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User's Manual

IE-784038-NS-EM1

Emulation Board

Target device

μPD784038 Subseries μPD784038Y Subseries

Document No. U13760EJ1V0UM00 (1st edition)
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- Availability of related technical literature
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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
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Tel: 01-30-67 58 00
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NEC Electronics Hong Kong Ltd.
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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-784038-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.

- μPD784038 Subseries: μPD784031, 784035, 784036, 784037, 784038, 78P4038
- μPD784038Y Subseries: μPD784031Y, 784035Y, 784036Y, 784037Y, 784038Y, 78P4038Y

Target Readers

This manual is intended for engineers who will use the IE-784038-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-784038-NS-EM1, refer to not only this manual (supplied with the IE-784038-NS-EM1) but also the manual that is supplied with the IE-78K4-NS.

IE-78K4-NS User's Manual	IE-784038-NS-EM1 User's Manual
• Basic specifications • System configuration • External interface functions	• 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-784038-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 (a real chip) that is the target for emulation.
Target system	The device that is targeted for debugging. 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-78K4-NS and the IE-784038-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	
	English	Japanese
IE-78K4-NS	U13356E	U13356J
IE-784038-NS-EM1	This manual	U13760J
ID78K4-NS Integrated Debugger Reference Windows™ Based	U12796E	U12796J
μPD784038, 784038Y, Subseries Hardware	U11316E	U11316J

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

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[MEMO]

CHAPTER 1 GENERAL

The IE-784038-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.

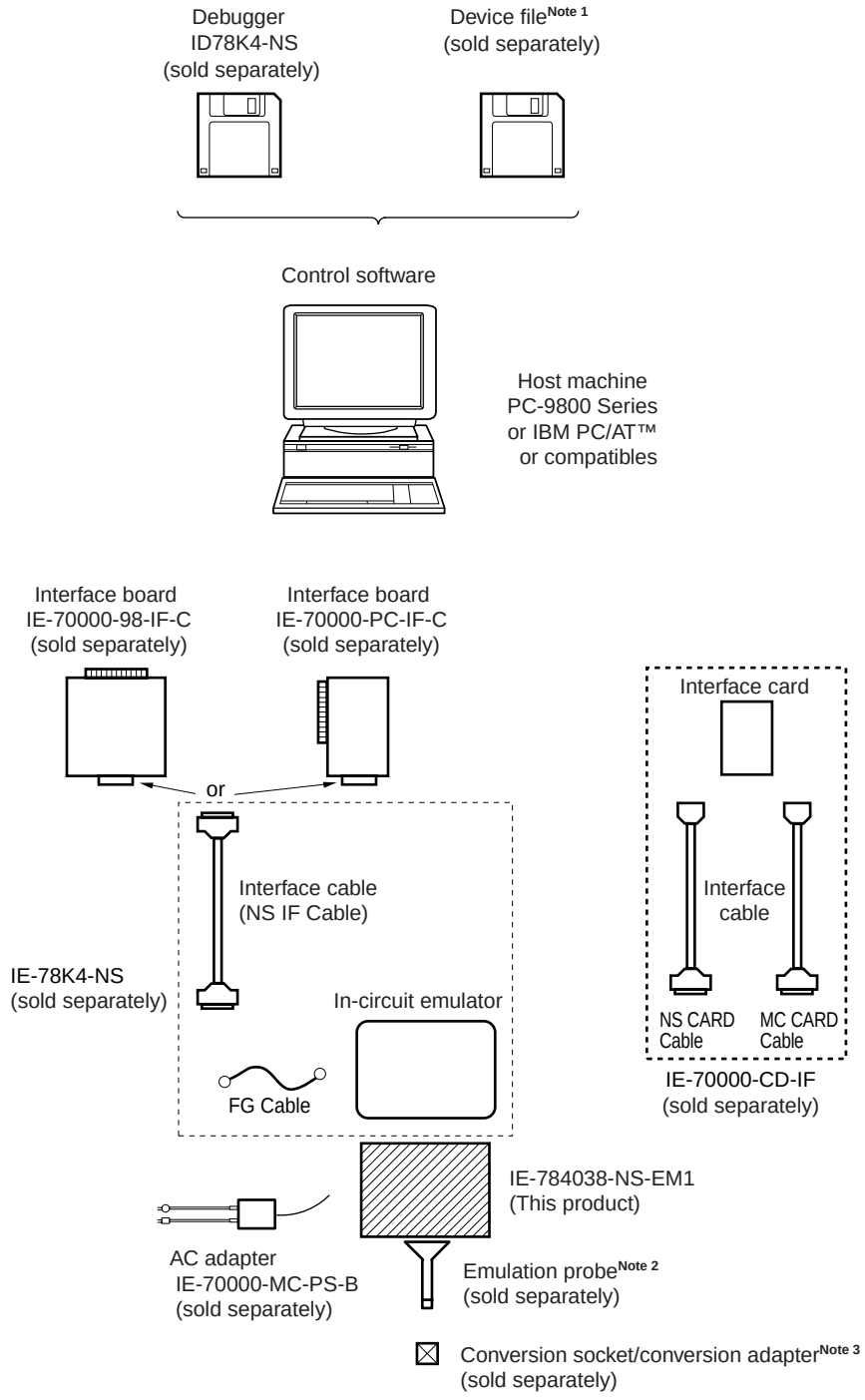
This chapter describes the IE-784038-NS-EM1's system configuration and basic specifications.

- Target device
  - μPD784038 Subseries
  - μPD784038Y Subseries

1.1 System Configuration

Figure 1-1 illustrates the IE-784038-NS-EM1's system configuration.

