

**User's Manual**

**NEC**

# **IE-780018-NS-EM1**

**Emulation Board**

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**Target device**

**$\mu$ PD780018AY Subseries**

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## **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.**

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Tel: 01908-691-133  
Fax: 01908-670-290

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Milano, Italy  
Tel: 02-66 75 41  
Fax: 02-66 75 42 99

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Benelux Office  
Eindhoven, The Netherlands  
Tel: 040-2445845  
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Velizy-Villacoublay, France  
Tel: 01-30-67 58 00  
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Fax: 91-504-2860

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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

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## 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.

- $\mu$ PD780018AY Subseries :  $\mu$ PD780016AY, 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.

<b>IE-78K0-NS User's Manual</b>
-------------------------------------

- Basic specifications
- System configuration
- External interface functions

<b>IE-780018-NS-EM1 User's Manual</b>
---

- 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 $\mu$ PD780018AY 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
$\mu$ PD780018AY 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.

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## 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.

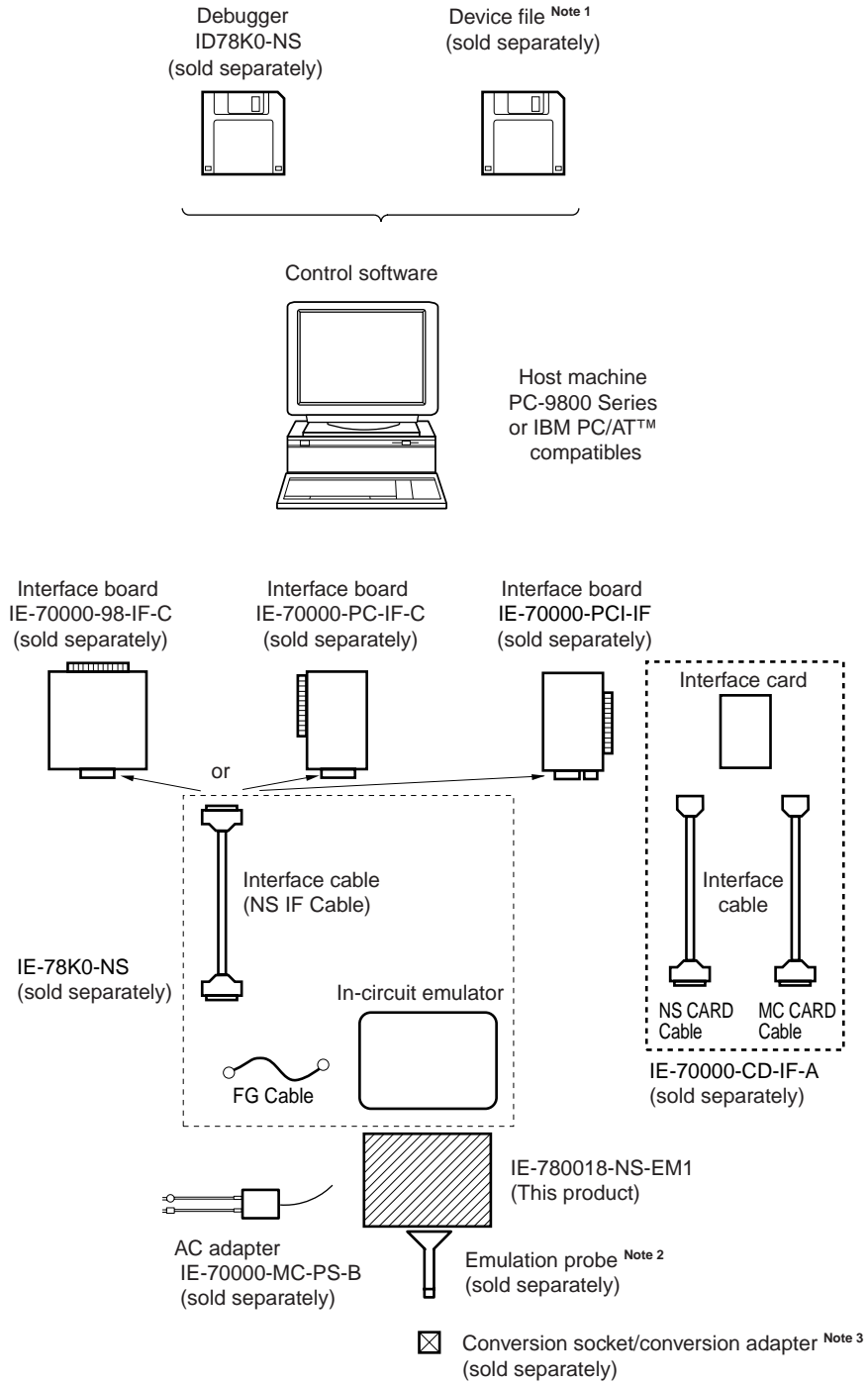
This chapter describes the IE-780018-NS-EM1's system configuration and basic specifications.

- Target device
  - $\mu$ PD780018AY 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.

$\mu$  SxxxxDF780018:  $\mu$  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 Densai Machidaseisakusho Co., Ltd.

