

To our customers,

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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# User's Manual

# QB-78K0LX3

## In-Circuit Emulator

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### Target Devices

**78K0/LC3**

**78K0/LD3**

**78K0/LE3**

**78K0/LF3**

Document No. U18511EJ2V0UM00 (2nd edition)  
Date Published September 2007 NS

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## General Precautions for Handling This Product

### 1. Circumstances not covered by product guarantee

- If the product was disassembled, altered, or repaired by the customer
- If it was dropped, broken, or given another strong shock
- Use at overvoltage, use outside guaranteed temperature range, storing outside guaranteed temperature range
- If power was turned on while connection to the AC adapter, USB interface cable, or target system was in an unsatisfactory state
- If the cable of the AC adapter, the USB interface cable, the emulation probe, or the like was bent or pulled excessively
- If an AC adapter other than the supplied product was used
- If the product got wet
- If this product is connected to the target system when there is a potential difference between the GND of this product and GND of the target system.
- If the connectors or cables are plugged/unplugged while this product is in the power-on state.
- If excessive load is applied to the connectors or sockets (As for handling, please see **2.5 Mounting and Connecting Connectors**).
- If a metal part of the power switch, cooling fan, or another such part comes in contact with an electrostatic charge.
- If the product is used or stored in an environment where an electrostatic or electrical noise is likely to occur.

### 2. Safety precautions

- If used for a long time, the product may become hot (50°C to 60°C). Be careful of low temperature burns and other dangers due to the product becoming hot.
- Be careful of electrical shock. There is a danger of electrical shock if the product is used as described above in **1. Circumstances not covered by product guarantee**.
- The AC adapter supplied with the product is exclusively for this product, so do not use it with other products.

## INTRODUCTION

**Readers** This manual is intended for users who wish to perform debugging using the QB-78K0LX3. The readers of this manual are assumed to be familiar with the device functions and usage, and to have knowledge of debuggers.

**Purpose** This manual is intended to give users an understanding of the basic specifications and correct usage of the QB-78K0LX3.

**Organization** This manual is divided into the following sections.

- General
- Setup procedure
- Settings at product shipment
- Differences between target interface circuit and target device
- Notes

**How to Read This Manual** It is assumed that the readers of this manual have general knowledge in the fields of electrical engineering, logic circuits, and microcontrollers.

This manual describes the basic setup procedures and how to set switches.

To understand the overall functions and usages of the QB-78K0LX3

→Read this manual in the order of the **CONTENTS**. The mark "<R>" shows major revised points. The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

To know the manipulations, command functions, and other software-related settings of the QB-78K0LX3

→See the user's manual of the debugger (supplied with the QB-78K0LX3) to be used.

### Conventions

**Note:** Footnote for item marked with **Note** in the text

**Caution:** Information requiring particular attention

**Remark:** Supplementary information

Numeric representation: Binary ... xxxx or xxxxB

Decimal ... xxxx

Hexadecimal ... xxxxH

Prefix indicating power of 2

(address space, memory

capacity):

K (kilo):  $2^{10} = 1,024$

M (mega):  $2^{20} = 1,024^2$



## Terminology

The meanings of the terms used in this manual are described in the table below.

Term	Meaning
Target device	This is the device to be emulated.
Target system	This is the system to be debugged. This includes the target program and the hardware provided by the user.
78K0/Lx3	Generic name indicating 78K0/LC3, 78K0/LD3, 78K0/LE3 and 78K0/LF3.
IECUBE™	Generic name for NEC Electronics' high-performance/compact in-circuit emulator.

## Related Documents

Please use the following documents in conjunction with this manual.

The related documents listed below may include preliminary versions. However, preliminary versions are not marked as such.

### Documents Related to Development Tools (User's Manuals)

Document Name		Document Number
QB-78K0LX3 In-Circuit Emulator		This manual
RA78K0 Assembler Package Ver. 3.80	Operation	U17199E
	Language	U17198E
	Structured Assembly Language	U17197E
CC78K0 C Compiler Ver. 3.70	Operation	U17201E
	Language	U17200E
ID78K0-QB Integrated Debugger Ver. 2.94	Operation	U18330E
PM plus Ver. 5.20		U16934E

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

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## CHAPTER 1 GENERAL

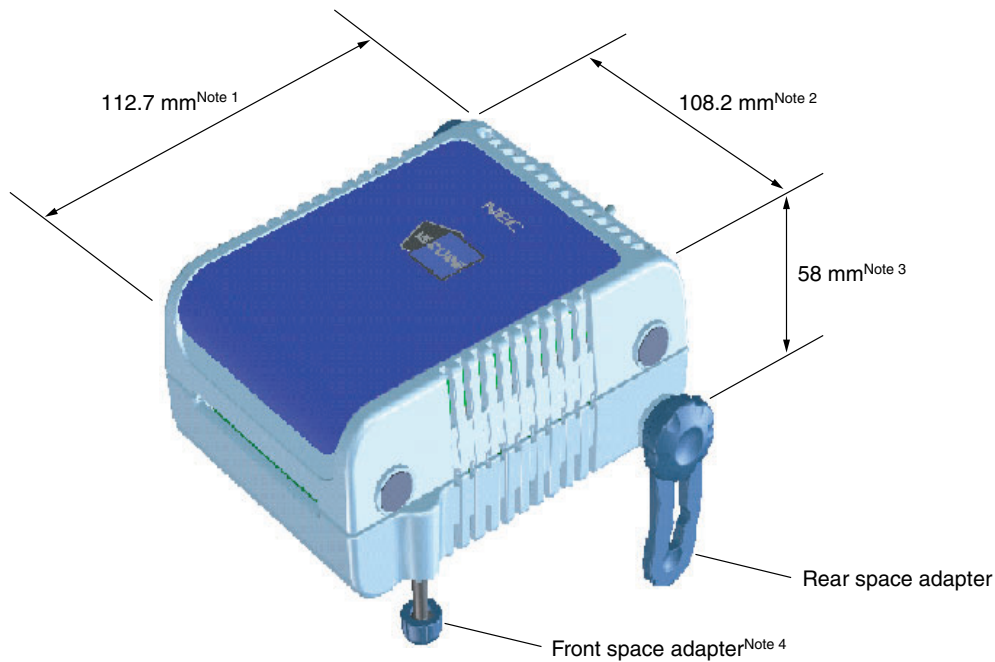
The QB-78K0LX3 is an in-circuit emulator for emulating the 78K0/Lx3.

Hardware and software can be debugged efficiently in the development of systems in which the 78K0/Lx3 is used. This manual describes basic setup procedures, hardware specifications, system specifications, and how to set switches.

1.1 Hardware Specifications

Table 1-1. QB-78K0LX3 Hardware Specifications

Parameter		Specification
Target device		78K0/LC3, 78K0/LD3, 78K0/LE3, 78K0/LF3
Operating voltage		1.8 to 5.5 V
Operating frequency	Main system clock	2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V: 2 to 10 MHz 1.8 V ≤ V <sub>DD</sub> < 2.7 V: 2 to 5 MHz
	Internal high-speed oscillation clock	1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V: 8 MHz TYP.
	Subsystem clock	1.8 V ≤ V <sub>DD</sub> ≤ 5.5 V: 32.768 kHz
Operating temperature range		0 to 40°C (No condensation)
Storage temperature range		-15 to 60°C (No condensation)
External dimensions		See figure below
Power consumption	AC adapter for QB-78K0LX3	Output: DC15 V, 1 A Input: AC100 to 240 V
	Target system power supply	Voltage: 1.8 to 5.5 V Current: approx. 275 μA MAX.
Weight		Approx. 400 g
Host interface		USB interface (1.1, 2.0)



- Notes**
1. Does not include projection of power switch
  2. Includes projection of screw that fixes rear space adapter
  3. Rear space adapter can adjust the height from 30 mm (longest) to 0 mm (shortest)
  4. Front space adapter can adjust the height from 20 mm (longest) to 5 mm (shortest)

## 1.2 System Specifications

This section shows the QB-78K0LX3 system specifications.

**Table 1-2. QB-78K0LX3 System Specifications (1/2)**

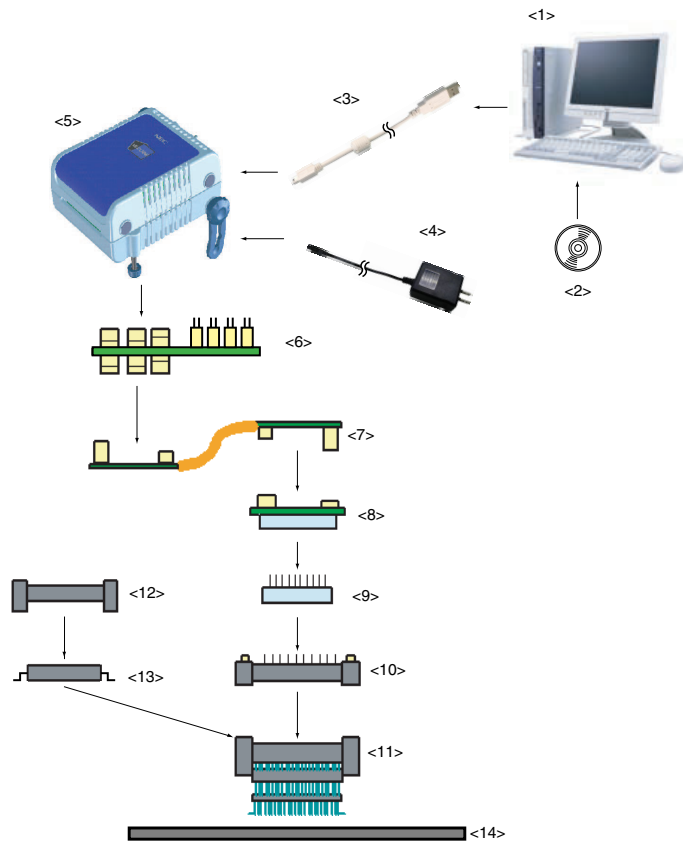
Parameter		Specification
Emulation memory capacity	Internal ROM	512 KB (MAX.)
	Internal RAM	61.75 KB (MAX.)
Program execution functions	Real-time execution function	Go, Start from Here, Come Here, Restart, Return Out, Ignore break points and Go
	Non-real-time execution function	Step In, Next Over, Slowmotion, Go & Go
Memory manipulation		Available (initialize, copy, compare)
Register manipulation		Available (general-purpose registers, control registers, SFRs)
Disassemble function		Available
Local variable view		Local variables
Watch data view		Local variables, global variables, or else
Stack trace view		Available
Break functions	Event break	Execution: 8 points Access: 8 points
	Software break	2000 points
	Pre-execution break	4 to 8 points <sup>Note</sup>
	Fail-safe break	Non-map, write protect, SFR illegal access, stack overflow, or else
	Other	Forcible break, trace full break, trace delay break, timeout break, timer overflow break
Trace functions	Trace data types	Program address, program data, access address, access data, status, time tag
	Trace modes	Unconditional trace, section trace, qualify trace, delay trigger trace
	Trace functions	Non-stop, full stop, full break, delay trigger stop, delay trigger break
	Memory capacity	128K frames
Real-time RAM monitoring function		All internal RAM spaces
Time measurement functions	Measurement clock	60 MHz
	Measurement objects	Start through end of program execution Start event through end event
	Maximum measurement time	Approx. 40 hours and 43 minutes (Resolution: 17 ns)
	Number of timers for measurement	Start through end of program execution: 1 Start event through end event: 2
	Measurement results	Execution time (start through end of execution) Maximum, minimum, average, total, pass count (between events)
	Other	Timer overflow break function, timeout break function
Other functions		Command functions set in the console, mapping function, event function, coverage function, snapshot function, DMM function, power-off emulation function, pin mask function, flash self programming emulation function

**Note** The number of breaks that can be set varies depending on the location where the break is set.

### 1.3 System Configuration

This section shows the system configuration when using the QB-78K0LX3 connected to a PC (Windows™ PC (Windows2000 and WindowsXP), PC/AT™ compatible). Connection is possible even without optional products.

Figure 1-1. System Configuration



- |                                   |  |
|-----------------------------------|--|
| <1> Host machine                  | : Windows PC (Windows2000 and WindowsXP), IBM PC/AT compatible can be used |
| <2> ID78K0-QB Disk/Accessory Disk | : Debugger, USB drivers, manual, etc.                                      |
| <3> USB interface cable           | : Cable connecting QB-78K0LX3 to host machine                              |
| <4> AC adapter                    | : Support input AC100 to 240 V   |
| <5> QB-78K0LX3                    | : This product   |
| <6> Check pin adapter (optional)  | : Adapter used for monitoring waveforms with oscilloscope                  |
| <7> Emulation probe               | : Flexible type of emulation probe   |
| <8> Exchange adapter              | : Adapter that performs pin conversion                                     |
| <9> Space adapter (optional)      | : Adapter used for height adjustment                                       |
| <10> YQ connector                 | : Connector that connects exchange adapter to target connector             |
| <11> Target connector             | : Connector soldered to target system                                      |
| <12> Mount adapter (optional)     | : Adapter used for mounting target device into socket                      |
| <13> Device                       | : Target device  |
| <14> Target system                |  |

**Remarks 1.** Obtain device files from the NEC Electronics website.

<http://www.necel.com/micro/ods/eng/>

**2.** Refer to **1.5 Package Contents** for the purchase forms of the above products.

**3.** As for handling of connectors, refer to **2.5 Mounting and Connecting Connectors**.

## 1.4 System Configuration for Each Target Device

The following table lists the system configuration for each target device of the QB-78K0LX3.