Figure 1-1. System Configuration



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

μS××××DF784038: μPD784038, 784038Y Subseries

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

NP-80GC: 80-pin plastic QFP (GC type)

NP-80GK: 80-pin plastic TQFP (GK type)

The NP-80GC/GK are products of Naito Densei Machida Mfg. Co., Ltd.

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

3. The conversion socket/conversion adapter are as follows, in accordance with the package.

EV-9200GC-80: 80-pin plastic QFP (GC type)

TGK-080SDW: 80-pin plastic TQFP (GK type)

The TGK-080SDW is a product of TOKYO ELETECH CORPORATION.

For further information, contact to Daimaru Kogyo Co., Ltd.

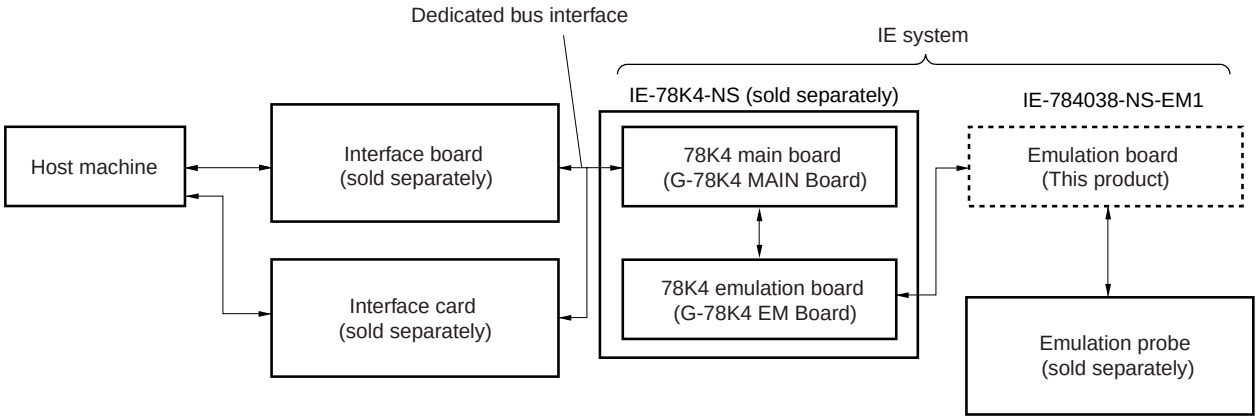
Tokyo Electronics Department (TEL: +81-3-3820-7112)

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

1.2 Hardware Configuration

Figure 1-2 shows the IE-784038-NS-EM1's position in the basic hardware configuration.

Figure 1-2. Basic Hardware Configuration



1.3 Basic Specifications

The IE-784038-NS-EM1's basic specifications are listed in Table 1-1.

Table 1-1. Basic Specifications

Parameter	Description
Target device	μPD784038, 784038Y Subseries
System clock	16.0 MHz
Main system clock supply	External: Input via an emulation probe from the target system Internal: Mounted on emulation board (32 MHz), or mounted on the board by the user
Low-voltage support	2 V or higher (same as target device)

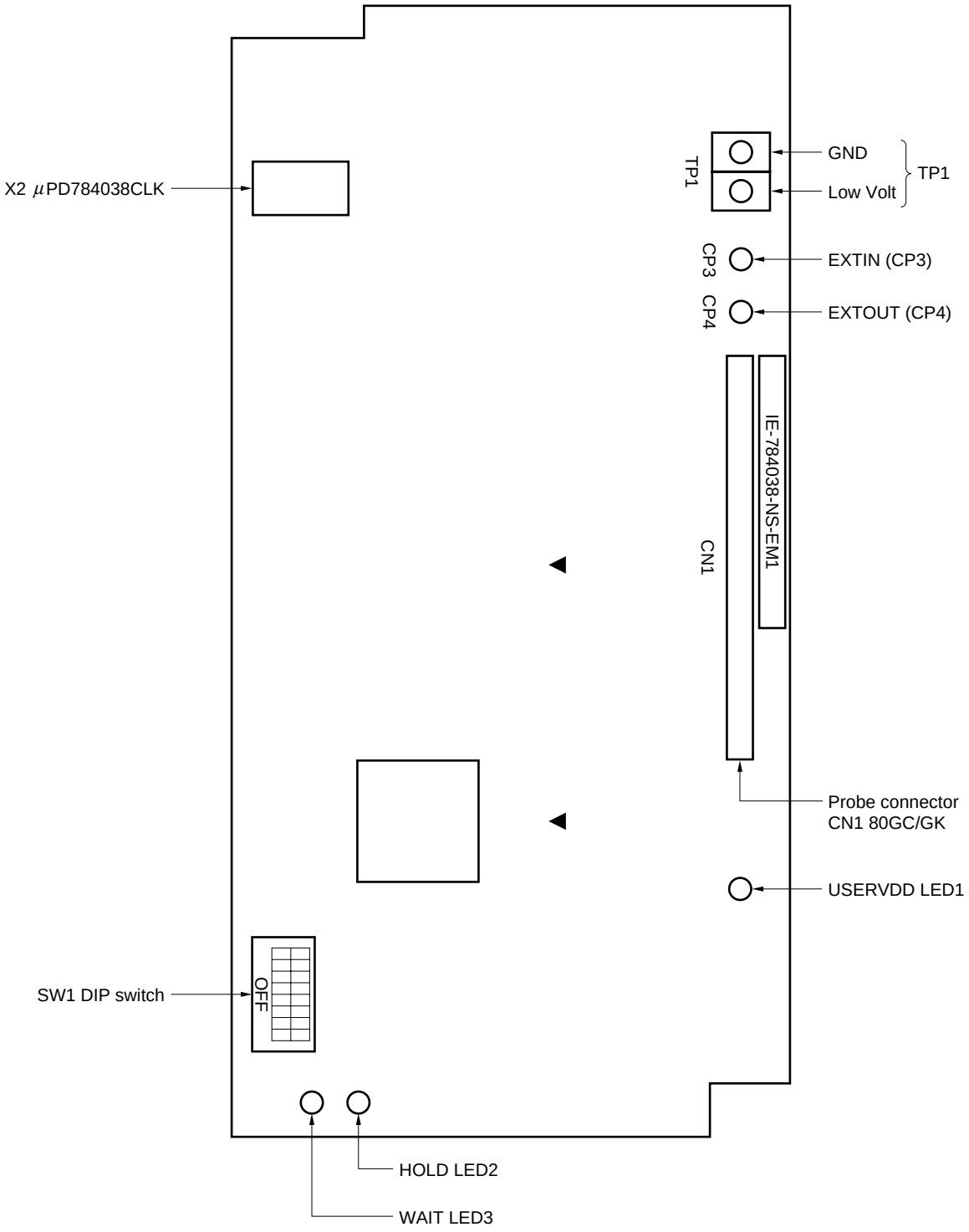
[MEMO]