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

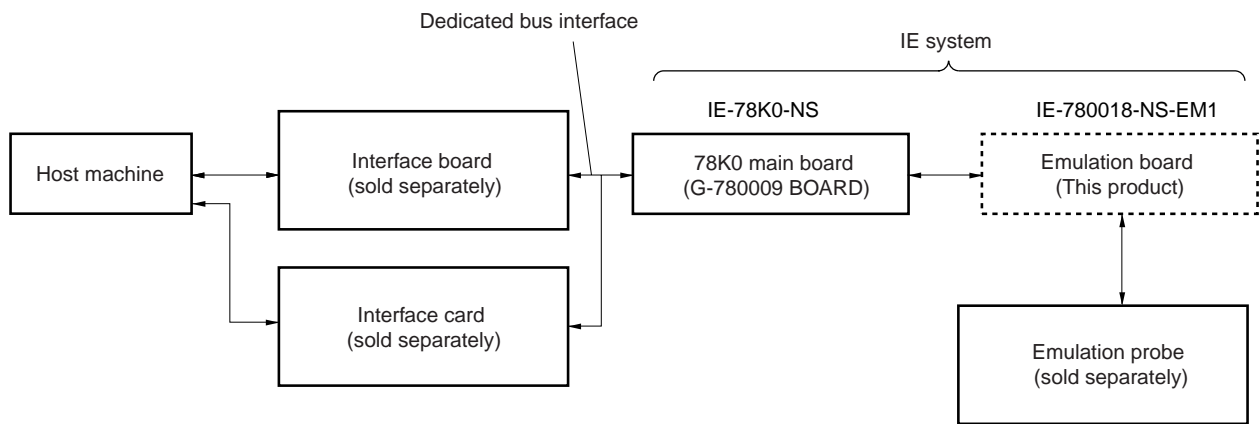
3. The conversion socket is as follows, in accordance with the package.

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	$\mu$ PD780018AY 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)

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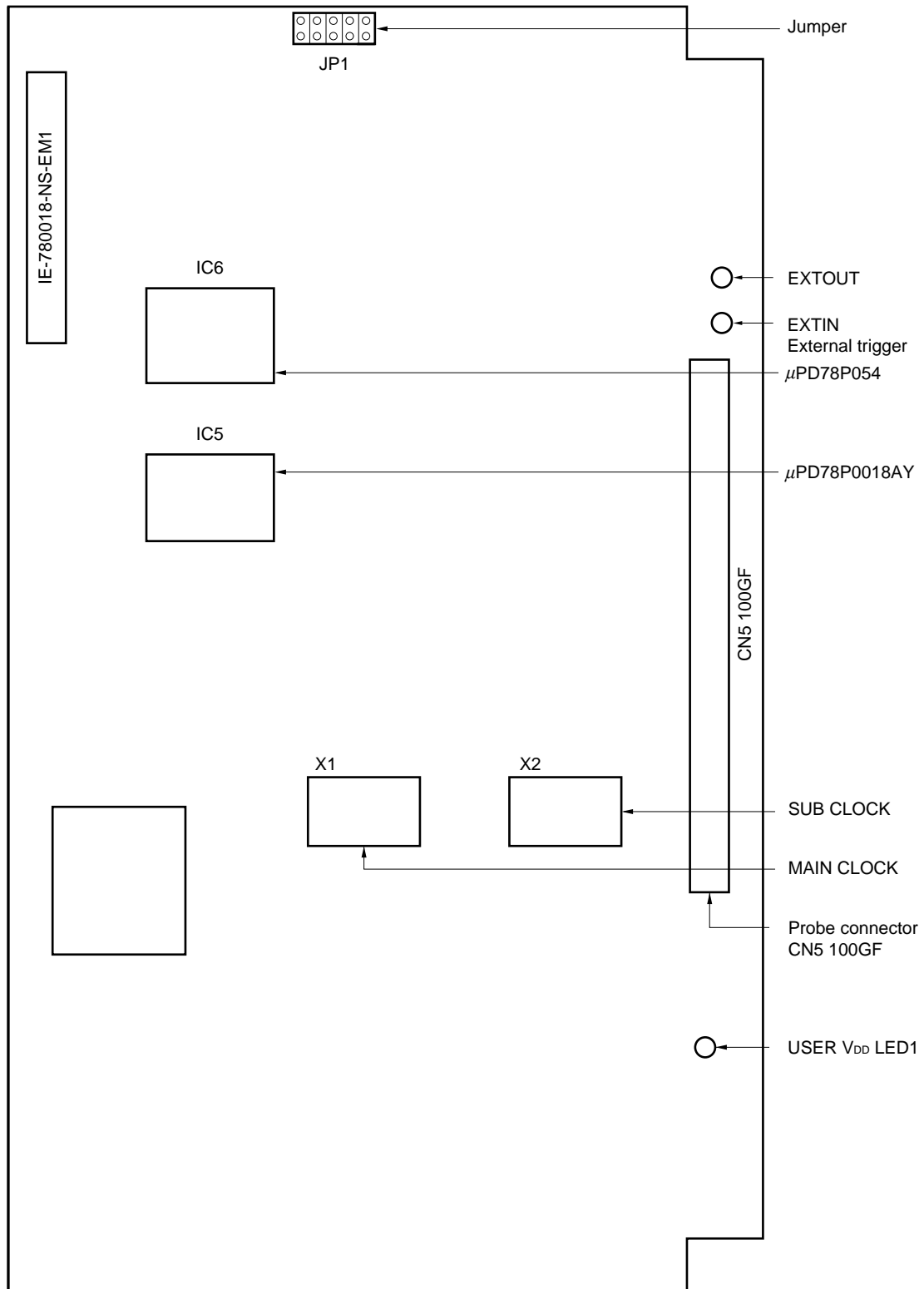


## CHAPTER 2 PART NAMES

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.