**Table 1-3. Adapters and Connectors for Each Target Device**

Target Device	Package	Exchange Adaptor	Space Adaptor	YQ Connector	Target Connector	Mount Adaptor
78K0/LC3	48GA	QB-48GA-EA-03T (sold separately) <sup>Note</sup>	QB-48GA-YS-01T (sold separately)	QB-48GA-YQ-01T (sold separately) <sup>Note</sup>	QB-48GA-NQ-01T (sold separately) <sup>Note</sup>	QB-48GA-HQ-01T (sold separately)
78K0/LD3	52GB	QB-52GB-EA-03T (sold separately) <sup>Note</sup>	QB-52GB-YS-01T (sold separately)	QB-52GB-YQ-01T (sold separately) <sup>Note</sup>	QB-52GB-NQ-01T (sold separately) <sup>Note</sup>	QB-52GB-HQ-01T (sold separately)
78K0/LE3	64GB	QB-64GB-EA-09T (sold separately) <sup>Note</sup>	QB-64GB-YS-01T (sold separately)	QB-64GB-YQ-01T (sold separately) <sup>Note</sup>	QB-64GB-NQ-01T (sold separately) <sup>Note</sup>	QB-64GB-HQ-01T (sold separately)
	64GK	QB-64GK-EA-07T (sold separately) <sup>Note</sup>	QB-64GK-YS-01T (sold separately)	QB-64GK-YQ-01T (sold separately) <sup>Note</sup>	QB-64GK-NQ-01T (sold separately) <sup>Note</sup>	QB-64GK-HQ-01T (sold separately)
78K0/LF3	80GK	QB-80GK-EA-01T (sold separately) <sup>Note</sup>	QB-80GK-YS-01T (sold separately)	QB-80GK-YQ-01T (sold separately) <sup>Note</sup>	QB-80GK-NQ-01T (sold separately) <sup>Note</sup>	QB-80GK-HQ-01T (sold separately)
	80GC	QB-80GC-EA-01T (sold separately) <sup>Note</sup>	QB-80GC-YS-01T (sold separately)	QB-80GC-YQ-01T (sold separately) <sup>Note</sup>	QB-80GC-NQ-01T (sold separately) <sup>Note</sup>	QB-80GC-HQ-01T (sold separately)

**Table 1-4. Common Probe and Adapter**

Name	Part Number
Check pin adapter	QB-144-CA-01 (sold separately)
Emulation probe	QB-80-EP-01T (sold separately) <sup>Note</sup>

**Note** These items are included with the QB-78K0LX3, depending on the ordering code.

- If QB-78K0LX3-ZZZ is ordered  
The exchange adapter, YQ connector, target connector and emulation probe are not included.
- If QB-78K0LX3-T80GK is ordered  
The QB-80GK-EA-01T, QB-80GK-YQ-01T, QB-80GK-NQ-01T and QB-80-EP-01T are included.
- If QB-78K0LX3-T80GC is ordered  
The QB-80GC-EA-01T, QB-80GC-YQ-01T, QB-80GC-NQ-01T and QB-80-EP-01T are included.
- If QB-78K0LX3-T64GB is ordered  
The QB-64GB-EA-09T, QB-64GB-YQ-01T, QB-64GB-NQ-01T and QB-80-EP-01T are included.
- If QB-78K0LX3-T64GK is ordered  
The QB-64GK-EA-07T, QB-64GK-YQ-01T, QB-64GK-NQ-01T and QB-80-EP-01T are included.
- If QB-78K0LX3-T52GB is ordered  
The QB-52GB-EA-03T, QB-52GB-YQ-01T, QB-52GB-NQ-01T and QB-80-EP-01T are included.
- If QB-78K0LX3-T48GA is ordered  
The QB-48GA-EA-03T, QB-48GA-YQ-01T, QB-48GA-NQ-01T and QB-80-EP-01T are included.

**Remark** For notes on target system design and package drawings, refer to **[Related Information]** on the following URL.

<http://www.necel.com/micro/english/iecube/index.html>

## 1.5 Package Contents

The following items have been placed in the QB-78K0LX3 packing box. Please check the contents.

### Products supplied with QB-78K0LX3-ZZZ

- 1: QB-78K0LX3
- 2: AC adapter
- 3: USB interface cable (2 meters)
- 4: Online user registration card (warranty card and software contract in one)
- 5: ID78K0-QB Disk (CD-ROM)
- 6: Accessory Disk (CD-ROM)
- 7: IECUBE Setup Manual (Japanese/English)
- 8: Packing list
- 9: QB-MINI2

### Products supplied with QB-78K0LX3-T80GK

- 1 to 9
- 10: Emulation probe QB-80-EP-01T
  - 11: Exchange adapter QB-80GK-EA-01T
  - 12: YQ connector QB-80GK-YQ-01T
  - 13: Target connector QB-80GK-NQ-01T

### Products supplied with QB-78K0LX3-T80GC

- 1 to 9
- 10: Emulation probe QB-80-EP-01T
  - 11: Exchange adapter QB-80GC-EA-01T
  - 12: YQ connector QB-80GC-YQ-01T
  - 13: Target connector QB-80GC-NQ-01T

### Products supplied with QB-78K0LX3-T64GB

- 1 to 9
- 10: Emulation probe QB-80-EP-01T
  - 11: Exchange adapter QB-64GB-EA-09T
  - 12: YQ connector QB-64GB-YQ-01T
  - 13: Target connector QB-64GB-NQ-01T

### Products supplied with QB-78K0LX3-T64GK

- 1 to 9
- 10: Emulation probe QB-80-EP-01T
  - 11: Exchange adapter QB-64GK-EA-07T
  - 12: YQ connector QB-64GK-YQ-01T
  - 13: Target connector QB-64GK-NQ-01T



Products supplied with QB-78K0LX3-T52GB

1 to 9

- 10: Emulation probe QB-80-EP-01T
- 11: Exchange adapter QB-52GB-EA-03T
- 12: YQ connector QB-52GB-YQ-01T
- 13: Target connector QB-52GB-NQ-01T

Products supplied with QB-78K0LX3-T48GA

1 to 9

- 10: Emulation probe QB-80-EP-01T
- 11: Exchange adapter QB-48GA-EA-03T
- 12: YQ connector QB-48GA-YQ-01T
- 13: Target connector QB-48GA-NQ-01T

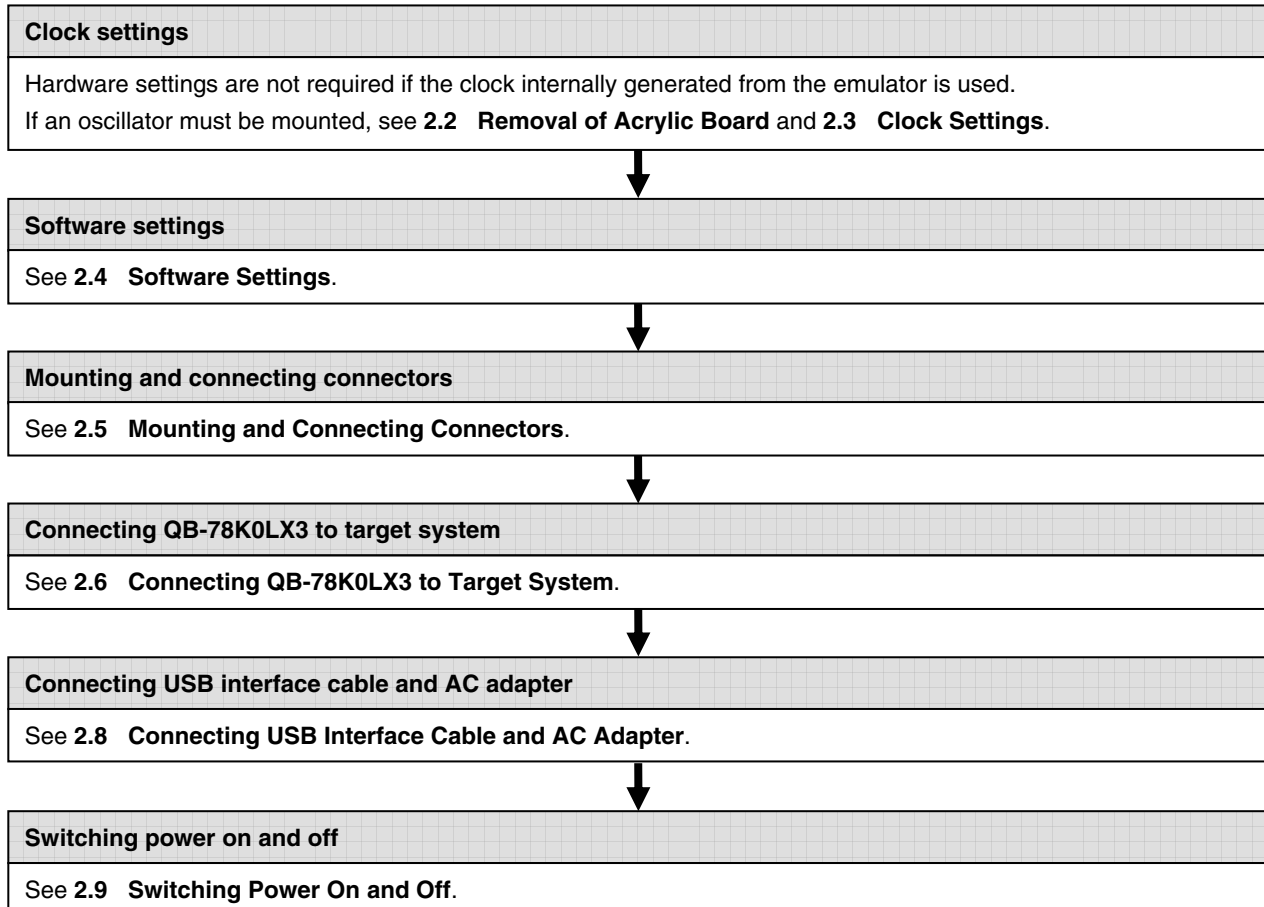
## CHAPTER 2 SETUP PROCEDURE

This chapter explains the QB-78K0LX3 setup procedure.

Setup can be completed by performing installation setup in the order in which it appears in this chapter.

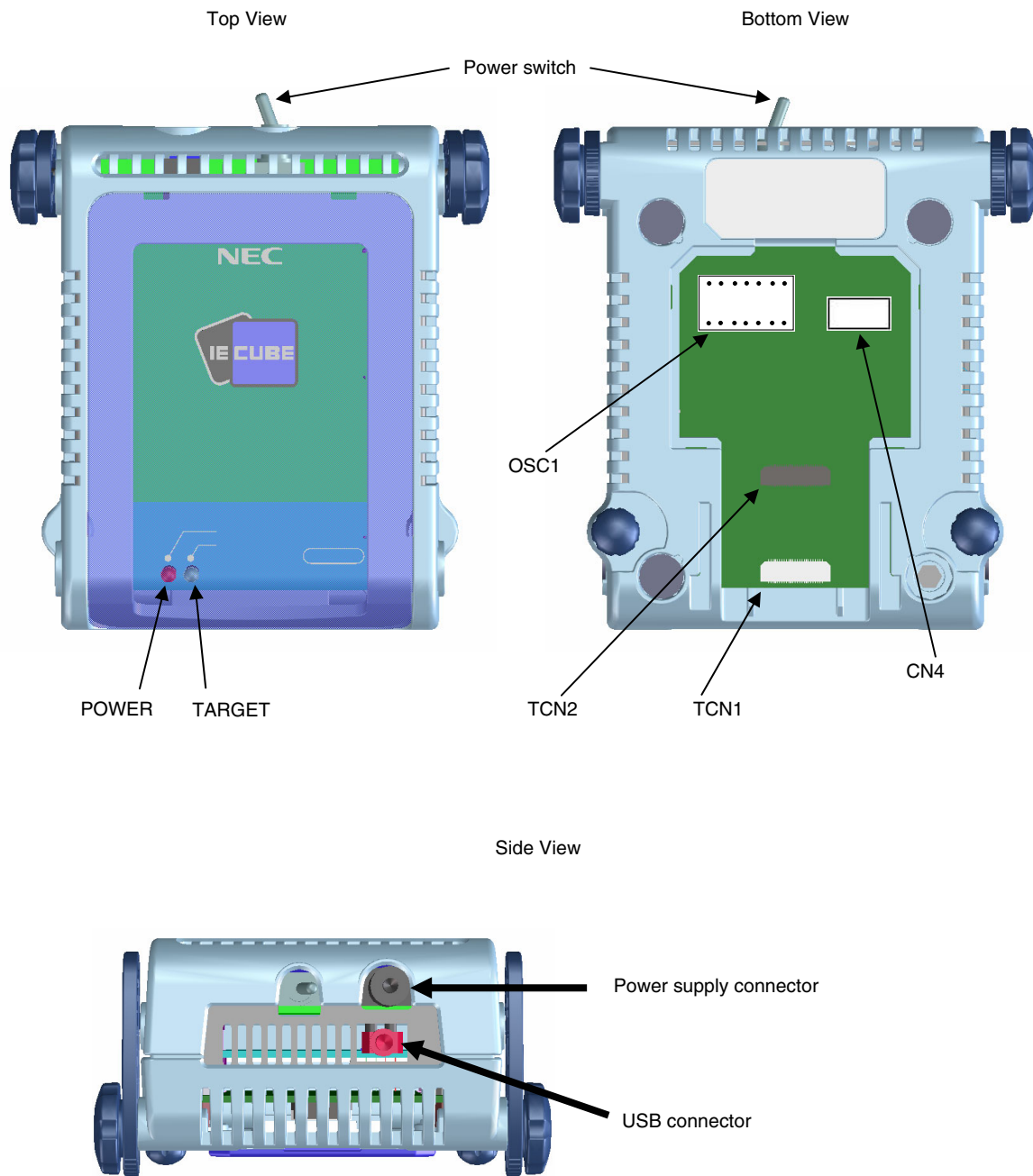
Perform setup along the lines of the following procedure.