CHAPTER 2 PART NAMES

This chapter introduces the parts of the IE-784038-NS-EM1 main unit.
The packing box contains the emulation board (IE-784038-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-784038-NS-EM1 Part Names



CHAPTER 3 INSTALLATION

This chapter describes methods for connecting the IE-784038-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-784038-NS-EM1 to the IE-78K4-NS.

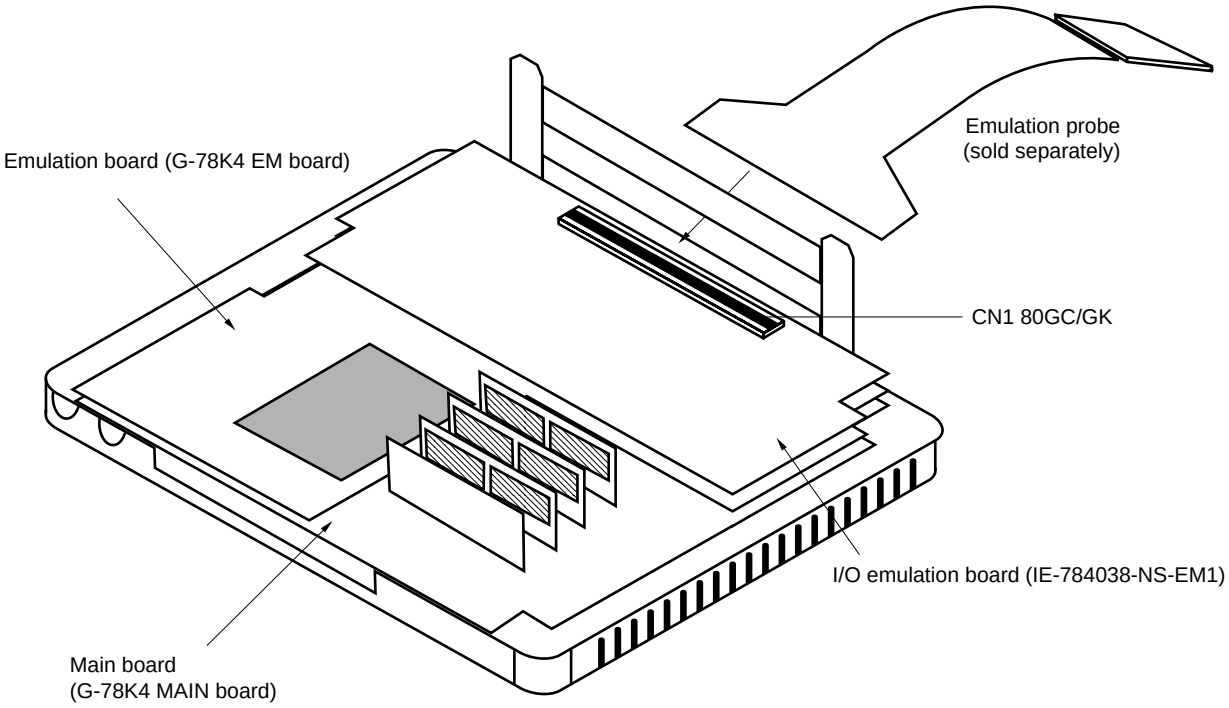
(2) Connection with emulation probe

See the IE-78K4-NS User's Manual (U13356E) for a description of how to connect an emulation probe to the IE-784038-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.

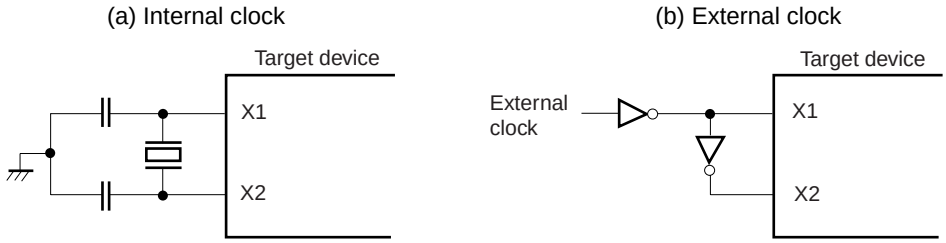
(1) Clock that is already mounted on emulation board
(2) Clock that is mounted by user
(3) External clock

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, it uses the clock that is mounted on the emulation board, which is installed for the IE-78K4-NS.