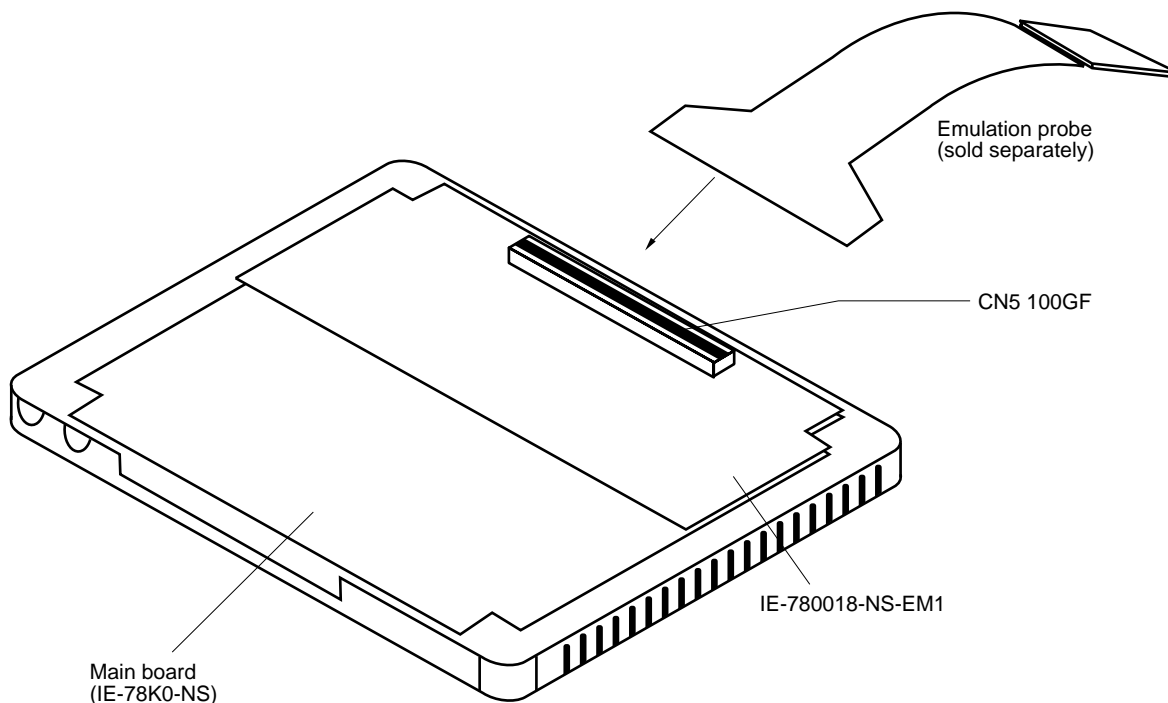
(2) Connection with emulation probe

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



## 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.

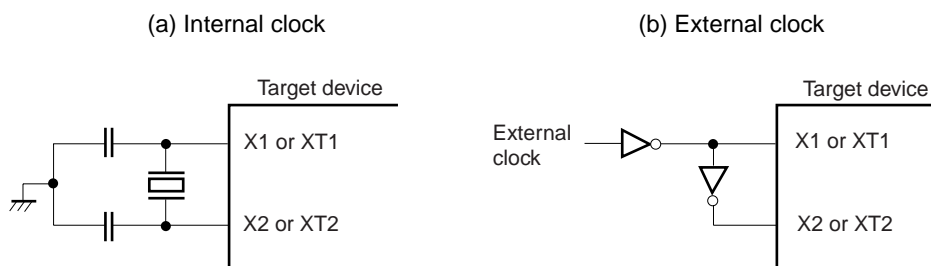
- (1) Clock that is already mounted on emulation board
- (2) Clock that is mounted by user
- (3) External clock

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.

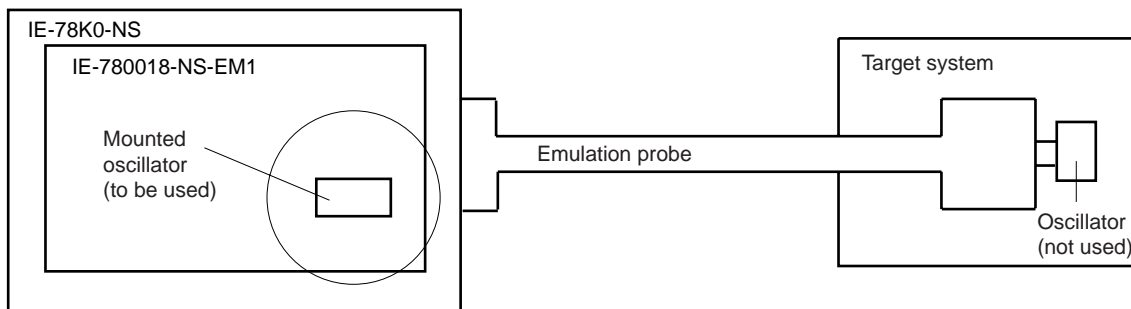
**Figure 3-2. External Circuits Used as System Clock Oscillation Circuit**