See **2.1 Names and Functions of Hardware** for clock positions.



2.1 Names and Functions of Hardware

Figure 2-1. Names of Parts of QB-78K0LX3



(1) TCN1, TCN2

These are connectors for connecting a check pin adapter or emulation probe.

(2) OSC1

This is a socket for mounting the oscillator.

(3) CN4

This is a connector for the shipment inspection. It is not something that the user will need.

(4) POWER (Red LED)

This is an LED that shows whether the power supply of the QB-78K0LX3 is switched on.

LED State	QB-78K0LX3 State
Lit	Power switch ON
Not lit	Power switch OFF or AC adapter not connected to QB-78K0LX3
Blinking	Internal error occurred (Contact an NEC Electronics sales representative or distributor)

(5) TARGET (Green LED)

This is an LED that shows whether the power supply of the target system is switched on.

LED State	Target System State
Lit	Target system power supply ON
Not lit	Target system power supply OFF or target system not connected

(6) Power switch

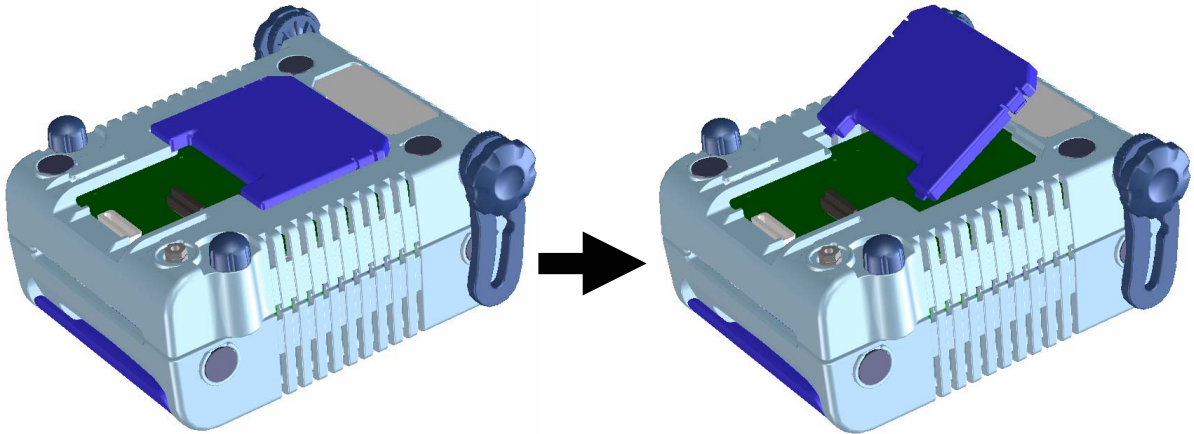
This is the power switch of the QB-78K0LX3.

It is OFF at shipment.

## 2.2 Removal of Acrylic Board

To modify the clock setting, the acrylic board on the bottom of the QB-78K0LX3 must be removed. The acrylic board can be removed by lifting it up.

**Figure 2-2. Acrylic Board Removal Method**



## 2.3 Clock Settings

### 2.3.1 Overview of clock settings

The following three types of clock settings are available. Each clock setting is listed below.

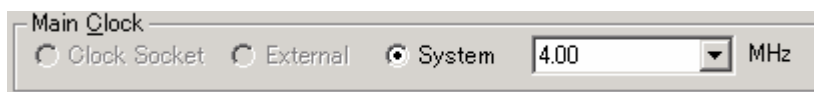
Clock Used	Clock Supply	Debugger Setting (in Configuration Dialog)
(1) High-speed system clock	Uses the clock internally generated from the emulator	System
	Uses the square-wave clock from the target system	External
	Uses the clock generated from the oscillator (OSC1) mounted on the emulator	Clock Socket
(2) Internal high-speed oscillation clock	Uses the clock internally generated from the emulator	–
(3) Subsystem clock	Uses the clock internally generated from the emulator	System
	Uses the square-wave clock from the target system	External

Oscillation with the resonator on the target system is not supported. Therefore, the in-circuit emulator cannot emulate the oscillation operation of the clock on the target system.

- (1) High-speed system clock  
 The clock settings are listed below.

**Table 2-1. Settings for High-Speed System Clock**

Type of Clock to Be Used	OSC1	Debugger Setting
(a) Uses the clock internally generated from the emulator	–	System
(b) Uses the square-wave clock from the target system <sup>Note</sup>	–	External
(c) Uses the clock generated from the oscillator (OSC1) mounted on the emulator	Oscillator mounted	Clock Socket



**Note** This setting is not possible when TARGET LED is not lit.

**Remarks 1.** Settings other than the above are prohibited.

2. Selection of (a) or (b) is possible regardless of whether the oscillator is not mounted in the OSC1socket.

- (a) Uses the clock internally generated from the emulator

Select the “System” in the debugger and select the desired frequency from the drop-down list.

The following frequencies are selectable.

2.00, 3.00, 3.57, 4.00, 4.19, 4.91, 5.00, 6.00, 8.00, 8.38, 10.00 [MHz]

- (b) Uses the square-wave clock from the target system

Select the “External” in the debugger. The clock input from the target system is then used.

Oscillation with the resonator on the target system is not supported. To input a clock from the target system, input to the clock pin (X2) the square-wave signal with the same voltage potential as that of the target device supply voltage (V<sub>DD</sub>). Inputting the inverted signal to X1 is not necessary.

The selectable frequencies are same as those of the target device.

- (c) Uses the clock generated from the oscillator (OSC1) mounted on the emulator

Mount an oscillator in the OSC1 socket in the emulator and then select the “Clock socket” in the debugger. The clock generated from the oscillator mounted on the emulator is used.

The selectable frequencies are same as those of the target device.

As an oscillator<sup>Note</sup> to be mounted in the OSC1 socket in the emulator, use the one that satisfies the following specifications.

- Supply voltage: 5 V
- Output level: CMOS

**Note** An oscillator that uses a resonator cannot be used.

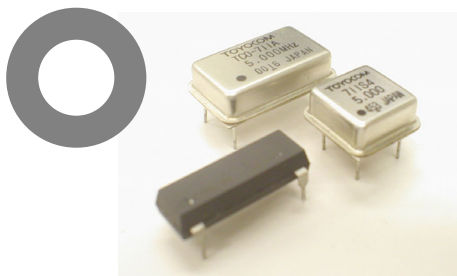


Figure 2-3. Oscillator Shape

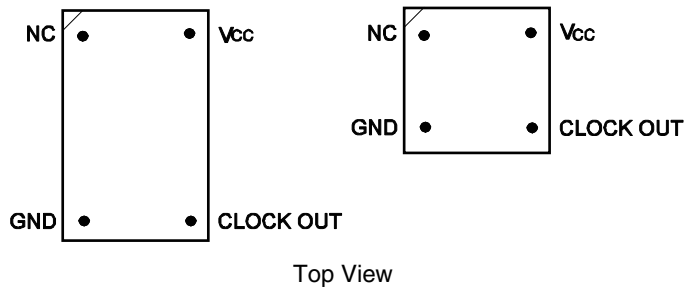
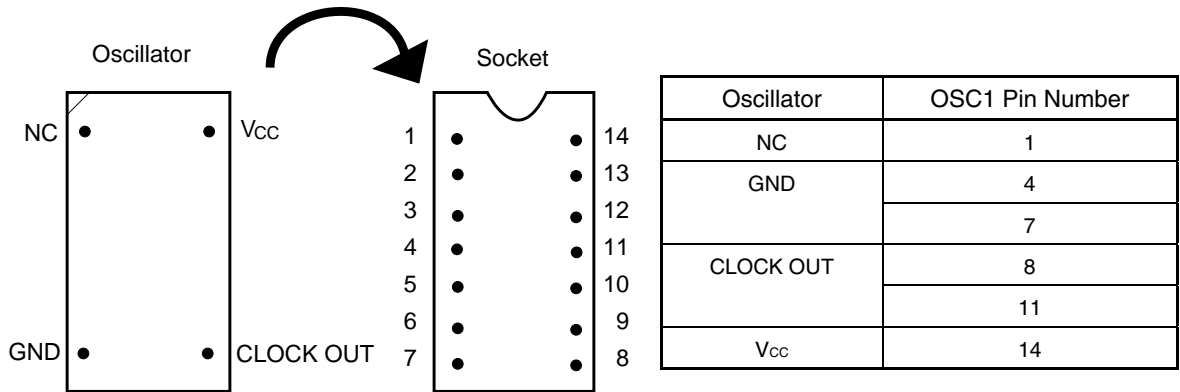


Figure 2-4. Mapping of Oscillator to Socket



**Remark** Insert the oscillator into the socket, take care for the pin 1 position.

(2) Internal high-speed oscillation clock

The debugger setting is not necessary.

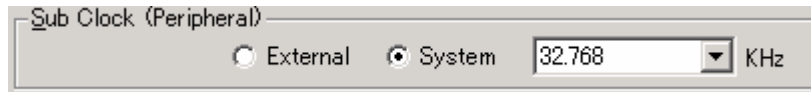
The use of the internal high-speed oscillation clock can be specified in the user program.

## (3) Subsystem clock

The clock settings are listed below.

**Table 2-2. Settings for Subsystem Clock**

Type of Clock to Be Used	Debugger Setting
(a) Uses the clock internally generated from the emulator	System
(b) Uses the square-wave clock from the target system <sup>Note</sup>	External



**Note** This setting is not possible when TARGET LED is not lit.

**Remark** Settings other than above are prohibited.

## (a) Uses the clock internally generated from the emulator

Select the “System” in the debugger and select “32.768” [kHz] as the frequency from the drop-down list.

32.768 [kHz]

**Note** “38.400” [kHz] can also be selected from the list, but do not select this frequency; it is not supported by the device.

## (b) Uses the square-wave clock from the target system

Select the “External” in the debugger. The clock input from the target system is then used.

Oscillation with the resonator on the target system is not supported. To input a clock from the target system, input to the clock pin (XT2) the square-wave signal with the same voltage potential as that of the target device supply voltage ( $V_{DD}$ ). Inputting the inverted signal to XT1 is not necessary.

The selectable frequencies are same as those of the target device.

## 2.4 Software Settings

For details, see the **ID78K0-QB Ver. 2.94 Integrated Debugger Operation User's Manual** (U18330E).



## 2.5 Mounting and Connecting Connectors

This section describes the methods of connecting the QB-78K0LX3 and target system.

Make connections with both the QB-78K0LX3 and target system powered OFF.

The following abbreviations are used in this section:

- TC: Target connector
- YQ: YQ connector
- EA: Exchange adapter
- MA: Mount adapter
- CA: Check pin adapter
- SA: Space adapter

### 2.5.1 Mounting TC to target system

- (1) Thinly apply a two-component epoxy adhesive (hardening time at least 30 minutes) to the ends of the four projections on the base of the TC and adhere the TC to the user board (clean the surface of the target system board using alcohol or the like). If alignment of target system pads to TC leads is difficult, align them as in (2).
- (2) Align by inserting the guide pins for alignment for the TC (NQGUIDE) through the pin holes on the top of the TC. Accessory holes are  $\phi 1.0$  mm non-through holes in two or three places.  
(For hole positions, see the particular TC drawing.)
- (3) Solder after fitting the MA to the TC. This is to prevent troubles such as flux or solder splashing and adhering to the TC contact pins when soldering.
 