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.

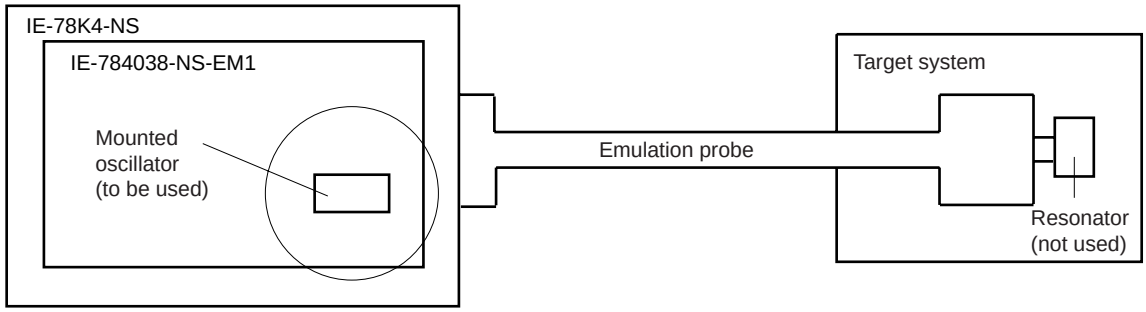
Figure 3-2. External Circuits Used as System Clock Oscillator



(1) Clock that is already mounted on emulation board

A crystal oscillator is already mounted on the emulation board. Its frequency is 32 MHz.

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

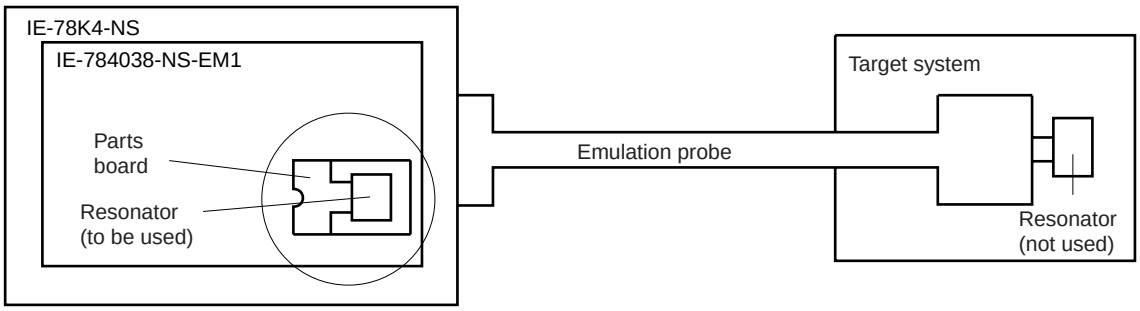


Remark The clock that is supplied by the IE-784038-NS-EM1's oscillator (encircled in the figure) is used.

(2) Clock that is mounted by user

The user is able to mount any clock supported by the set specifications on the IE-784038-NS-EM1. First mount the resonator on the parts board, then attach the parts board to the IE-784038-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

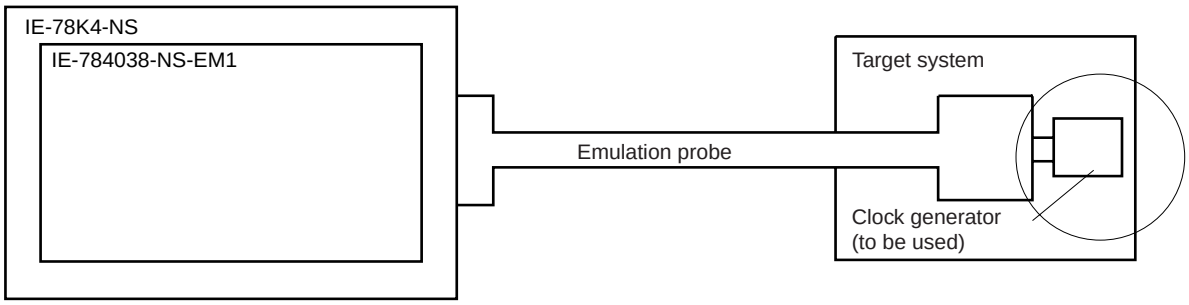


Remark The clock that is supplied by the IE-784038-NS-EM1's resonator (encircled in the figure) is used.

(3) External clock

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

Figure 3-5. When Using 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-784038-NS-EM1 Parts Board (X2)	CPU Clock Source Selection (ID)
When using clock that is already mounted on emulation board	32 MHz	Oscillator used	Internal
When using clock mounted by user	Other than 32 MHz	Oscillator assembled by user	
When using external clock		Oscillator not used	External

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-784038-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-784038-NS-EM1 is shipped, a 32-MHz crystal oscillator is already mounted in the IE-784038-NS-EM1's X2 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

The settings described under either (a) or (b) are required, 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

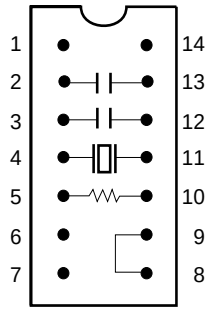
- Items to be prepared
  - Parts board (supplied with IE-78K4-NS)
  - Ceramic resonator or crystal resonator
  - Resistor Rx
  - Capacitor CA
  - Capacitor CB
  - Solder kit