## (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**

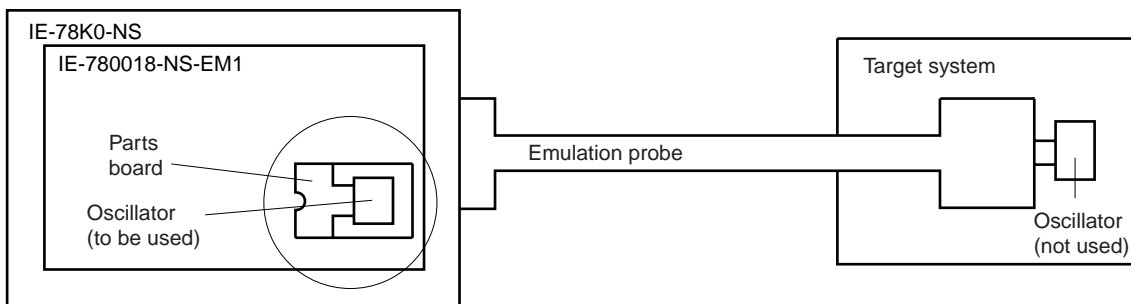


**Remark** The clock that is supplied by the IE-780018-NS-EM1's oscillator (encircled in the figure) is used.

## (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**

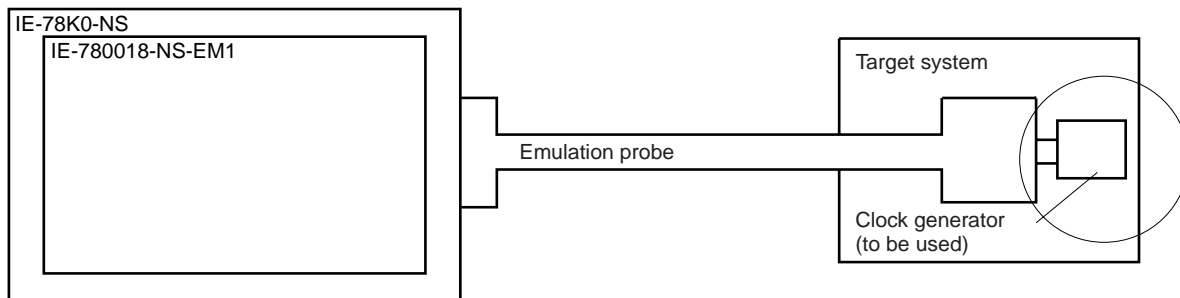


**Remark** The clock that is supplied by the IE-780018-NS-EM1's oscillator (encircled in the figure) is used.

(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 Selection (ID)
		Parts board (X1)	
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

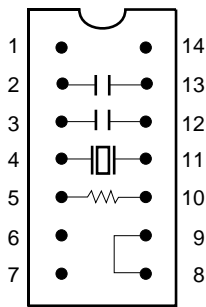
- Parts board (supplied with IE-78K0-NS)
- Ceramic oscillator or crystal resonator
- Resistor Rx
- Capacitor CA
- Capacitor CB
- Solder kit

<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).

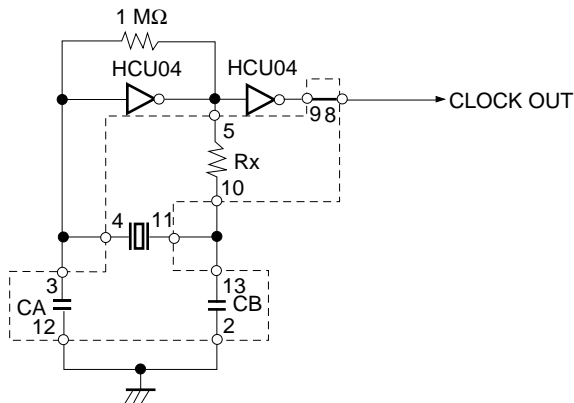
**Figure 3-6. Connections on Parts Board (When Using Main System Clock or User-Mounted Clock)**