- Soldering conditions	Solder reflow	260°C × 10 seconds or less
	Manual soldering	350°C × 5 seconds or less (1 pin)

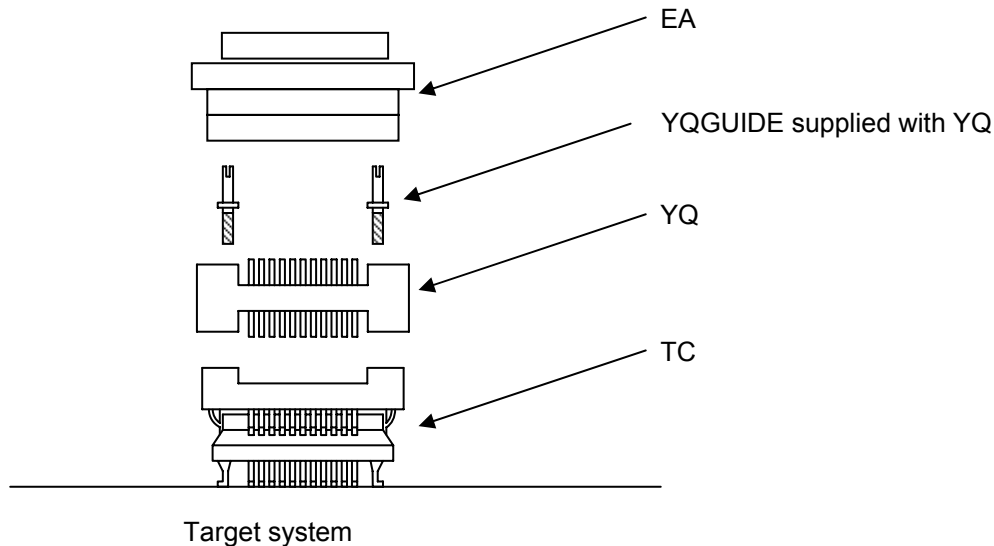
**Caution** Do not perform washing by flux immersion or vapor.

- (4) Take away the guide pins.

### 2.5.2 Mounting YQ to TC

- <R>
- (1) After confirming that there are no broken or bent YQ contact pins, fit the YQ in the TC and fasten it using the supplied YQGUIDE (for the fastening method, see the next step, (2)). If repeatedly inserting and removing, be sure to inspect the YQ pins before fitting. If pins are bent, correct them using something thin and flat such as the edge of a knife.

- <R> (2) Fasten YQ to the TC on the target system using the supplied YQGUIDE. Fasten the screws equally in the four corners using the supplied flat-blade screwdriver or a torque driver. The tightening torque of YQGUIDE is 0.054 Nm (MAX.). Too great tightening causes bad connections. Four screws for fitting to the MA (M2 x 10 mm / 4 units) are included with YQ.



### 2.5.3 Plugging EA into YQ

Match the pin 1 position of the YQ or SA (corner cuts match in both) to the pin 1 position of the EA and plug in.

- When plugging or unplugging, press on the TC, YQ, and SA with a finger so that there is no force on the TC.
- When plugging or unplugging, be careful of the direction of wiggling.

As a tool when unplugging, insert some kind of thin non-conductive material such as a wooden stick between the YQ (SA) and EA and wiggle while slowly unplugging. Be careful since the connector will be damaged if this is done in the wrong direction.

### 2.5.4 Precautions for handling TC, YQ, SA, and CA

- (1) When taking the TC from the box, press down on the body and take out the sponge first.
- (2) Since the pins of the YQ are thin and easily bent, be careful. When inserting it in the TC, confirm that there are no bent pins.
- (3) When screwing a YQ soldered to a board to the TC, fasten the screws in four places in turn using a #0 or #1 Phillips precision screwdriver or torque driver after tentatively tightening them. Fix the torque at 0.054 Nm (MAX.).  
If just one place is overtightened, it may cause poor contact. Moreover, a board being connected to the YQ must have accessory holes in prescribed positions (four places:  $\phi 2.3$  mm or  $\phi 3.3$  mm). The  $\phi 3.8$  mm or  $\phi 4.3$  mm that is the screw head size is an area where wiring is prohibited.
- (4) In YQ and SA removal, since there is a danger of YQ pins being bent or broken when prying and wiggling, remove them gradually using a flatbladed screwdriver from four directions. Moreover, to connect and use the YQ and SA, screw the YQ to the TC according to the YQGUIDE (included with the YQ) using a 2.3 mm flatbladed screwdriver and then connect it to the SA. Fix the torque at 0.054 Nm (MAX.). If even one place is overtightened, it may cause poor contact.

- (5) For the TC, YQ, and SA, since there is a danger that washing fluid on the structure will remain in the connector, do not perform washing.
- (6) TC, IC, and YQ cannot be used in combination.
- (7) A TC/YQ system cannot be used in an environment of vibrations or shocks.
- (8) It is assumed that this product will be used in system development and evaluation. Moreover, when used in Japan, Electrical Appliance and Material Control Law and electromagnetic disturbance countermeasures have not been applied.
- (9) Since there are rare cases of shape change if the box is left for a long time in a place where it is 50°C or higher, for safekeeping, store it in a place where it is no higher than 40°C and direct sunlight does not hit it.
- (10) For details about handling the TC, YQ, and SA, see the NQPACK series technical materials at the website of Tokyo Eletech Corporation.  
URL: <http://www.tetc.co.jp/>
- (11) CA  
The CA is an optional product for IECUBE, and can be used to measure the waveform between IECUBE and the target system.  
Since the pins on the CA do not correspond to the pin layout in each device, the pin header cover must be mounted according to the device to be used. For mounting methods of the pin header cover, refer to **[Related Information]** on the following URL.  
<http://www.necel.com/micro/english/iecube/index.html>

### 2.5.5 Precautions for mounting IC using TC and MA

- (1) Confirm that there is no weld flash in the resin (sealant part) of the IC. If there is weld flash, remove it using a knife or the like.
- (2) Confirm that there is no weld flash breaking or bending of IC leads. In particular, confirm the planarity of IC leads. If there is abnormality in the planarity, correct that portion.
- (3) Viewing the TC contact pins from the top, if there are foreign bodies on them, remove them using a brush or the like.  
After confirming (1) to (3), fit the IC to the TC. Also fit the MA.
- (4) Put the supplied M2 x 6 mm screws in the four accessory holes of the MA and fasten the screws in opposite corners. At that time, use either the dedicated screwdriver that is supplied or a torque driver to fasten them equally in turn with a tightening torque of 0.054 Nm (MAX.). Since the contact is poor if tightening is too great, once you have lightly fastened the MA screws, tighten them again.
- (5) Depending on the use environment, when starting up a device that has been left for a long time, starting it may be difficult. In this case, loosen the screws slightly and then retighten them.
- (6) If startup still is difficult after (5) above, check (1) to (3) again.
- (7) Tightening the screws of the MA too much may give rise to cracks in the molded part of the MA (plastic part) and bend the mold into a bowed shape, making contact poor.
- (8) After soldering the TC, do not perform cleaning by flux immersion or vapor.

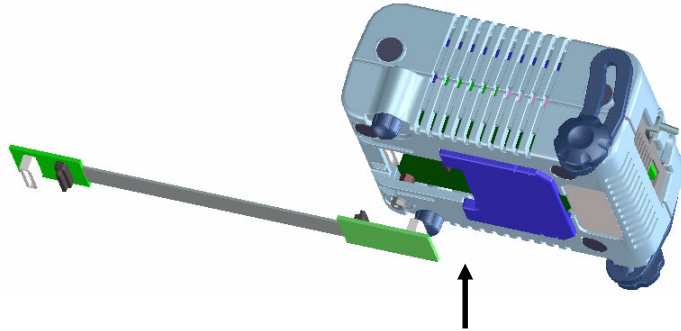
## 2.6 Connecting QB-78K0LX3 to Target System

If connecting the emulation probe (QB-80-EP-01T), connect it to the QB-78K0LX3 and the target system by the following procedure.

### (a) Connection of emulation probe

Connect the emulation probe to the QB-78K0LX3.

**Figure 2-5. Emulation Probe Connection Method**



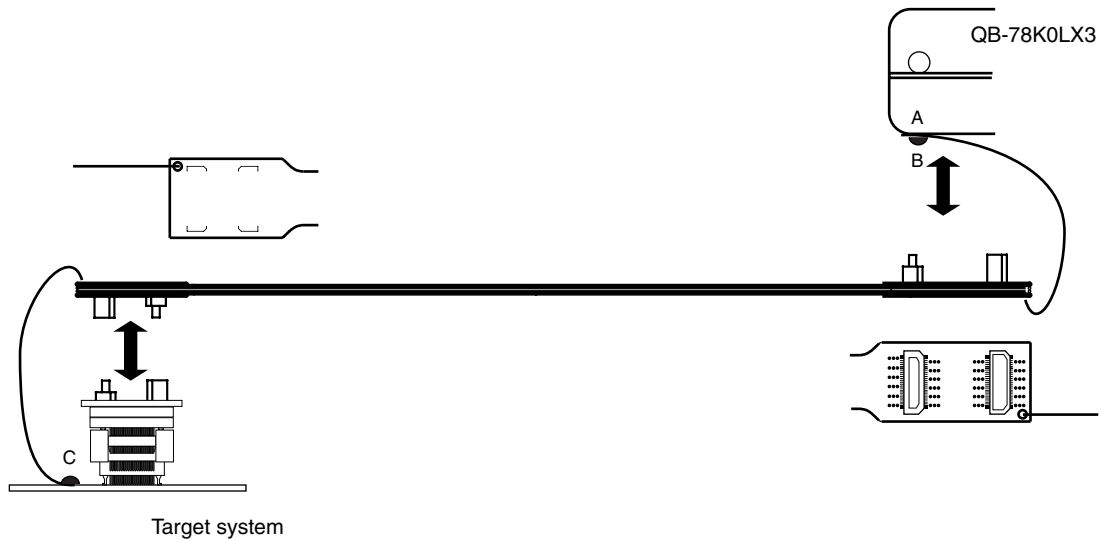
Insert CN1 and CN2 of the probe into TCN1 and TCN2 of the QB-78K0LX3.

**(b) Connection of emulation probe GND wire**

There are 2 GND wires in the emulation probe. Connect them to the QB-78K0LX3 and target system.

- <1> Fasten the GND wire on the QB-78K0LX3 side of the emulation probe to the nut on the bottom of the QB-78K0LX3 using a #0 or #1 Phillips precision driver (connection of B to A in Figure 2-6).
- <2> Next plug the connector on top of the emulation probe into the connector at the opening on the bottom of the QB-78K0LX3 from below being careful of the insertion direction.

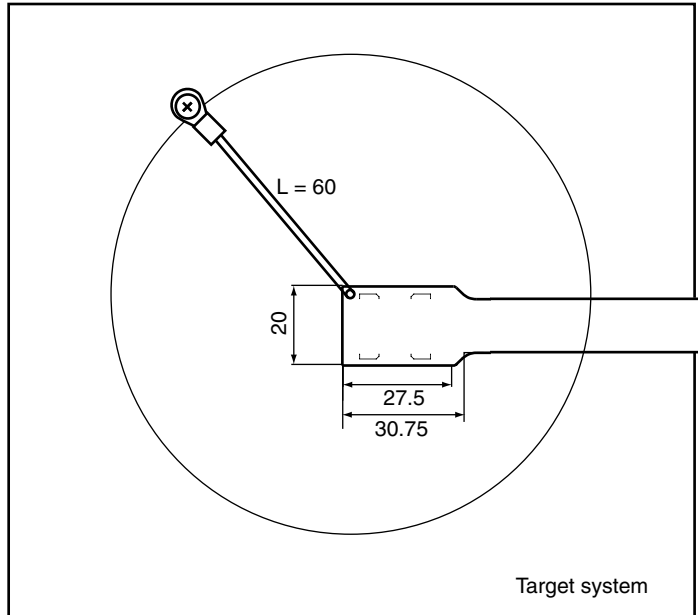
**Figure 2-6. GND Wire**



- <3> Connect the exchange adapter and emulation probe to the target connector.
- <4> Connect the GND wire on the target system side of the emulation probe to the target system GND. If a pin or screw is fastened to the target system GND, remove the transparent terminal cover on the end of the GND wire and fasten the Y terminal of the GND wire to the target system (C in Figure 2-6). If the GND on the target system is an exposed pad, likewise fasten the Y terminal to the pad on the target system by soldering (recommended soldering iron temperature setting: 300°C).