<Steps>

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

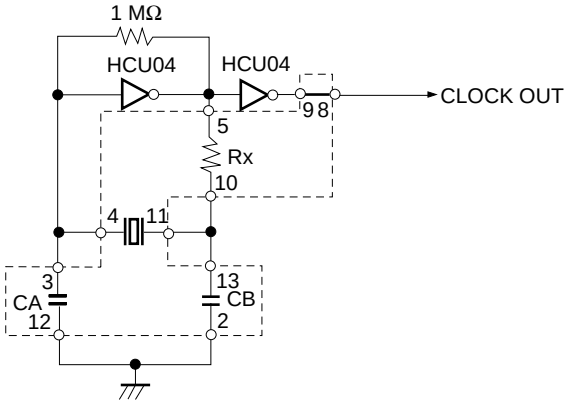
Figure 3-6. Connections on Parts Board (When Using Main System Clock or User-Mounted Clock)

Parts board (X2)



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-784038-NS-EM1.

<3> Remove the crystal oscillator that is mounted in the IE-784038-NS-EM1's socket (the socket marked as X2).

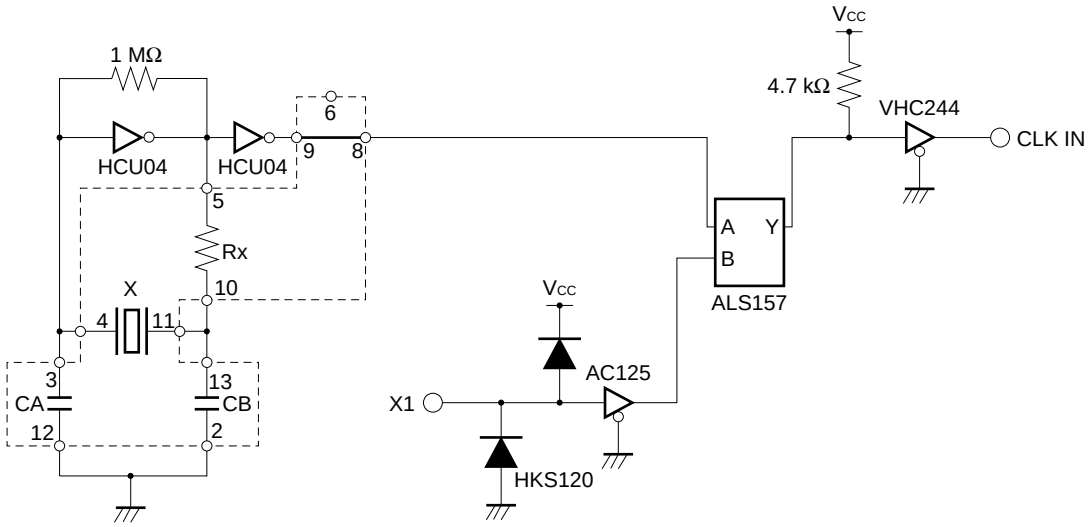
<4> Connect the parts board (from <1> above) to the socket (X2) from which the crystal oscillator was removed. Check the pin 1 mark to make sure the board is mounted in the correct direction.

<5> Make sure that the parts board mounted in the X2 socket on the emulation board is wired as shown in Figure 3-6 above.

<6> Install the IE-784038-NS-EM1 in 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.

IE-78K4-NS side
(Emulation device)

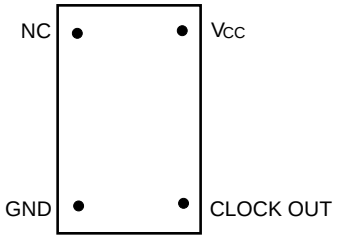


Remark The sections enclosed in broken lines indicate parts that are attached to the parts board.

(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)



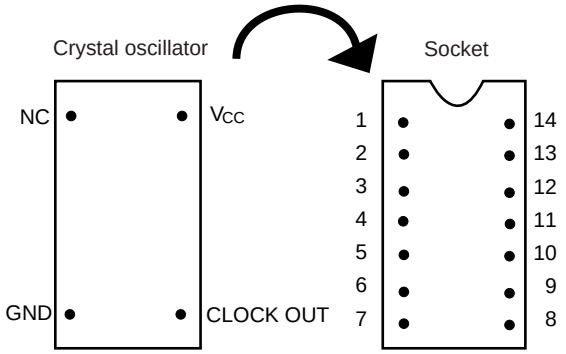
<Steps>

<1> Prepare the IE-784038-NS-EM1.

<2> Remove the crystal oscillator that is mounted in the IE-784038-NS-EM1's socket (the socket marked as X2).

<3> Connect the crystal oscillator (from <2> above) to the socket (X2) from which the crystal oscillator was removed. Insert the crystal oscillator pin into the socket aligning the pins as shown in the figure below.

