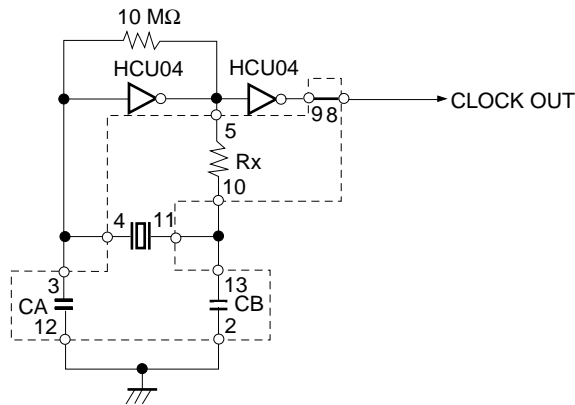
Remark   The sections enclosed in broken lines indicate parts that are attached to the parts board.

<2>   Prepare the IE-780018-NS-EM1.

<3>   Remove the crystal oscillator that is mounted in the IE-780018-NS-EM1's socket (the socket marked as "X2").

<4>   Connect the parts board (from <1> above) to the socket (X2) 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>   Install the IE-780018-NS-EM1 in the IE-78K0-NS.

The above steps configure a circuit and enable clock output to be supplied from the mounted oscillator to the emulation device.
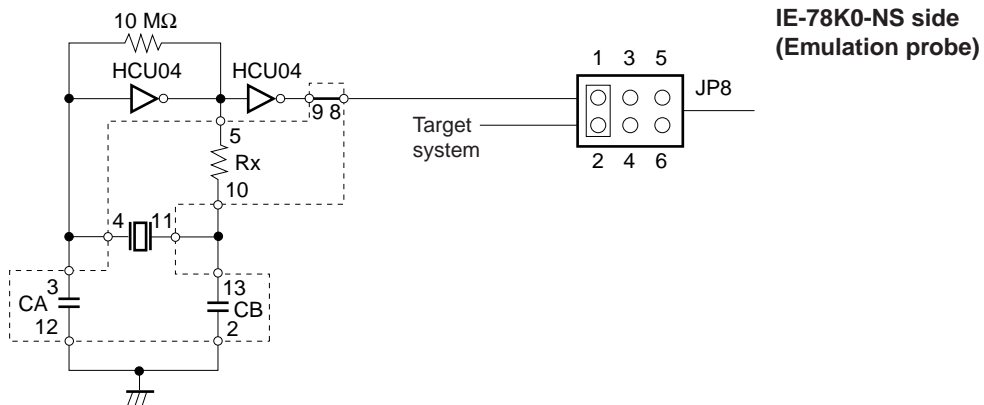
Remarks 1. The section enclosed in broken lines indicates parts that are attached to the parts board.
2. Jumper JP8 is in the IE-78K0-NS.

(b) When using a crystal oscillator

- Items to be prepared
  - Crystal oscillator (see pinouts shown in Figure 3-10)

Figure 3-10. Crystal Oscillator (When Using Subsystem Clock or User-mounted Clock)
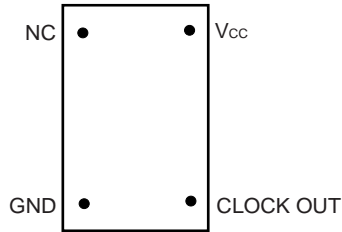
<Steps>

<1> Prepare the IE-780018-NS-EM1.

<2> Remove the crystal oscillator that is mounted in the IE-780018-NS-EM1's socket (the socket marked as "X2").

<3> Connect the parts board (from <2> above) to the socket (X2) from which the crystal oscillator was removed. Insert the crystal oscillator into the socket so as to align the pins as shown below.
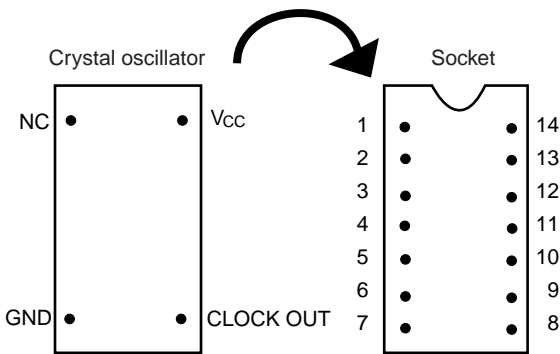
Crystal Oscillator Pin Name	Socket Pin No.
NC	1
GND	7
CLOCK OUT	8
V_{CC}	14

<4> Install the IE-780018-NS-EM1 in the IE-78K0-NS.