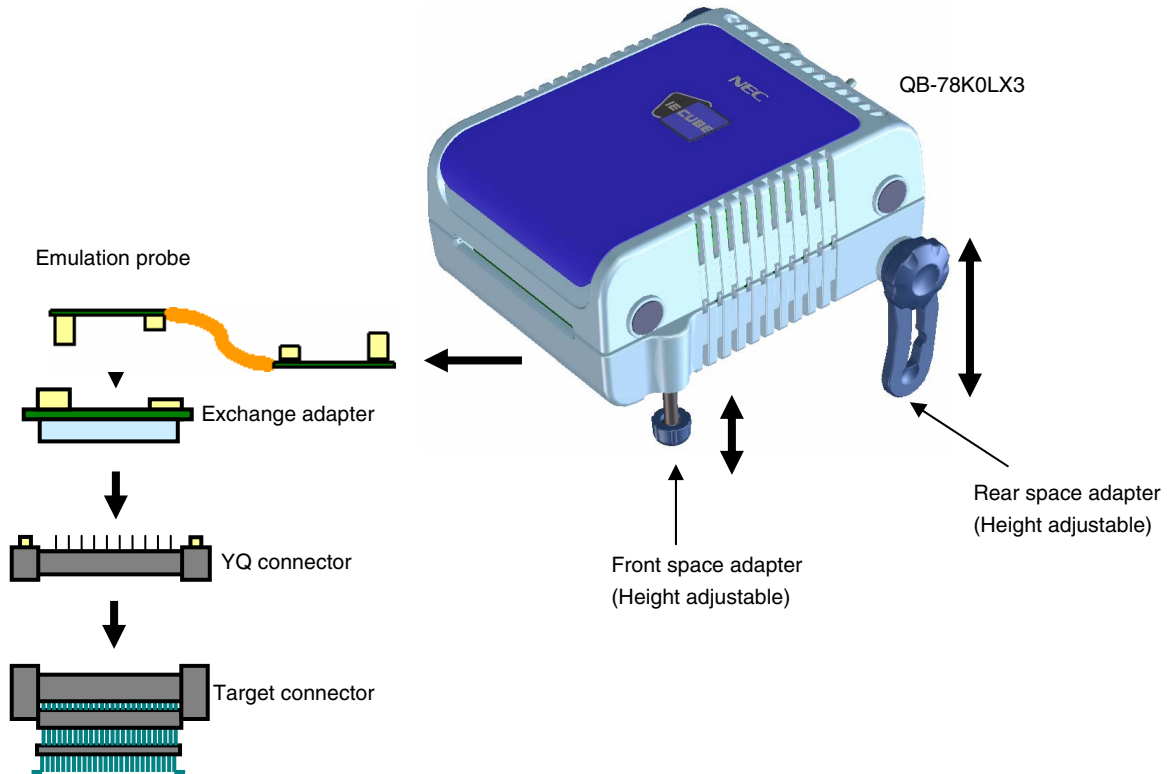
<5> Since the length of the GND wire below the head (insulated part) is approximately 60 mm, there must be a GND to which it can be connected to within the range of an approximately 60 mm radius section of the target system for connecting the emulation probe, as shown in Figure 2-7.

**Figure 2-7. Where GND Wire Can Be Connected**



**(c) Ensuring isolation**

When connecting the target system to the QB-78K0LX3 using an emulation probe, adjust the height using the front space adapter or rear space adapter of the QB-78K0LX3 and ensure isolation from the target system.

**Figure 2-8. Connection Using Emulation Probe****(d) Precautions related to emulation probe**

The following precautions pertain to using the emulation probe.

- <1> Be careful that stress of the emulation probe is not placed on the target connector. Moreover, when removing the emulation probe, remove it slowly while pressing down on the exchange adapter with a finger so that there is no stress on the target connector.
- <2> Be sure to connect the GND wire of the emulation probe to the QB-78K0LX3 and the target system. If not, the impedance of the cable becomes unstable, resulting in the lowering of signal transmission characteristics or distortion of the output waveform for an input waveform.

## 2.7 Notes on Power Supply and GND Pin Connection

For power supplies and GND pins of the target device, be sure to connect all pins to each power supply or GND.

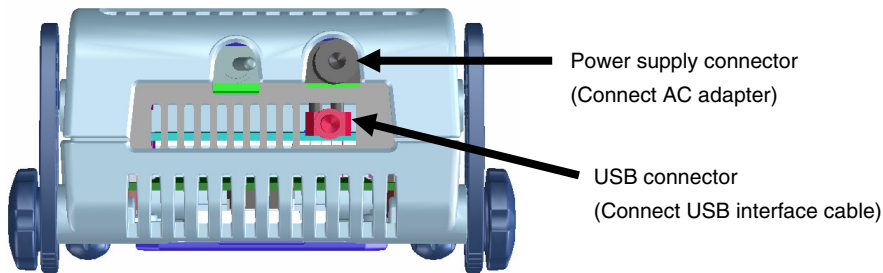
## 2.8 Connecting USB Interface Cable and AC Adapter

Plug the USB interface cable supplied with the QB-78K0LX3 into the USB connector of the host machine, and plug the other side into the USB connector on the rear of the QB-78K0LX3.

Plug the AC adapter supplied with the QB-78K0LX3 into a receptacle and plug the other side into the power supply connector on the rear of the QB-78K0LX3.

For QB-78K0LX3 connector positions, see **Figure 2-9**.

**Figure 2-9. Connector Positions**



## 2.9 Switching Power On and Off

Be sure to switch the power on and off according to the following procedures.

- |  |   |
|--|---|
| - Switching power on                       | - Switching power off                       |
| <1> QB-78K0LX3 power on                    | <1> Debugger termination                    |
| <2> Target system power on <sup>Note</sup> | <2> Target system power off <sup>Note</sup> |
| <3> Debugger startup                       | <3> QB-78K0LX3 power off                    |

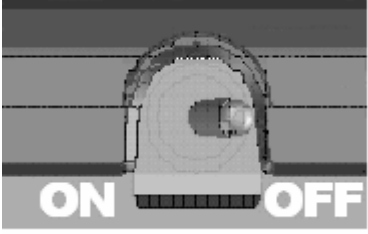
**Note** In the procedures, <2> is unnecessary if the target system is not connected.

**Caution** If the wrong sequence was used for the operation, the target system or QB-78K0LX3 may fail.



## CHAPTER 3 SETTINGS AT PRODUCT SHIPMENT

Table 3-1. Settings at Shipment

Item	Setting	Remarks
OSC1	Not mounted	Oscillator can be mounted <sup>Note</sup> .
Power switch		Set to OFF at shipment.

**Note** The oscillation circuit using an oscillation cannot be used.

## CHAPTER 4 DIFFERENCES BETWEEN TARGET INTERFACE CIRCUIT AND TARGET DEVICE

This chapter explains the differences between the signal lines of a target interface circuit of the QB-78K0LX3 and the signal lines of a target device

Although the target device is a CMOS circuit, the target interface circuit of the QB-78K0LX3 consists of an emulation circuit that depends on the emulation CPU, TTL, CMOS-IC, or other.

When the target system is debugged by connecting it to the QB-78K0LX3, the QB-78K0LX3 emulates just as if the actual target device were operating on the target system.

However, small differences arise because the QB-78K0LX3 actually is emulating.

- (1) Signals input and output by emulation CPU (FPGA,  $\mu$  PD78F0945EM)
- (2) Other signals

The circuits of the QB-78K0LX3 for the signals in (1) and (2) above are shown below by target device.

## 4.1 For 78K0/LC3 Emulation

For the signals in (1) and (2) below, see **Figure 4-1 Emulation Circuit Equivalent Circuit 1**.

### (1) Signals input and output by emulation CPU (FPGA, $\mu$ PD78F0945EM)

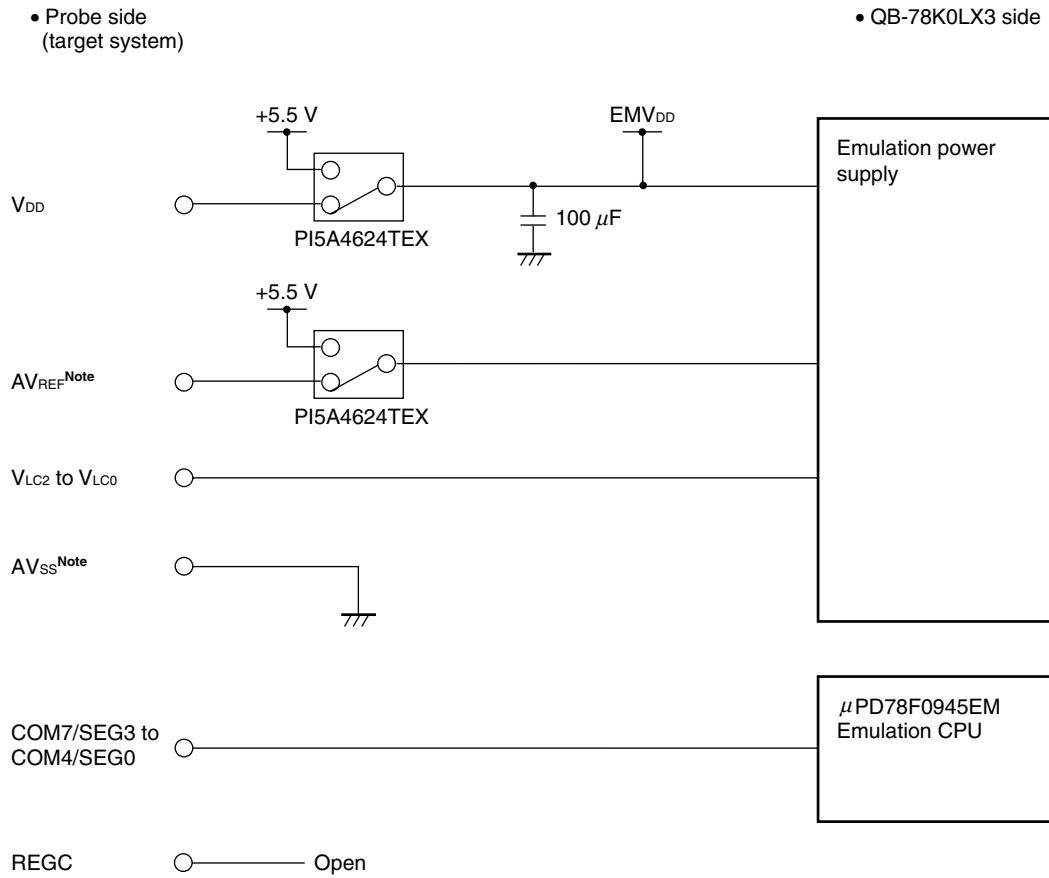
- P13, P12
- P25 to P20
- P34 to P31
- P40
- P101, P100
- P113, P112
- P124, P123, P121, P120
- P143 to P140
- P153 to P150
- COM7 to COM4
- X2,  $\overline{\text{RESET}}$ ,  $V_{SS}$ , FLMD0

### (2) Other signals

- $V_{DD}$ ,  $AV_{REF}$ <sup>Note</sup>,  $AV_{SS}$ <sup>Note</sup>
- $V_{LC2}$  to  $V_{LC0}$
- REGC

**Note** Transpose  $AV_{REF}$  and  $AV_{SS}$  to  $V_{DD}$  and  $V_{SS}$ , respectively, in the case of the product without A/D converter.