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

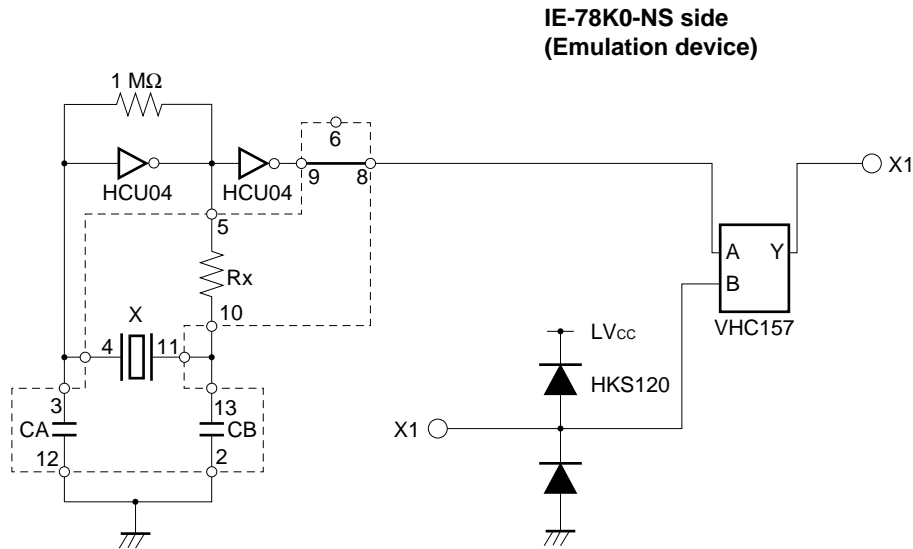


**Remark** The sections enclosed in broken lines indicate parts that are attached to the parts board.



- <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.

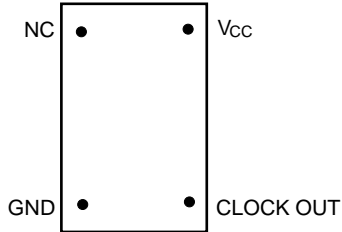


**Remark** The sections enclosed in broken lines indicate parts that are attached to the parts board.

(b) When using a crystal oscillator

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

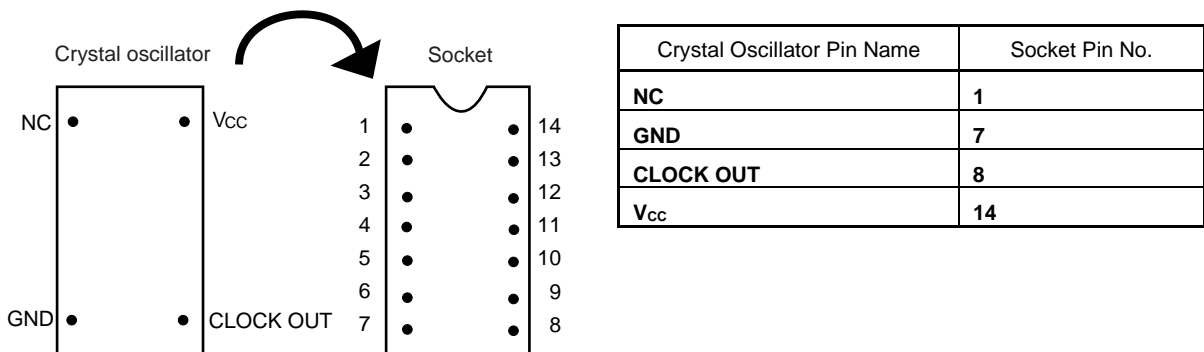
**Figure 3-7. Crystal Oscillator (When Using Main System Clock or User-mounted Clock)**



<Steps>

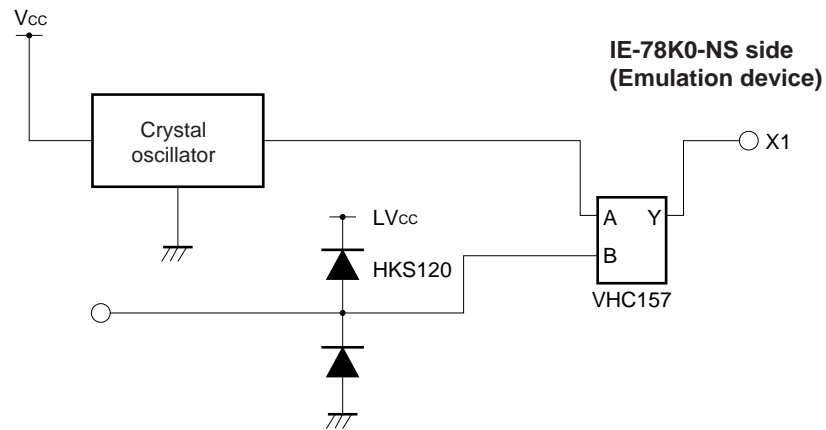
- <1> Prepare the IE-780018-NS-EM1.
- <2> Remove the crystal oscillator that is mounted in the IE-780018-NS-EM1's socket (the socket marked as "X1").
- <3> Connect the parts board (from <2> above) to the socket (X1) from which the crystal oscillator was removed. Insert the crystal oscillator into the socket so as to align the pins as shown in the figure below.

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



- <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

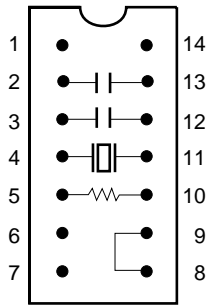
- Parts board (supplied with IE-78K0-NS)
- Ceramic oscillator or crystal resonator
- Resistor Rx
- Capacitor CA
- Capacitor CB
- Solder kit

## &lt;Steps&gt;

<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).

