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# User's Manual

# QB-78K0RLX3

## In-Circuit Emulator

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### Target Devices

**78K0R/LF3**

**78K0R/LG3**

**78K0R/LH3**

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Date Published April 2009 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-78K0RLX3. 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-78K0RLX3.

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

- General
- Setup procedure
- Settings at product shipment
- Cautions

**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-78K0RLX3

→ 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-78K0RLX3

→ See the user's manual of the debugger (supplied with the QB-78K0RLX3) 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.
78K0R/Lx3	Generic name indicating 78K0R/LF3, 78K0R/LG3 and 78K0R/LH3.
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-78K0RLX3 In-Circuit Emulator		This manual
RA78K0R Ver. 1.20 Assembler Package	Operation	U18547E
	Language	U18546E
CC78K0R Ver. 2.00 C Compiler	Operation	U18549E
	Language	U18548E
ID78K0R-QB Ver. 3.20 Integrated Debugger	Operation	U17839E
PM+ Ver. 6.31 Project Manager		U18416E

**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-78K0RLX3 is an in-circuit emulator for emulating the 78K0R/Lx3.

Hardware and software can be debugged efficiently in the development of systems in which the 78K0R/Lx3 is used. This manual describes basic setup procedures, hardware specifications, system specifications, and how to set switches.