Figure 4-1. Emulation Circuit Equivalent Circuit 1 (1/2)

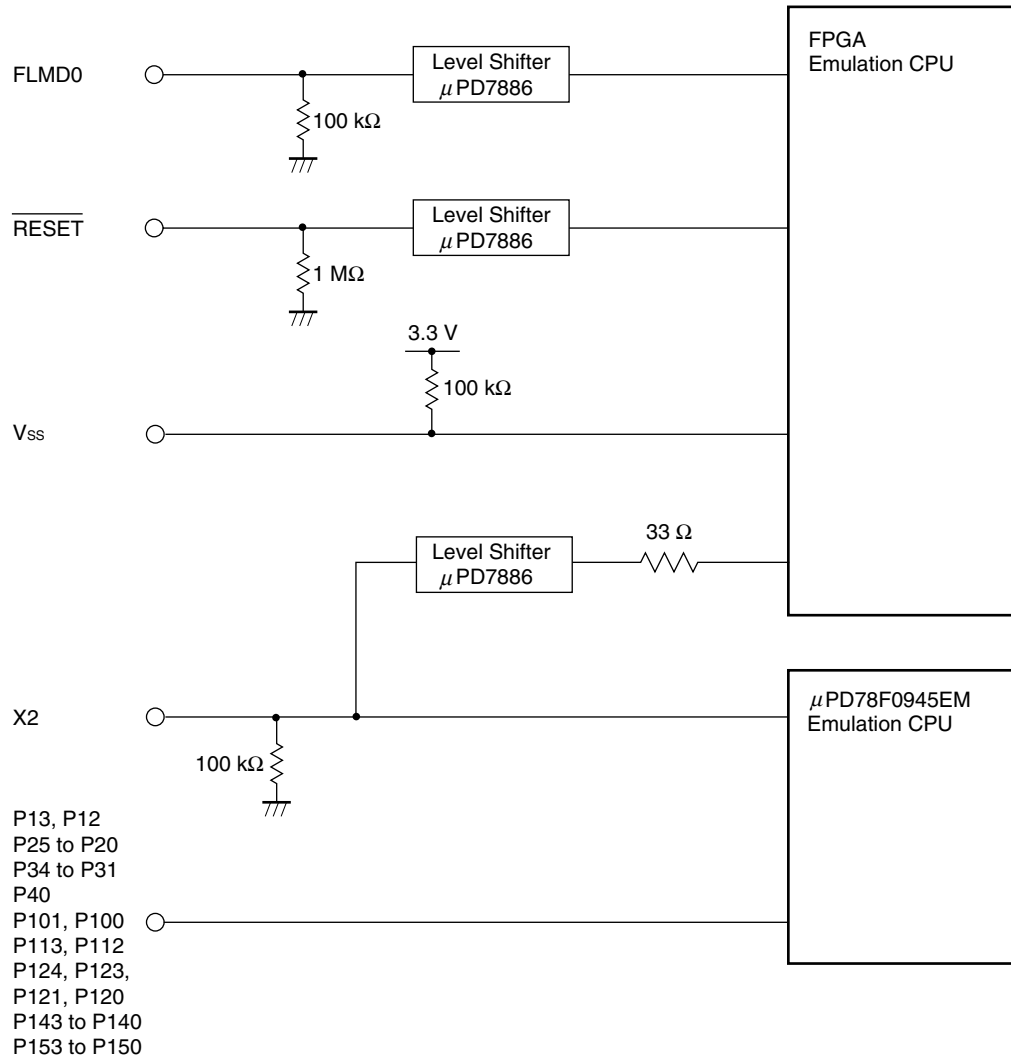


**Note** Transpose  $AV_{REF}$  and  $AV_{SS}$  to  $V_{DD}$  and  $V_{SS}$ , respectively, in the case of the product without A/D converter.

Figure 4-1. Emulation Circuit Equivalent Circuit 1 (2/2)

• Probe side  
(target system)

• QB-78K0LX3 side



## 4.2 For 78K0/LD3 Emulation

For the signals in (1) and (2) below, see **Figure 4-2 Emulation Circuit Equivalent Circuit 2**.

### (1) Signals input and output by emulation CPU (FPGA, $\mu$ PD78F0945EM)

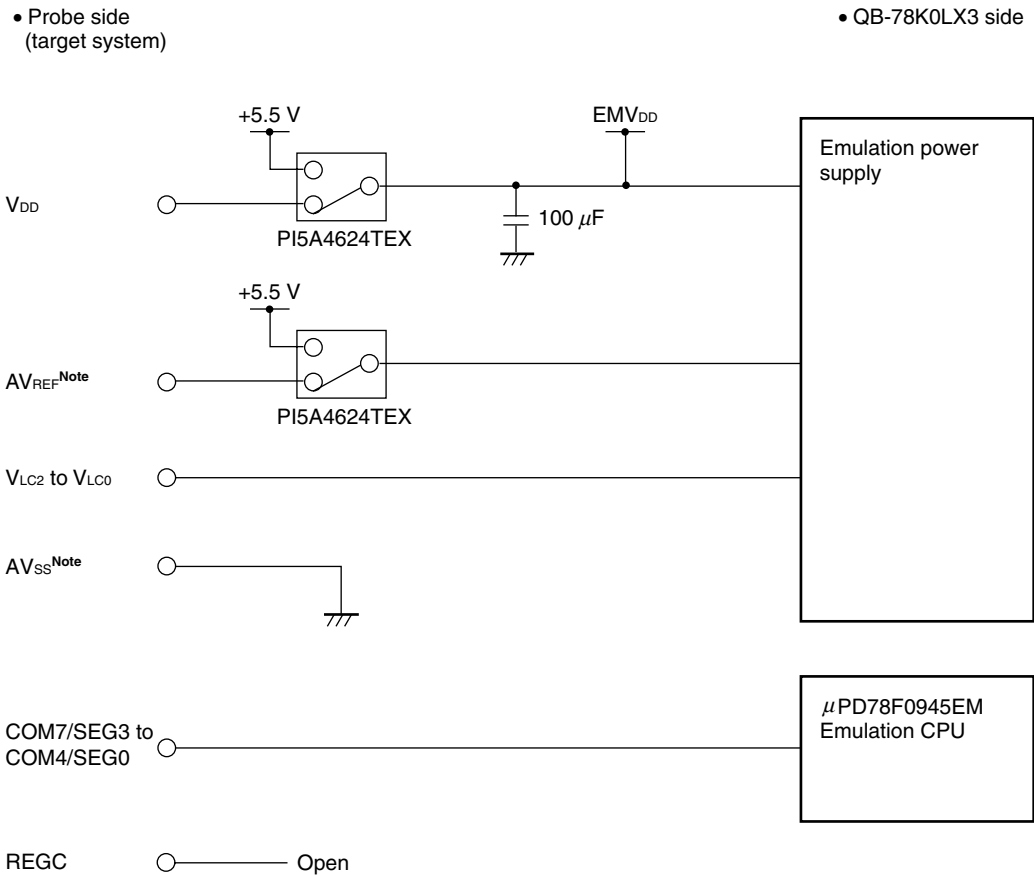
- P13 to P11
- P25 to P20
- P34 to P31
- P41, P40
- P80
- P101, P100
- P113 to P111
- P124, P123, P121, P120
- P143 to P140
- P153 to P150
- COM7 to COM4
- X2,  $\overline{\text{RESET}}$ ,  $V_{SS}$ , FLMD0

### (2) Other signals

- $V_{DD}$ ,  $AV_{REF}^{\text{Note}}$ ,  $AV_{SS}^{\text{Note}}$
- $V_{LC2}$  to  $V_{LC0}$
- REGC

**Note** Transpose  $AV_{REF}$  and  $AV_{SS}$  to  $V_{DD}$  and  $V_{SS}$ , respectively, in the case of the product without A/D converter.

Figure 4-2. Emulation Circuit Equivalent Circuit 2 (1/2)

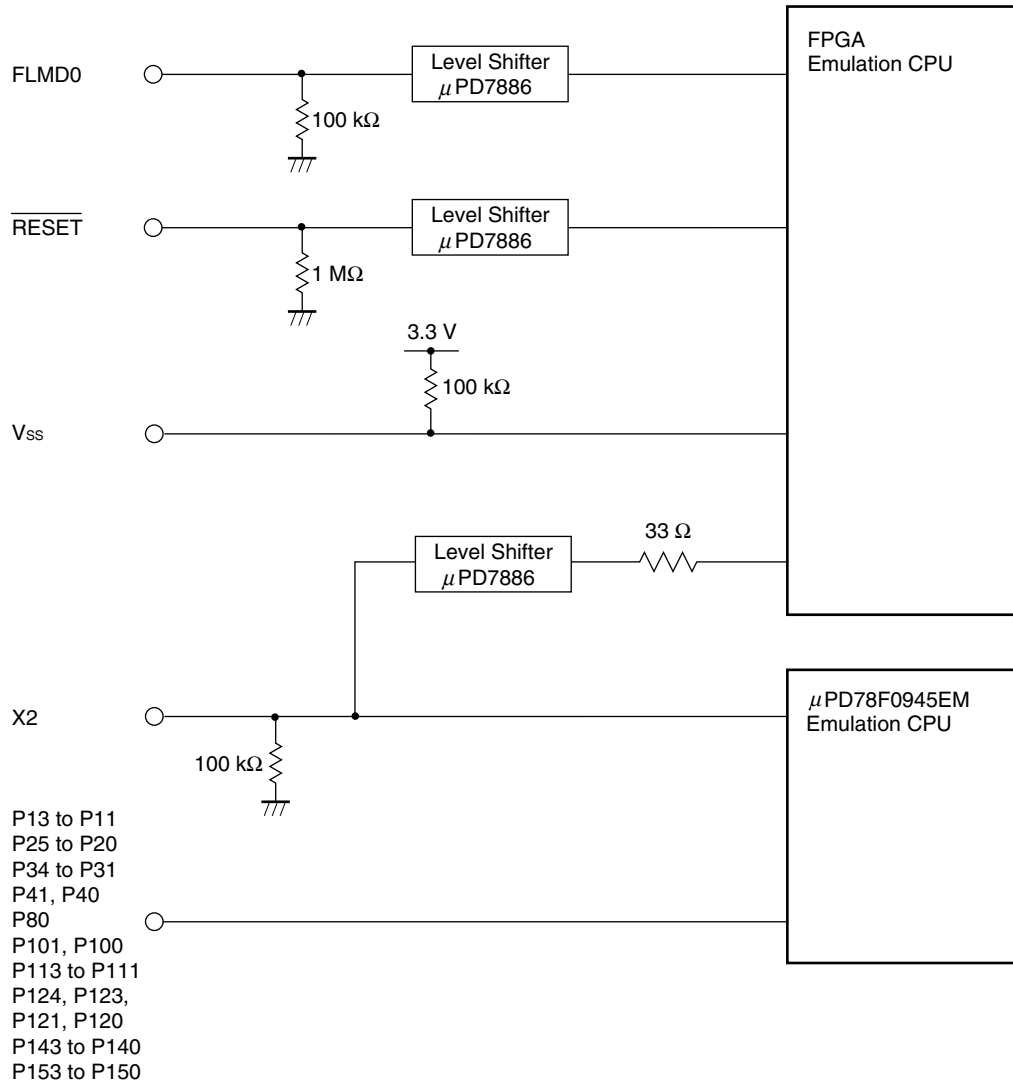


**Note** Transpose AV<sub>REF</sub> and AV<sub>SS</sub> to V<sub>DD</sub> and V<sub>SS</sub>, respectively, in the case of the product without A/D converter.

Figure 4-2. Emulation Circuit Equivalent Circuit 2 (2/2)

• Probe side  
(target system)

• QB-78K0LX3 side





### 4.3 For 78K0/LE3 Emulation

For the signals in (1) and (2) below, see **Figure 4-3 Emulation Circuit Equivalent Circuit 3**.

#### (1) Signals input and output by emulation CPU (FPGA, $\mu$ PD78F0945EM)

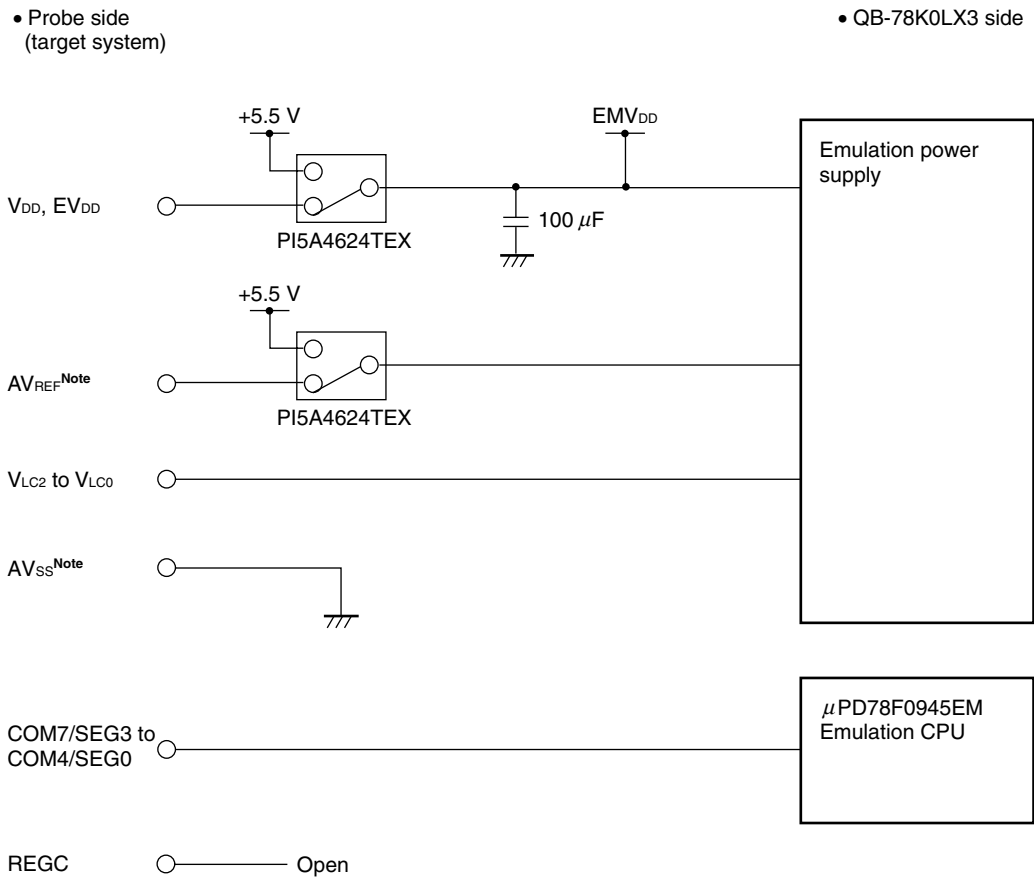
- P14 to P11
- P27 to P20
- P34 to P31
- P44 to P40
- P83 to P80
- P103 to P100
- P113 to P110
- P124, P123, P121, P120
- P143 to P140
- P153 to P150
- COM7 to COM4
- X2,  $\overline{\text{RESET}}$ ,  $V_{SS}$ ,  $EV_{SS}$ , FLMD0