The above steps configure a circuit and enable clock output to be supplied from the mounted oscillator to the emulation device.

**IE-78K0-NS side
(Emulation device)**
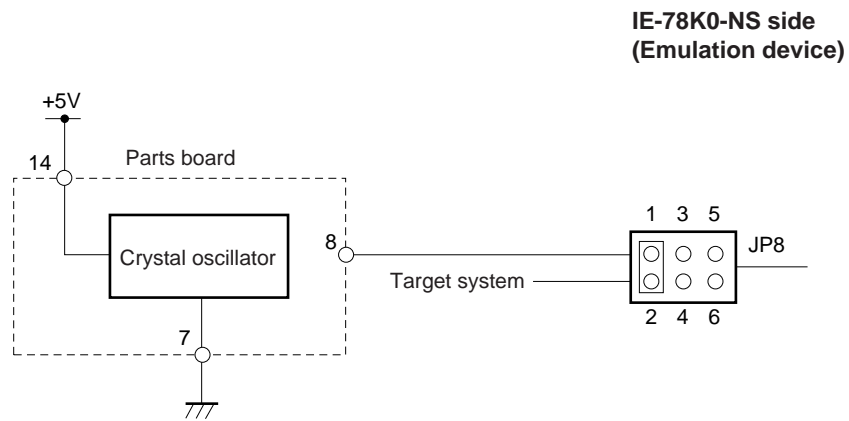
Remarks 1. The section enclosed in broken lines indicates parts that are attached to the parts board.
　　　　　2. Jumper JP8 is in the IE-78K0-NS.

(3) When using an external clock
　　Short pins 3 and 4 on the IE-78K0-NS's jumper (JP8). There is no need to make any settings via the integrated debugger (ID78K0-NS).

3.3 External Trigger

To set up an external trigger, connect the IE-780018-NS-EM1's check pin, EXTOUT, and EXTIN as shown below.

See the in-circuit emulator (IE-78K0-NS) User's Manual and integrated debugger (ID78K0-NS) User's Manual for description of related use methods and pin characteristics.

Figure 3-11. External Trigger Input Position
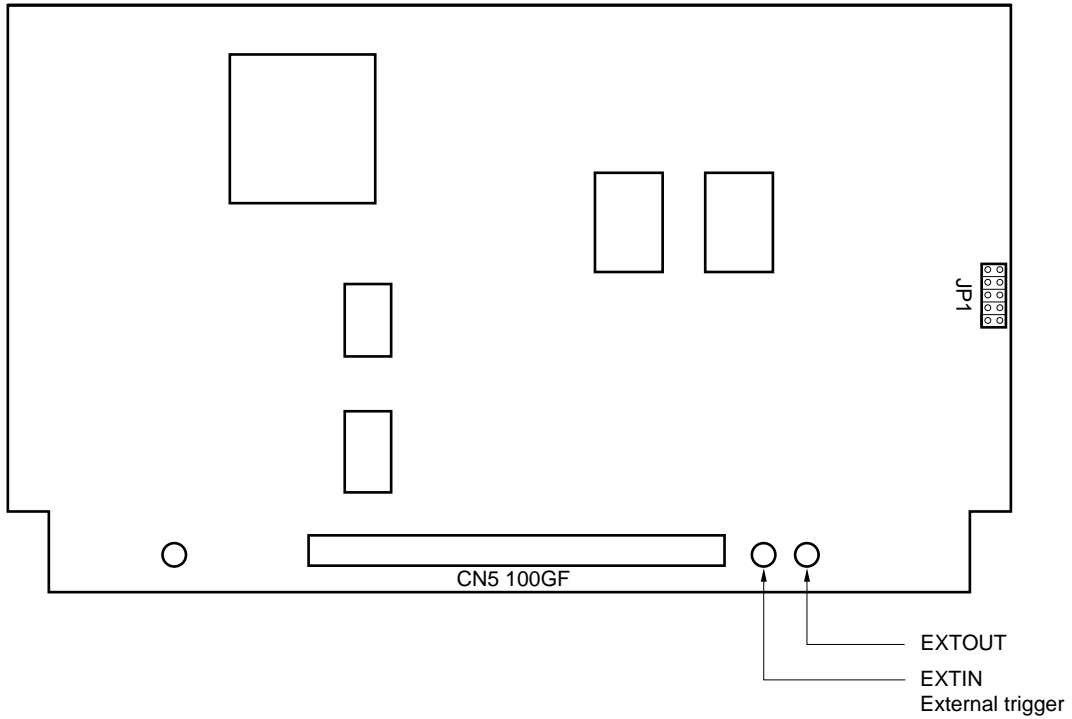
3.4 Jumper Settings

3.4.1 Jumper settings on IE-78K0-NS

When using the IE-780018-NS-EM1, set the jumpers on the IE-78K0-NS as shown below. For details of these jumper settings, see the **IE-78K0-NS's User's Manual (U13731E)**.