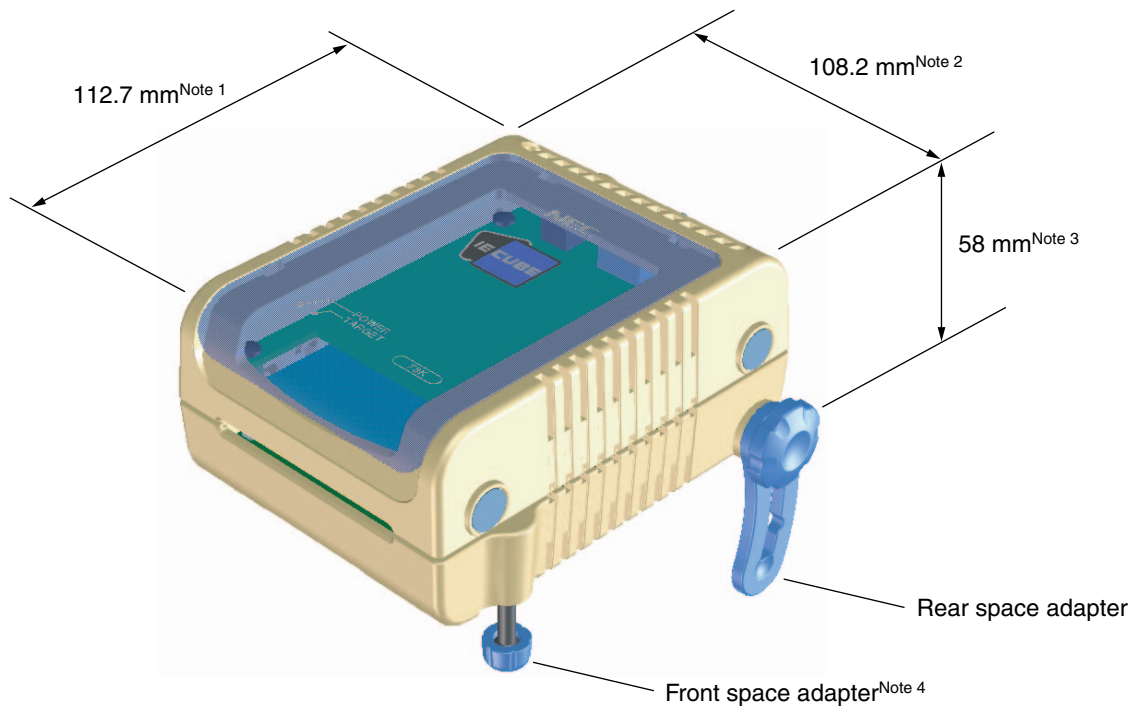
### 1.1 Hardware Specifications

**Table 1-1. QB-78K0RLX3 Hardware Specifications**

Parameter		Specification
Target device		78K0R/LF3, 78K0R/LG3, 78K0R/LH3
Operating voltage		1.8 to 5.5 V
Operating frequency <sup>Note</sup>		High-speed system clock $2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ : 2 to 20 MHz $1.8\text{ V} \leq V_{DD} \leq 2.7\text{ V}$ : 2 to 5 MHz
		Internal high-speed oscillation clock $2.7\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ : An 8 MHz clock is supplied from the oscillator in the QB-78K0RLX3 $1.8\text{ V} \leq V_{DD} < 2.7\text{ V}$ : An 1 MHz clock is supplied from the oscillator in the QB-78K0RLX3
		Subsystem clock A 32.768 kHz clock is supplied from the oscillator in the QB-78K0RLX3
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-78K0RLX3	Output: DC15 V, 1 A Input: AC100 to 240 V
	Target system power supply	Voltage: 1.8 to 5.5 V Current: approx. 10 mA MAX.
Weight		Approx. 480 g
Host interface		USB interface (1.1, 2.0)

<R>

**Note** Errors are within  $\pm 0.5\%$ . However, this does not apply to errors of the oscillator or clock system on the target board.



- 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-78K0RLX3 system specifications.

**Table 1-2. QB-78K0RLX3 System Specifications**

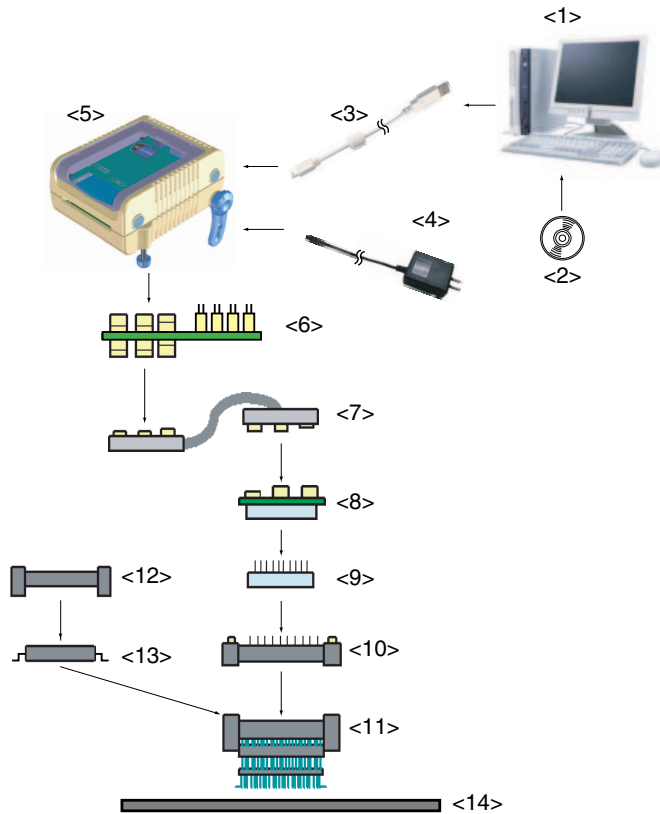
Parameter		Specification
Emulation memory capacity	Internal ROM	512 KB (MAX.)
	Internal RAM	61.75 KB (MAX.)
Program execution functions	Real-time execution function	Go, Start from Here, Come Here, Restart, Return Out, Ignore break points and Go
	Non-real-time execution function	Step In, Next Over, Slowmotion, 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-78K0RLX3 connected to a PC (Windows™ PC (Windows 2000 and Windows XP), PC/AT™ compatible). Connection is possible even without optional products.