#### (2) Other signals

- $V_{DD}$ ,  $EV_{DD}$ ,  $AV_{REF}^{\text{Note}}$ ,  $AV_{SS}^{\text{Note}}$
- $V_{LC2}$  to  $V_{LC0}$
- REGC

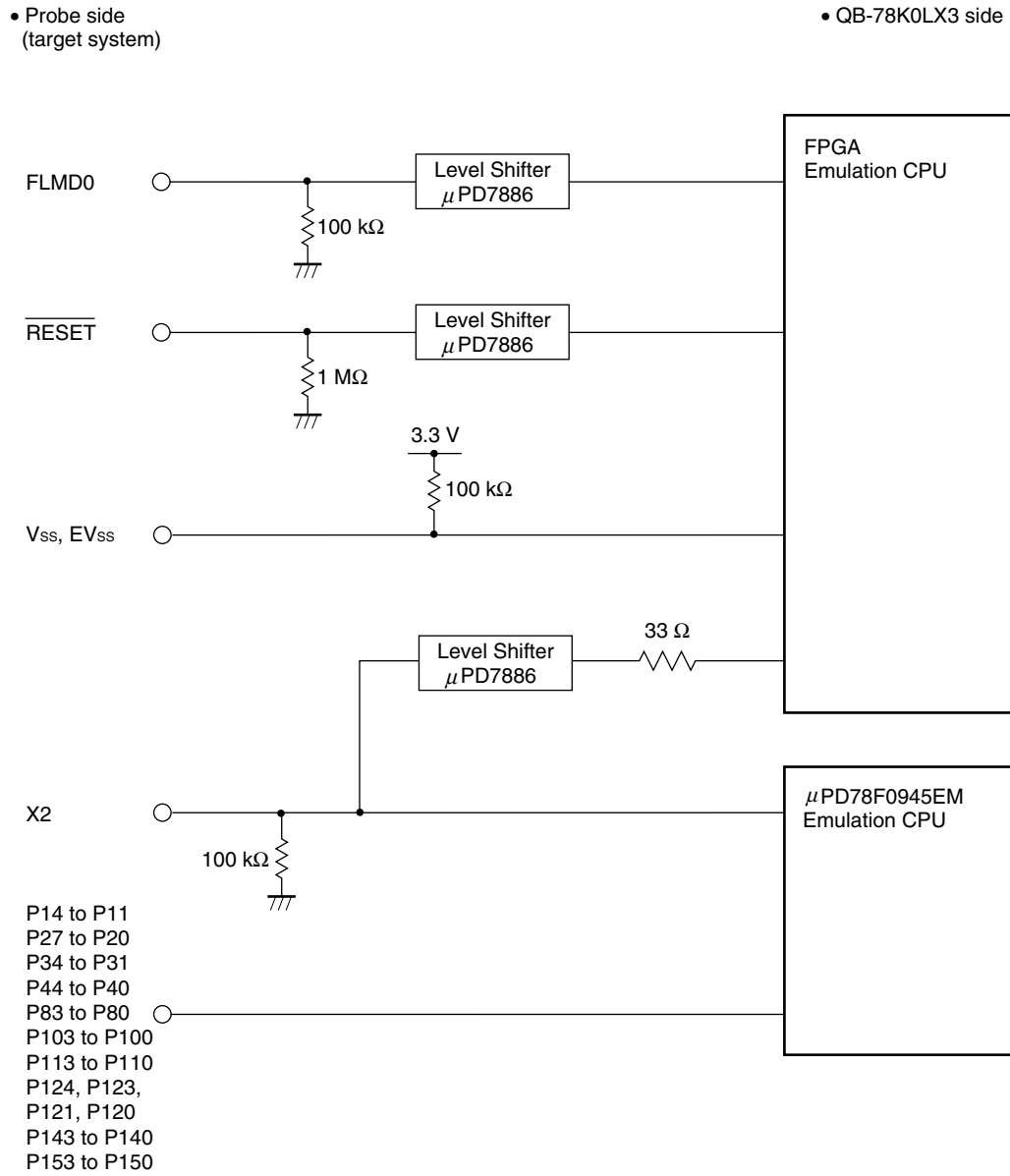
**Note** Transpose  $AV_{REF}$  and  $AV_{SS}$  to  $V_{DD}$  and  $V_{SS}$ , respectively, in the case of the product without A/D converter.

Figure 4-3. Emulation Circuit Equivalent Circuit 3 (1/2)



**Note** Transpose  $AV_{REF}$  and  $AV_{SS}$  to  $V_{DD}$  and  $V_{SS}$ , respectively, in the case of the product without A/D converter.

Figure 4-3. Emulation Circuit Equivalent Circuit 3 (2/2)



#### 4.4 For 78K0/LF3 Emulation

For the signals in (1) and (2) below, see **Figure 4-4 Emulation Circuit Equivalent Circuit 4**.

##### (1) Signals input and output by emulation CPU (FPGA, $\mu$ PD78F0945EM)

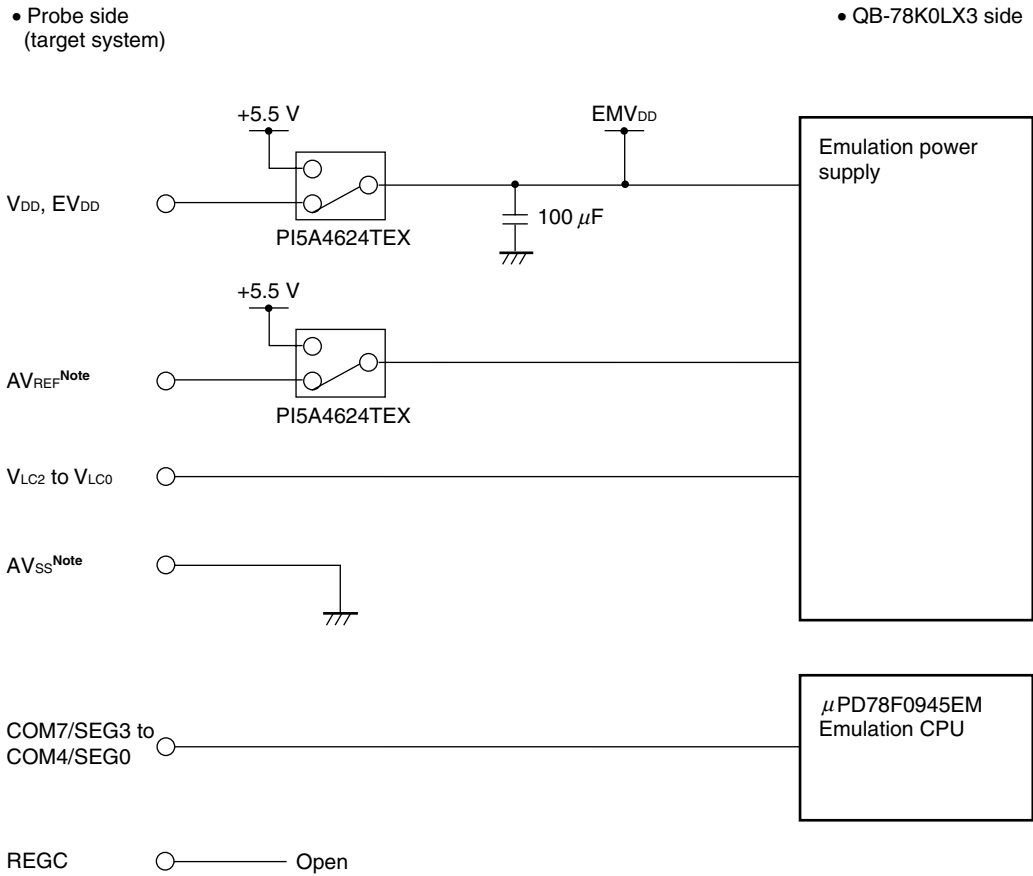
- P17 to P10
- P27 to P20
- P34 to P30
- P47 to P40
- P83 to P80
- P93 to P90
- P103 to P100
- P113 to P110
- P124, P123, P121, P120
- P133 to P130
- P143 to P140
- P153 to P150
- COM7 to COM4
- X2,  $\overline{\text{RESET}}$ ,  $V_{SS}$ ,  $EV_{SS}$ , FLMD0

##### (2) Other signals

- $V_{DD}$ ,  $EV_{DD}$ ,  $AV_{REF}^{\text{Note}}$ ,  $AV_{SS}^{\text{Note}}$
- $V_{LC2}$  to  $V_{LC0}$
- REGC

**Note** Transpose  $AV_{REF}$  and  $AV_{SS}$  to  $V_{DD}$  and  $V_{SS}$ , respectively, in the case of the product without A/D converter.

Figure 4-4. Emulation Circuit Equivalent Circuit 4 (1/2)

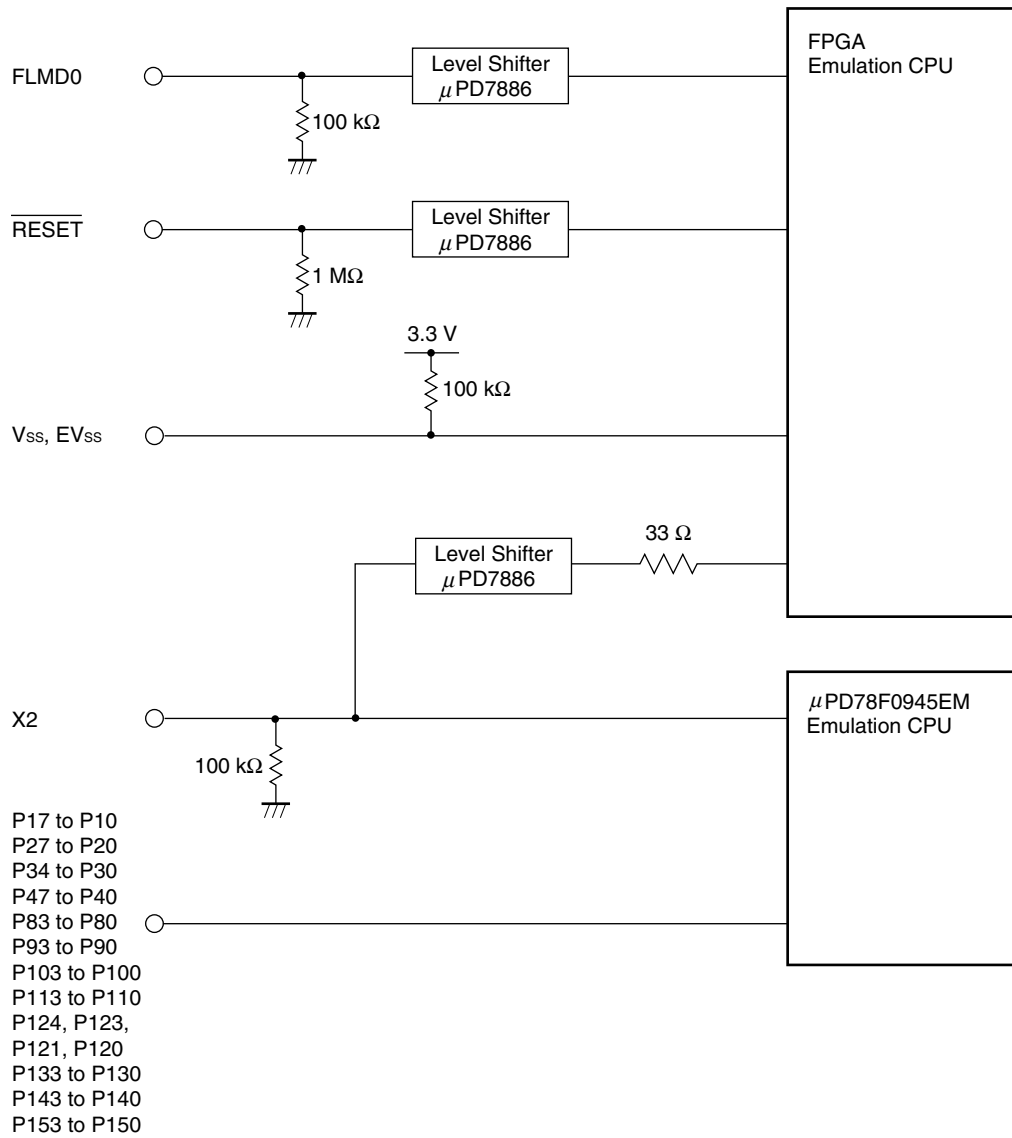


**Note** Transpose  $AV_{REF}$  and  $AV_{SS}$  to  $V_{DD}$  and  $V_{SS}$ , respectively, in the case of the product without A/D converter.