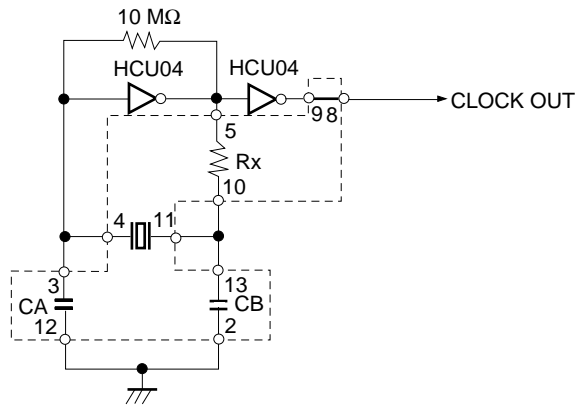
Figure 3-9. Connections on Parts Board (When Using Subsystem Clock or User-Mounted Clock)

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

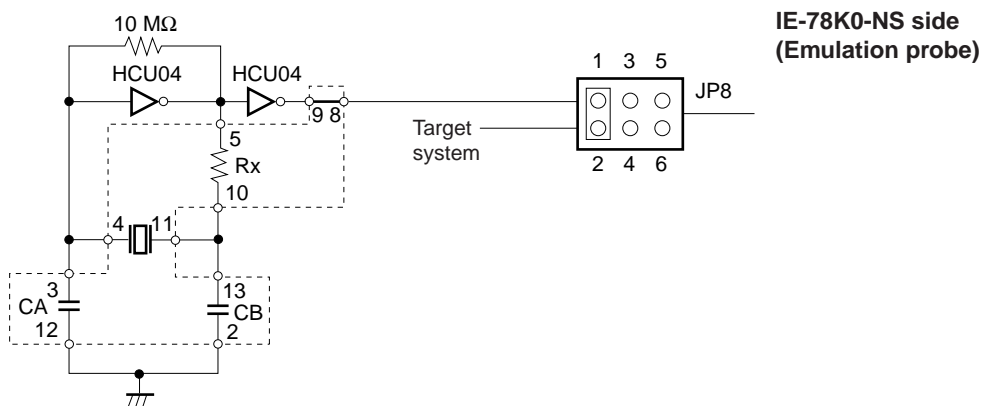
Circuit diagram



**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.

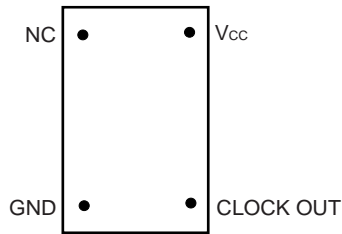


- Remarks**
1. The section enclosed in broken lines indicates parts that are attached to the parts board.
  2. Jumper JP8 is in the IE-78K0-NS.

(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)**

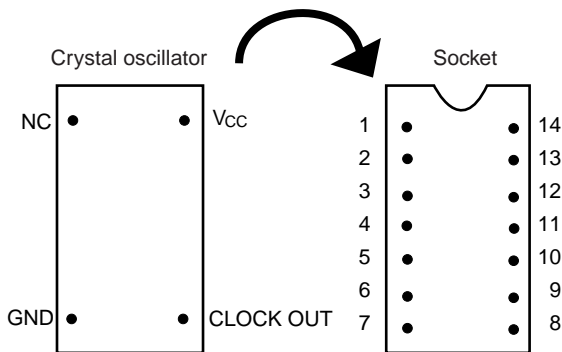


<Steps>

<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").

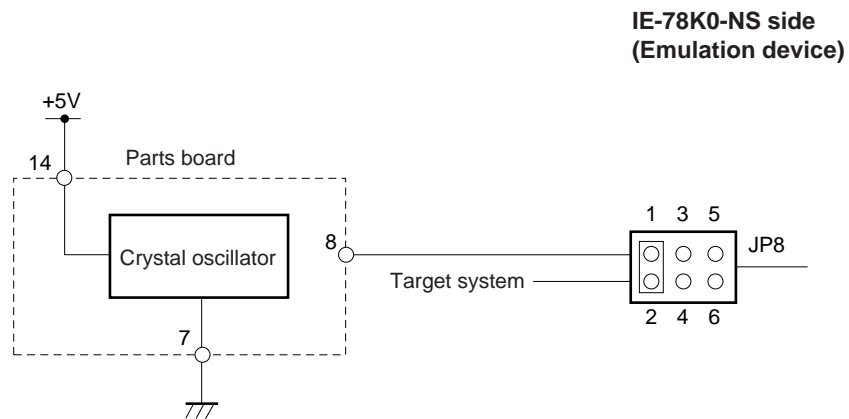
<3> Connect the parts board (from <2> above) to the socket (X2) from which the crystal oscillator was removed. Insert the crystal oscillator into the socket so as to align the pins as shown below.



Crystal Oscillator Pin Name	Socket Pin No.
NC	1
GND	7
CLOCK OUT	8
V <sub>cc</sub>	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.



- 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).