Table 3-3. Jumper Settings on IE-78K0-NS

	JP2	JP3	JP4	JP6	JP7	JP8
Short	2-3	1-2	1-2	3-4	5-6	1-2

Caution   For the setting of JP8, see Table 3-2 Subsystem Clock Settings.

3.4.2 Jumper settings on IE-780018-NS-EM1

Set the jumper on the IE-780018-NS-EM1 as shown below.

Table 3-4. Jumper Settings on IE-780018-NS-EM1

	JP1
Short	None

CHAPTER 4 DIFFERENCES AMONG TARGET DEVICES AND TARGET INTERFACE CIRCUITS

This chapter describes differences between the target device's signal lines and the signal lines of the IE-780018-NS-EM1's target interface circuit.

Although the target device is a CMOS circuit, the IE-780018-NS-EM1's target interface circuit consists of an emulation chip, TTL, CMOS-IC, and other components.

When connected the IE system with the target system for debugging, the IE system performs emulation so as to operate as the actual target device would operate on 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 μPD780009 emulation CPU
(2) Signals input to or output from the μPD78P0018AY emulation CPU
(3) Signals input to or output from the μPD78P054 emulation CPU
(4) Other signals

The IE system's circuit is used as follows for signals listed in (1) to (4) above.

(1) Signals input to or output from the μPD780009 emulation CPU
- Signals related to port 4
- Signals related to port 5
- Signals related to port 6

(2) Signals input to or output from the μPD78P0018AY emulation CPU
- Signals related to port 8
- Signals related to port 9
- Signals related to port 10
- Signals related to port 11
- Signals related to port 15

(3) Signals input to or output from the emulation CPU and the μPD78P054
- Signals related to port 0
- Signals related to port 2
- Signals related to port 3
- Signals related to port 1
- AV_{DD}, AV_{REF}, AV_{SS}

(4) Other signals
- V_{DD0}, V_{DD1}, V_{SS0}, V_{SS1}, X1, X2, XT1, XT2, $\overline{RESET}$, IC