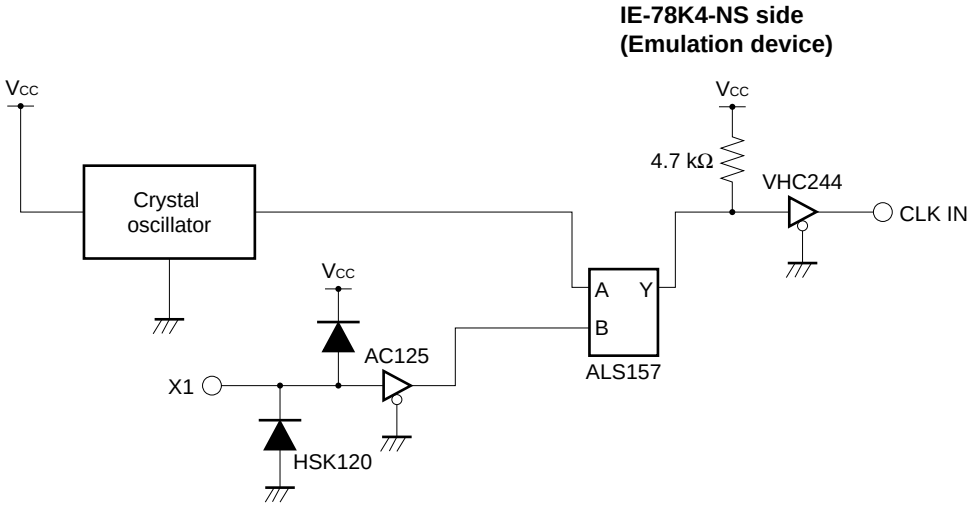
Figure 3-8. Pin Alignment of Crystal Oscillator and Socket



Crystal Oscillator Pin Name	Socket Pin No.
NC	1
GND	7
CLOCK OUT	8
V_{CC}	14

<4> Install the IE-784038-NS-EM1 in 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

No hardware settings are required for this situation.

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 Pin Mask Function Settings

3.3.1 Wait (WAIT)/hold (HOLD) mask function

By setting the DIP switch (SW1) in the IE-784038-NS-EM1, it is possible to mask the alternate function (WAIT) and (HOLD) of pin P66 in the μPD784038 Subseries.

Table 3-2. DIP Switch Setting for Wait (WAIT)/Hold (HOLD) Mask Function

Status	DIP Switch Setting		
	2 (WAITMSK)	3 (HOLDMSK)	4 (P66ON)
No mask (initial setting)	OFF	OFF	ON
Hold masked	OFF	ON	OFF
Wait masked	ON	OFF	OFF

Caution Do not set the DIP switch to settings other than those above.

3.3.2 Wait/hold display function

By setting the DIP switch (SW1) in the IE-784038-NS-EM1, it is possible to display the status of "waiting" and “holding” with an LED light.

Table 3-3. DIP Switch Setting for Wait/Hold Display Function

Status	DIP Switch Setting	
	5 (HOLDLED)	6 (WAITLED)
Hold (HOLD) status displayed, wait (WAIT) status not displayed (initial setting)	ON	OFF
Hold status not displayed, wait (WAIT) status displayed	OFF	ON

Caution When pin P66 is used as a port pin, unless the DIP switch (SW 1 to 5, 6) is turned OFF the LED may light up.

3.3.3 NMI interrupt mask function

By setting switch 1 of the DIP switch (SW1) in the IE-784038-NS-EM1, it is possible to mask the NMI interrupt, which is the alternate function of the P20 pin.

Table 3-4. DIP Switch Setting for NMI Interrupt Mask Function

Status	DIP Switch Setting
	1 (NMIMSK)
No NMI mask (initial setting)	ON
NMI masked	OFF

Caution Because the NMI interrupt is the alternate function of the P20 pin, this pin cannot operate as the P20 pin when the NMI mask status has been set.

3.4 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-784038-NS-EM1. Set the target voltage between 3 and 5 V.

- Maximum current consumption of TP1

  5 V 300 mA

  . .
  . .
  . .