Figure 4-4. Emulation Circuit Equivalent Circuit 4 (2/2)

• Probe side  
(target system)

• QB-78K0LX3 side



## CHAPTER 5 NOTES

Observe the following notes.

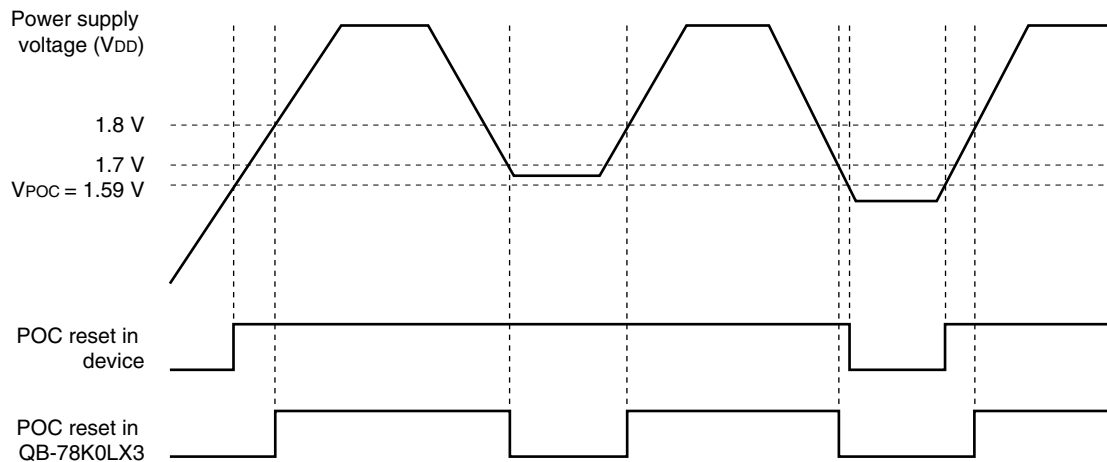
- The QB-78K0LX3 may be damaged if  $AV_{REF}$  is applied before the target powers  $V_{DD}$  and  $EV_{DD}$  are applied.
- Even when using the product without connecting a target system, connect and use the emulation probe and exchange adapter.

If the product is used without connecting the emulation probe and exchange adapter, a warning window is displayed but use is possible.

- Do not turn off the target power supply (do not allow it to become lower than the POC voltage) during a break (power supply can be turned off only during RUN).
- When inputting the external clock, input the square waveform with the same potential as the target device to the clock pins (X2, XT2).
- A WDT reset is not generated when an area for which the capacities of the internal ROM, internal high-speed ROM, and internal expansion RAM are not set with the IMS and IXS registers is illegally accessed. Emulation is performed with a fail-safe break.
- The POC detection voltage differs between the QB-78K0LX3 and the device.

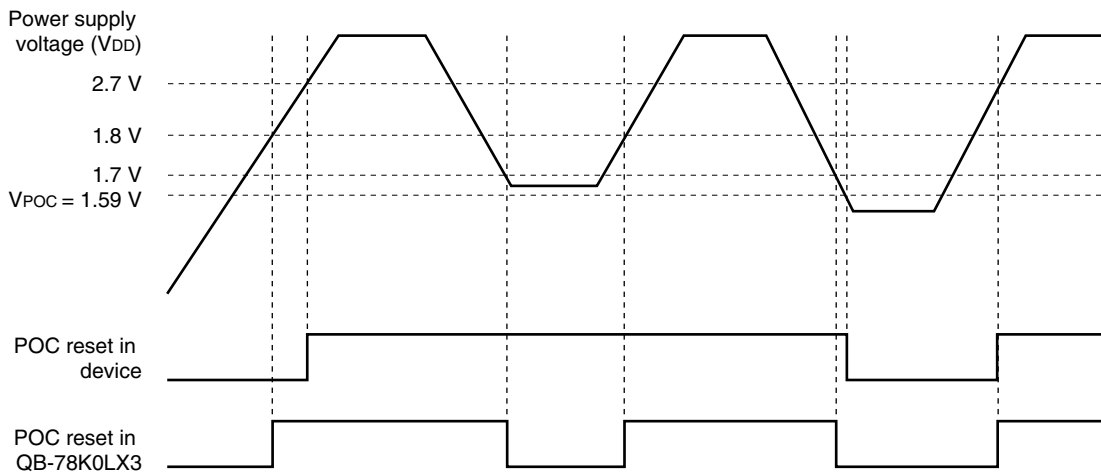
(1) In 1.59 V POC mode (option byte:  $POCMODE = 0$ )

- Device: An internal reset signal is generated at power application, and the reset state is released when the power supply voltage ( $V_{DD}$ ) exceeds the detection voltage ( $V_{POC} = 1.59\text{ V} \pm 0.15\text{ V}$ ). The power supply voltage ( $V_{DD}$ ) and detection voltage ( $V_{POC} = 1.59\text{ V} \pm 0.15\text{ V}$ ) are compared, an internal reset signal is generated when  $V_{DD}$  drops lower than  $V_{POC}$  ( $V_{DD} < V_{POC}$ ), and the reset state is released when  $V_{DD}$  becomes  $V_{POC}$  or higher ( $V_{DD} \geq V_{POC}$ ).
- QB-78K0LX3: An internal reset signal is generated at power application, and the reset state is released when the power supply voltage ( $V_{DD}$ ) exceeds 1.80 V. An internal reset signal is generated when  $V_{DD}$  drops lower than 1.70 V ( $V_{DD} < 1.70\text{ V}$ ), and the reset state is released when  $V_{DD}$  becomes 1.80 V or higher ( $V_{DD} \geq 1.80\text{ V}$ ).

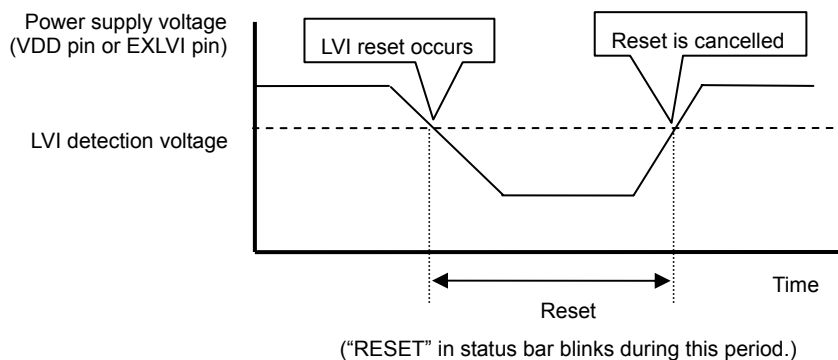


(2) In 2.7 V/1.59 V POC mode (option byte: POCMODE = 1)

- Device: An internal reset signal is generated at power application, and the reset state is released when the power supply voltage ( $V_{DD}$ ) exceeds  $V_{POC}$  (power detection voltage at power application;  $V_{POC} = 2.7\text{ V} \pm 0.2\text{ V}$ ).  
The power supply voltage ( $V_{DD}$ ) and detection voltage ( $V_{POC} = 1.59\text{ V} \pm 0.15\text{ V}$ ) are compared, an internal reset signal is generated when  $V_{DD}$  drops lower than  $V_{POC}$  ( $V_{DD} < V_{POC}$ ), and the reset state is released when  $V_{DD}$  becomes 2.7 V or higher ( $V_{DD} \geq 2.7\text{ V}$ ).
- QB-78K0LX3: An internal reset signal is generated at power application, and the reset state is released when the power supply voltage ( $V_{DD}$ ) exceeds 1.80 V.  
An internal reset signal is generated when the detection voltage ( $V_{POC} = 1.59\text{ V} \pm 0.15\text{ V}$ ) <  $V_{DD} < 1.70\text{ V}$ , and the reset state is released when  $V_{DD}$  becomes 1.80 V or higher ( $V_{DD} \geq 1.80\text{ V}$ ).  
If the power supply voltage ( $V_{DD}$ ) drops to a level of the detection voltage ( $V_{POC} = 1.59\text{ V} \pm 0.15\text{ V}$ ), the reset state is released the next time the power supply voltage ( $V_{DD}$ ) exceeds  $V_{POC}$  (power detection voltage at power application;  $V_{POC} = 2.7\text{ V} \pm 0.2\text{ V}$ ).



- When LVI reset occurs, “RESET”, which is displayed in the status bar of the debugger during reset periods, blinks. It is just an indication problem in the debugger.  
The blinking makes it seem as if the reset is set and cancelled repeatedly. It is in the reset state, however. See the following figure.





<R>

## APPENDIX A REVISION HISTORY

### A. 1 Major Revisions in This Edition

Page	Description
<b>CHAPTER 2 SETUP PROCEDURE</b>	
pp. 23, 24	Modification of 2.5.2 <b>Mounting YQ to TC</b>
<b>CHAPTER 5 NOTES</b>	
p. 46	Addition of note
<b>APPENDIX A REVISION HISTORY</b>	
p. 47	Addition of chapter

*For further information,  
please contact:*

**NEC Electronics Corporation**  
1753, Shimonumabe, Nakahara-ku,  
Kawasaki, Kanagawa 211-8668,  
Japan  
Tel: 044-435-5111  
<http://www.necel.com/>

**[America]**

**NEC Electronics America, Inc.**  
2880 Scott Blvd.  
Santa Clara, CA 95050-2554, U.S.A.  
Tel: 408-588-6000  
800-366-9782  
<http://www.am.necel.com/>

**[Europe]**

**NEC Electronics (Europe) GmbH**  
Arcadiastrasse 10  
40472 Düsseldorf, Germany  
Tel: 0211-65030  
<http://www.eu.necel.com/>

**Hanover Office**

Podbielskistrasse 166 B  
30177 Hannover  
Tel: 0 511 33 40 2-0

**Munich Office**

Werner-Eckert-Strasse 9  
81829 München  
Tel: 0 89 92 10 03-0

**Stuttgart Office**

Industriestrasse 3  
70565 Stuttgart  
Tel: 0 711 99 01 0-0

**United Kingdom Branch**

Cygnus House, Sunrise Parkway  
Linford Wood, Milton Keynes  
MK14 6NP, U.K.  
Tel: 01908-691-133

**Succursale Française**

9, rue Paul Dautier, B.P. 52  
78142 Velizy-Villacoublay Cédex  
France  
Tel: 01-3067-5800

**Sucursal en España**

Juan Esplandiu, 15  
28007 Madrid, Spain  
Tel: 091-504-2787

**Tyskland Filial**

Täby Centrum  
Entrance S (7th floor)  
18322 Täby, Sweden  
Tel: 08 638 72 00

**Filiale Italiana**

Via Fabio Filzi, 25/A  
20124 Milano, Italy  
Tel: 02-667541

**Branch The Netherlands**

Steijgerweg 6  
5616 HS Eindhoven  
The Netherlands  
Tel: 040 265 40 10

**[Asia & Oceania]**

**NEC Electronics (China) Co., Ltd**  
7th Floor, Quantum Plaza, No. 27 ZhiChunLu Haidian  
District, Beijing 100083, P.R.China  
Tel: 010-8235-1155  
<http://www.cn.necel.com/>

**Shanghai Branch**

Room 2509-2510, Bank of China Tower,  
200 Yincheng Road Central,  
Pudong New Area, Shanghai, P.R.China P.C:200120  
Tel:021-5888-5400  
<http://www.cn.necel.com/>

**Shenzhen Branch**

Unit 01, 39/F, Excellence Times Square Building,  
No. 4068 Yi Tian Road, Futian District, Shenzhen,  
P.R.China P.C:518048  
Tel:0755-8282-9800  
<http://www.cn.necel.com/>

**NEC Electronics Hong Kong Ltd.**

Unit 1601-1613, 16/F., Tower 2, Grand Century Place,  
193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: 2886-9318  
<http://www.hk.necel.com/>

**NEC Electronics Taiwan Ltd.**

7F, No. 363 Fu Shing North Road  
Taipei, Taiwan, R. O. C.  
Tel: 02-8175-9600  
<http://www.tw.necel.com/>

**NEC Electronics Singapore Pte. Ltd.**

238A Thomson Road,  
#12-08 Novena Square,  
Singapore 307684  
Tel: 6253-8311  
<http://www.sg.necel.com/>

**NEC Electronics Korea Ltd.**

11F., Samik Lavied'or Bldg., 720-2,  
Yeoksam-Dong, Kangnam-Ku,  
Seoul, 135-080, Korea  
Tel: 02-558-3737  
<http://www.kr.necel.com/>