Figure 4-1. Equivalent Circuit 1 from Emulation Circuit
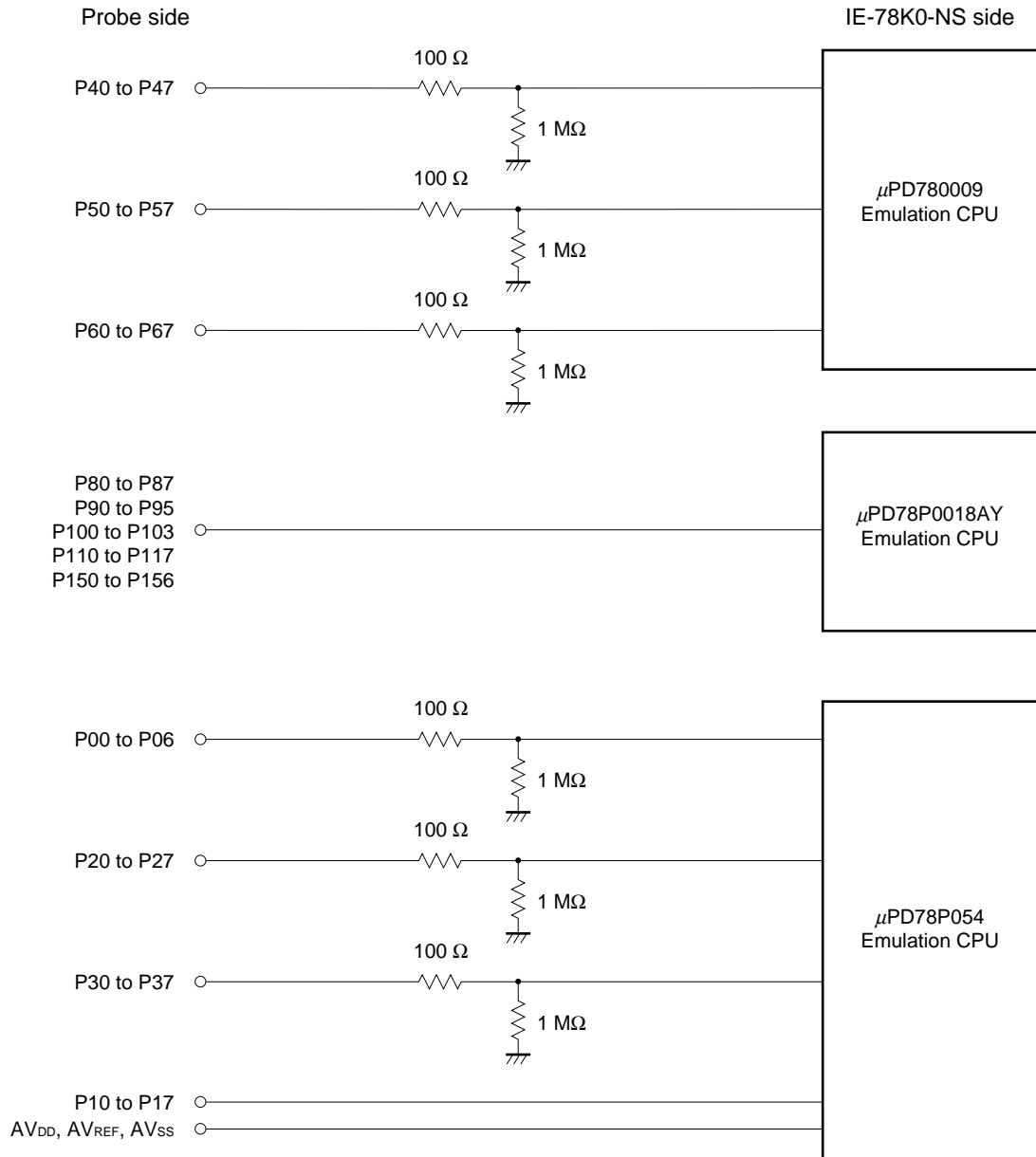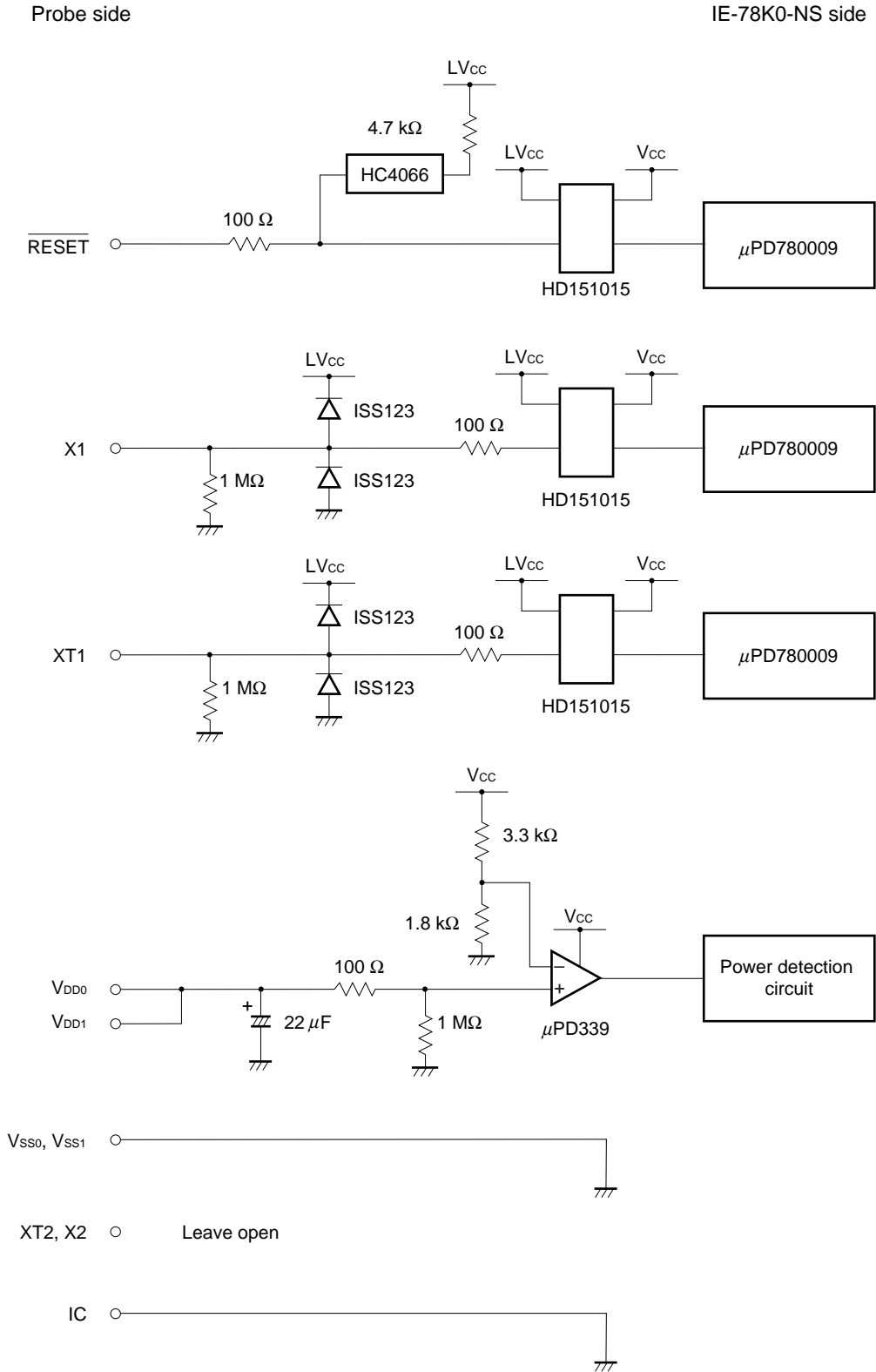
Figure 4-2. Equivalent Circuit 2 from Emulation Circuit