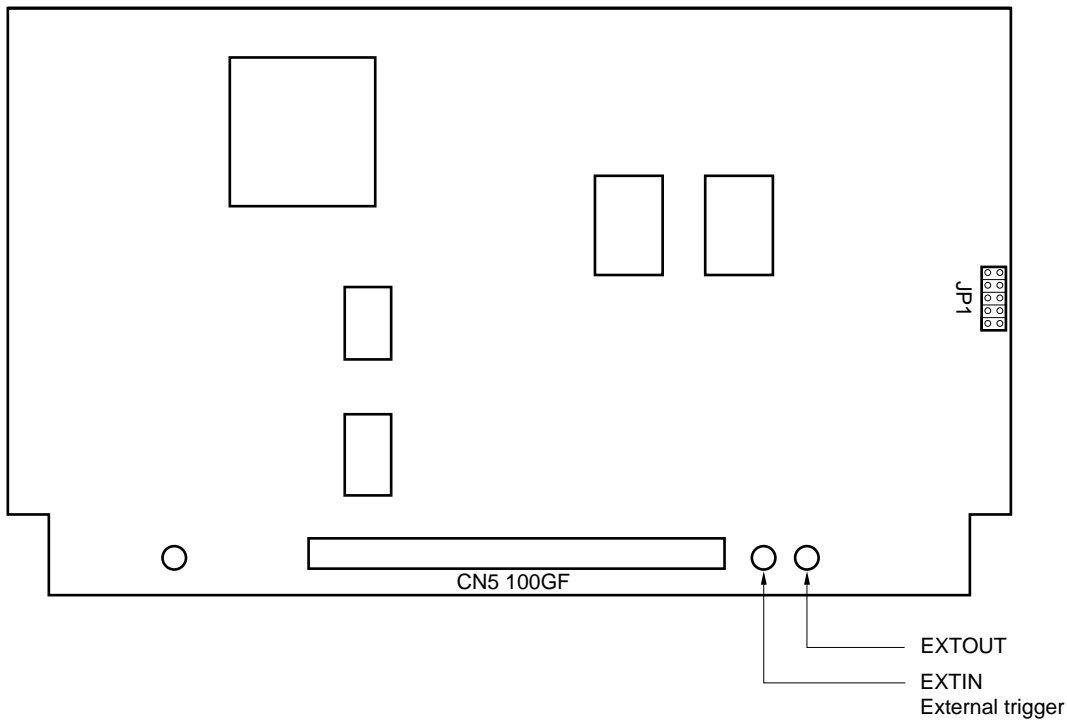


### 3.3 External Trigger

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  $\mu$ PD780009 emulation CPU
- (2) Signals input to or output from the  $\mu$ PD78P0018AY emulation CPU
- (3) Signals input to or output from the  $\mu$ PD78P054 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  $\mu$ PD780009 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  $\mu$ PD78P0018AY 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  $\mu$ PD78P054
  - 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