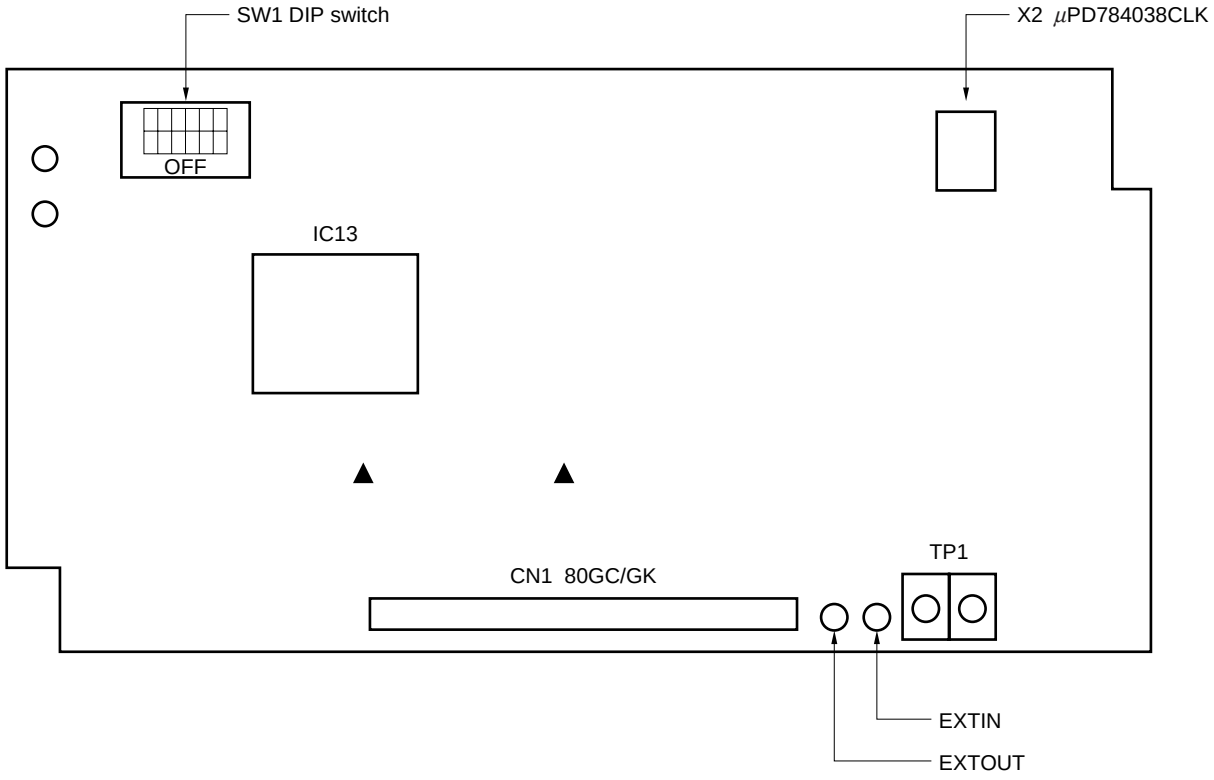
  3 V 150 mA

3.5 External Trigger

To set up an external trigger, connect it to the IE-784038-NS-EM1's check pin, EXTOUT pin, and EXTIN pin as shown below.

See the integrated debugger (ID-78K4-NS) User's Manual (U12796E) for descriptions of related use methods.

Figure 3-9. External Trigger Input Position



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-784038-NS-EM1's target interface circuit.

Although the target device is a CMOS circuit, the IE-784038-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.

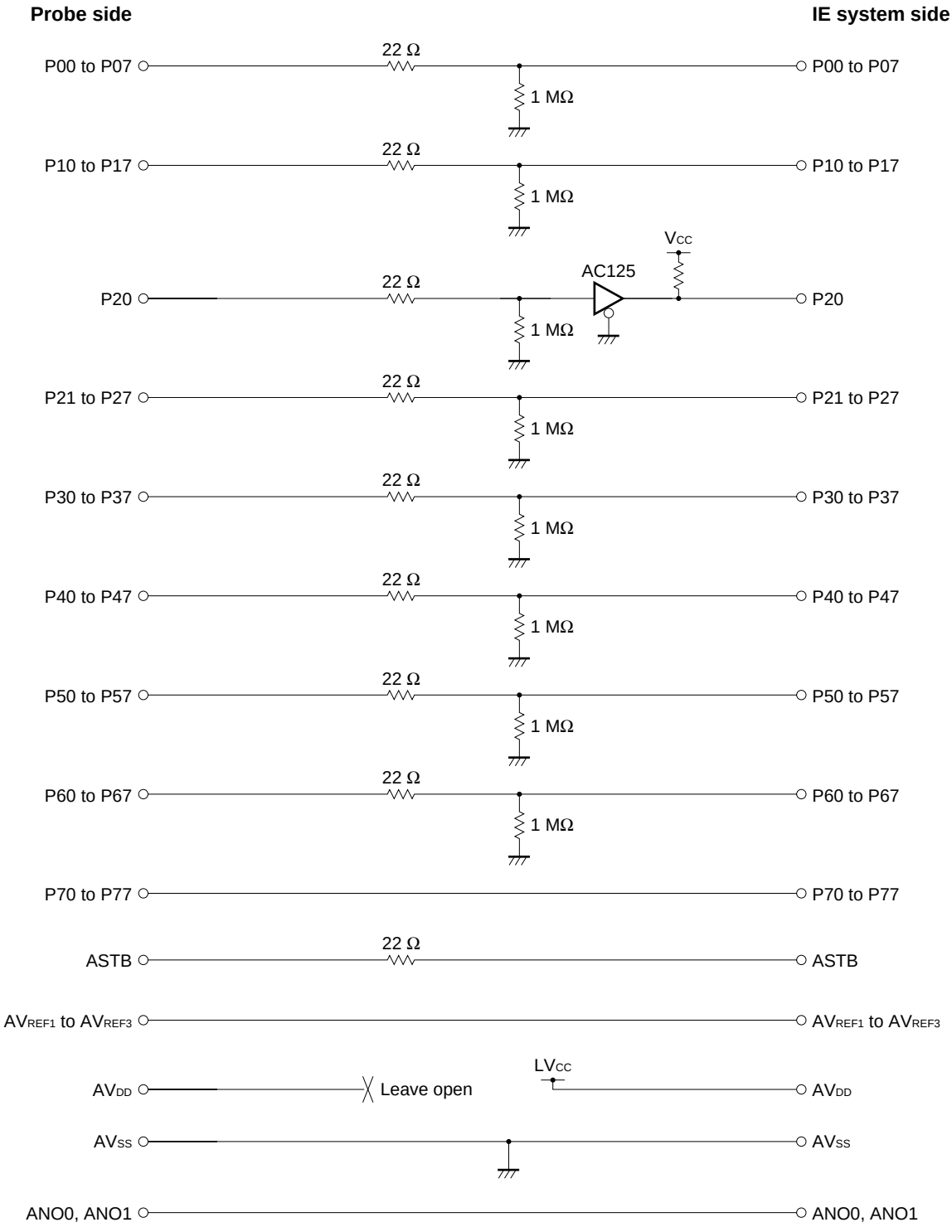
(1) Signals directly input/output to/from the emulation CPU

The following signals perform the same operations as in the μPD784038 Subseries. For the signals related to ports excluding port 7 (having alternate functions as pins for A/D converter), however, a 1-MΩ pull-down resistor and 22-Ω resistor are inserted in series.