[MEMO]

APPENDIX   EMULATION PROBE PIN ASSIGNMENT TABLE

Table A-1. NP-100GF Pin Assignments (1/2)

Emulation Probe	CN5 Pin No.	Emulation Probe	CN5 Pin No.
1	116	26	86
2	115	27	89
3	87	28	90
4	88	29	118
5	83	30	117
6	84	31	114
7	77	32	113
8	78	33	108
9	73	34	107
10	74	35	104
11	69	36	103
12	70	37	100
13	63	38	99
14	64	39	94
15	61	40	93
16	62	41	30
17	65	42	29
18	66	43	24
19	71	44	23
20	72	45	20
21	75	46	19
22	76	47	16
23	79	48	15
24	80	49	10
25	85	50	9

Remarks 1. The NP-100GF is a product of Naito Densei Machidaseisakusho 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 Pin Assignments (2/2)

Emulation Probe	CN5 Pin No.	Emulation Probe	CN5 Pin No.
51	6	76	36
52	5	77	31
53	33	78	32
54	34	79	4
55	37	80	3
56	38	81	8
57	43	82	7
58	44	83	14
59	47	84	13
60	48	85	18
61	51	86	17
62	52	87	22
63	57	88	21
64	58	89	28
65	59	90	27
66	60	91	92
67	55	92	91
68	56	93	98
69	49	94	97
70	50	95	102
71	45	96	101
72	46	97	106
73	41	98	105
74	42	99	112
75	35	100	111

Remarks 1. The NP-100GF is a product of Naito Densei Machidaseisakusho Co., Ltd.
2. The numbers in the "Emulation probe" column indicate the corresponding pin number on the emulation probe tip.

[MEMO]

[MEMO]

NEC

Facsimile Message

From:

_____
Name

_____
Company

_____
Tel.   FAX

_____
Address

Although NEC has taken all possible steps to ensure that the documentation supplied to our customers is complete, bug free and up-to-date, we readily accept that errors may occur. Despite all the care and precautions we've taken, you may encounter problems in the documentation. Please complete this form whenever you'd like to report errors or suggest improvements to us.

Thank you for your kind support.

North America NEC Electronics Inc. Corporate Communications Dept. Fax: 1-800-729-9288 1-408-588-6130	**Hong Kong, Philippines, Oceania** NEC Electronics Hong Kong Ltd. Fax: +852-2886-9022/9044	**Asian Nations except Philippines** NEC Electronics Singapore Pte. Ltd. Fax: +65-250-3583
Europe NEC Electronics (Europe) GmbH Technical Documentation Dept. Fax: +49-211-6503-274	**Korea** NEC Electronics Hong Kong Ltd. Seoul Branch Fax: 02-528-4411	**Japan** NEC Semiconductor Technical Hotline Fax: 044-548-7900
South America NEC do Brasil S.A. Fax: +55-11-6465-6829	**Taiwan** NEC Electronics Taiwan Ltd. Fax: 02-2719-5951	

I would like to report the following error/make the following suggestion:

Document title: _____

Document number: _____ Page number: _____

_____

_____

_____

If possible, please fax the referenced page or drawing.

Document Rating	Excellent	Good	Acceptable	Poor
Clarity	❏	❏	❏	❏
Technical Accuracy	❏	❏	❏	❏
Organization	❏	❏	❏	❏

CS 99.1