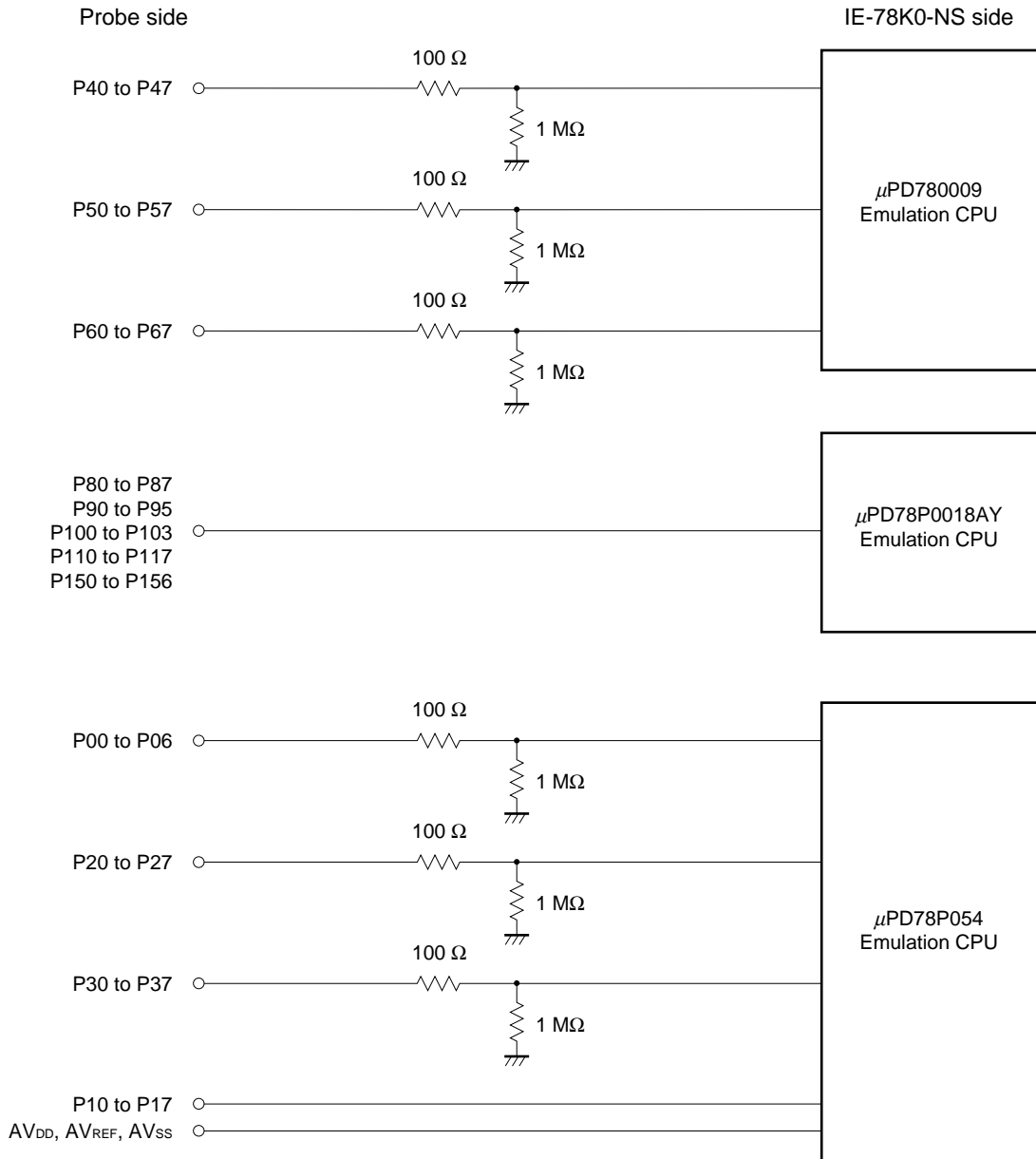
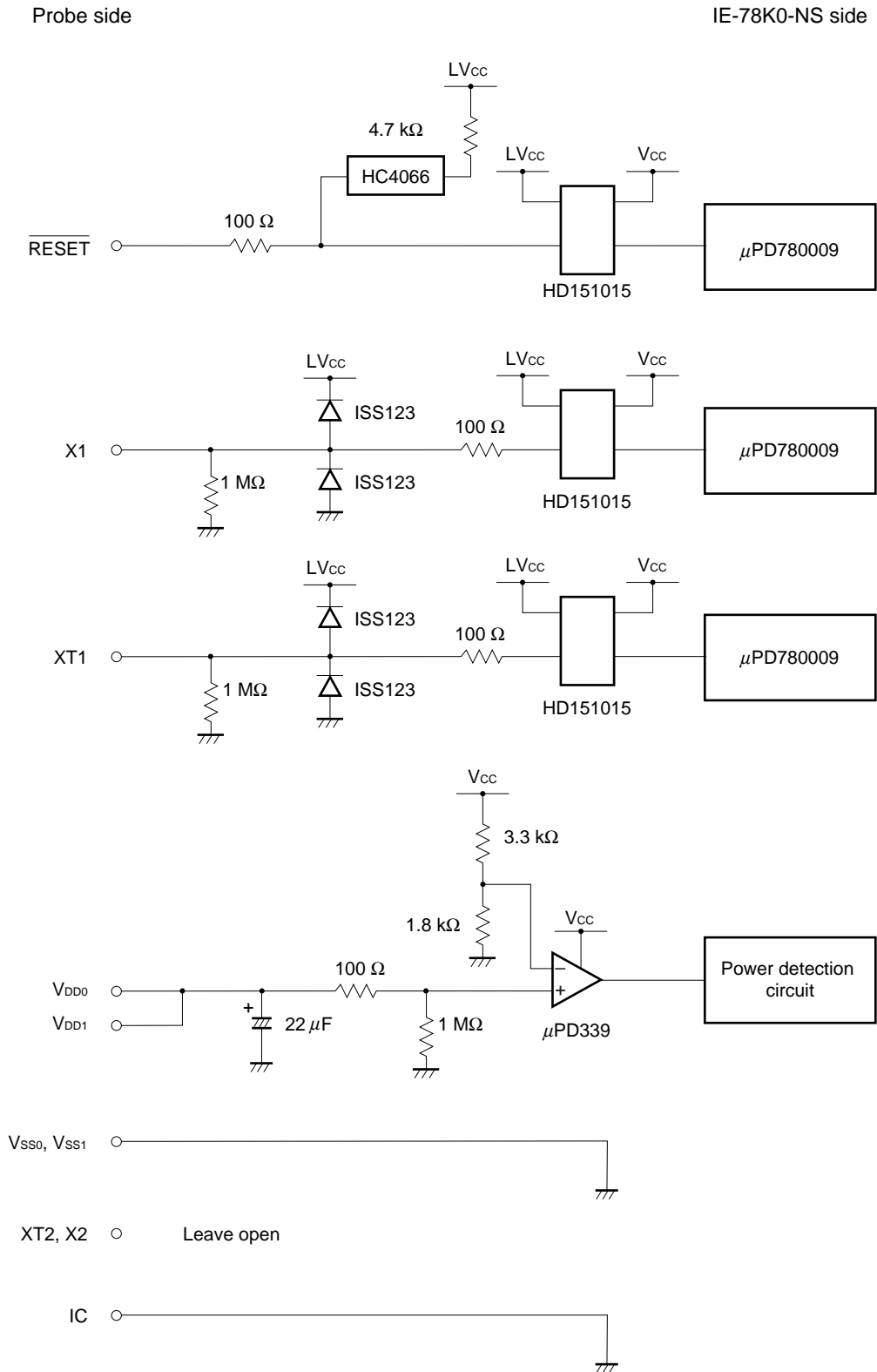


Figure 4-2. Equivalent Circuit 2 from Emulation Circuit



**[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 Densai 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 Densai Machidaseisakusho Co., Ltd.
  2. The numbers in the "Emulation probe" column indicate the corresponding pin number on the emulation probe tip.



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