- Signals related to port 0
- Signals related to port 1
- Signals related to port 2
- Signals related to port 3
- Signals related to port 4
- Signals related to port 5
- Signals related to port 6
- Signals related to port 7 (A/D converter input)
- ASTB signal
- Signals related to A/D converter
  - AV_{REF1} to AV_{REF3}
  - AV_{DD}
  - AV_{SS}
- Signals related to D/A converter
  - ANO0
  - ANO1

Caution The AV_{DD} 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_{DD} pin of the emulation CPU.

Figure 4-1. Equivalent Circuit 1 of Emulation Circuit

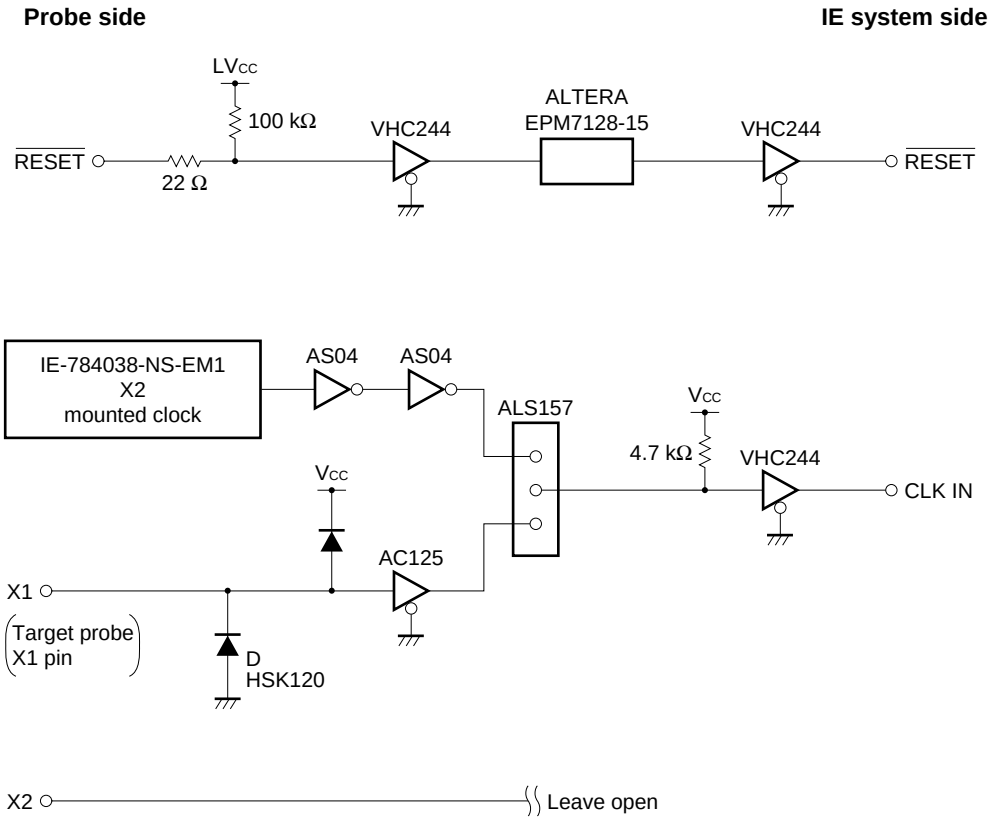


(2) Signals input from the target system via a gate

Since the following signals are input via a gate, their timing shows a delay compared to that of the μPD784038 Subseries. Their AC characteristics and DC characteristics are therefore different from μPD784038 Subseries, making it necessary to observe a stricter timing design than in the case of μPD784038 Subseries.

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

Figure 4-2. Equivalent Circuit 2 of Emulation Circuit



(3) Other signals

- V_{DD} 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_{DD} pin of the target system is only used to control the LED ($USERV_{DD}$) in the IE system that monitors the input of the target system's power supply.
- V_{SS} pin

  The V_{SS} pin is connected to GND inside the IE system.
- TEST pin

  The TEST pin is not used in the IE system.

[MEMO]

APPENDIX A EMULATION PROBE PIN ASSIGNMENT TABLE

Table A-1. NP-80GC/GK Pin Assignments (1/2)

Emulation Probe	CN1 Pin No.	Emulation Probe	CN1 Pin No.
1	114	34	49
2	113	35	50
3	108	36	45
4	107	37	46
5	104	38	41
6	103	39	42
7	100	40	35
8	99	41	8
9	94	42	7
10	93	43	14
11	30	44	13
12	29	45	18
13	24	46	17
14	23	47	22
15	20	48	21
16	19	49	28
17	16	50	27
18	15	51	92
19	10	52	91
20	9	53	98
21	37	54	97
22	43	55	102
23	44	56	101
24	47	57	106
25	48	58	105
26	51	59	112
27	52	60	111
28	57	61	83
29	58	62	77
30	59	63	78
31	60	64	73
32	55	65	74
33	56	66	69

Remarks 1. The NP-80GC/GK are products of Naito Densei Machida Mfg. Co., Ltd.

2. The numbers in the “Emulation probe” column indicate the corresponding pin number on the emulation probe tip.

Table A-1. NP-80GC/GK Pin Assignments (2/2)

Emulation Probe	CN1 Pin No.	Emulation Probe	CN1 Pin No.
67	70	74	71
68	63	75	72
69	64	76	75
70	61	77	76
71	62	78	79
72	65	79	80
73	66	80	85

Remarks 1. The NP-80GC/GK are products of Naito Densei Machida Mfg. Co., Ltd.

2. The numbers in the “Emulation probe” column indicate the corresponding pin number on the emulation probe tip.

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