Figure 1-1. System Configuration



- |  |  |
|--|--|
| <p>&lt;1&gt; Host machine</p> <p>&lt;2&gt; ID78K0R-QB Disk/Accessory Disk</p> <p>&lt;3&gt; USB interface cable</p> <p>&lt;R&gt; &lt;4&gt; AC adapter</p> <p>&lt;5&gt; QB-78K0RLX3</p> <p>&lt;6&gt; Check pin adapter (optional)</p> <p>&lt;7&gt; Emulation probe</p> <p>&lt;8&gt; Exchange adapter</p> <p>&lt;9&gt; Space adapter (optional)</p> <p>&lt;10&gt; YQ connector</p> <p>&lt;11&gt; Target connector</p> <p>&lt;12&gt; Mount adapter (optional)</p> <p>&lt;13&gt; Device</p> <p>&lt;14&gt; Target system</p> | <p>: Windows PC (Windows 2000 and Windows XP), IBM PC/AT compatible can be used</p> <p>: Debugger, USB drivers, manual, etc.</p> <p>: Cable connecting QB-78K0RLX3 to host machine</p> <p>: AC adapters classified by region</p> <p>: This product</p> <p>: Adapter used for monitoring waveforms with oscilloscope</p> <p>: High-characteristic FPC type emulation probe</p> <p>: Adapter that performs pin conversion</p> <p>: Adapter used for height adjustment</p> <p>: Connector that connects exchange adapter to target connector</p> <p>: Connector soldered to target system</p> <p>: Adapter used for mounting target device into socket</p> <p>: Target device</p> |
|--|--|

**Remarks 1.** Obtain device files from the NEC Electronics website.  
<http://www.necel.com/micro/en/ods/>

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**.

<R> 4. The part number of <4> differs depending on the region of use. See **Table 1-5 Part Numbers of AC Adapter for IECUBE Classified by Region** for the part numbers. The IECUBE requires an AC adapter that must be purchased separately.

<R> 5. See **Table 1-4 Common Probe and Adapter** for the part numbers of <6> and <7>.

<R> 6. The combination of <8>, <9>, <10>, <11>, and <12> varies depending on the emulation device. See **Table 1-3 Adapters and Connectors for Each Target Device** for the combinations.



## 1.4 System Configuration for Each Target Device

The following table lists the system configuration for each target device of the QB-78K0RLX3.

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

Target Device	Package	Exchange Adaptor	Space Adaptor	YQ Connector	Target Connector	Mount Adaptor
78K0R/LF3	80GC	QB-80GC-EA-09T	QB-80GC-YS-01T	QB-80GC-YQ-01T	QB-80GC-NQ-01T	QB-80GC-HQ-01T
	80GK	QB-80GK-EA-08T	QB-80GK-YS-01T	QB-80GK-YQ-01T	QB-80GK-NQ-01T	QB-80GK-HQ-01T
78K0R/LG3	100GC	QB-100GC-EA-08T	QB-100GC-YS-01T	QB-100GC-YQ-01T	QB-100GC-NQ-01T	QB-100GC-HQ-01T
78K0R/LH3	128GF	QB-128GF-EA-01T	QB-128GF-YS-01T	QB-128GF-YQ-01T	QB-128GF-NQ-01T	QB-128GF-HQ-01T

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

Name	Part Number
Check pin adapter	QB-144-CA-01
Emulation probe	QB-144-EP-02S

The adapter and connector for each device, and common probe and adapter are sold separately. An exchange adapter, a YQ connector, a target connector, and an emulation probe are included, depending on the order product name. For details, refer to **1.5 Package Contents**.

**Remark** For the package drawings of the connector, adapter, and probe, refer to the following URL.  
<http://www.necel.com/micro/en/development/asia/Emulator/IE/iecube.html>

## 1.5 Package Contents

The included products are described for each order product name.

### Products supplied with QB-78K0RLX3-ZZZ

- 1: QB-78K0RLX3
- 2: AC adapter
- 3: USB interface cable (2 meters)
- 4: Probe holder
- 5: Online user registration card (warranty card and software contract in one)
- 6: ID78K0R-QB Disk (CD-ROM)
- 7: Accessory Disk (CD-ROM)
- 8: IECUBE Setup Manual (Japanese/English)
- 9: Packing list
- 10: QB-MINI2

### Products supplied with QB-78K0RLX3-T128GF

- 1 to 10
- 11: Emulation probe QB-144-EP-02S
  - 12: Exchange adapter QB-128GF-EA-01T
  - 13: YQ connector QB-128GF-YQ-01T
  - 14: Target connector QB-128GF-NQ-01T

### Products supplied with QB-78K0RLX3-T100GC

- 1 to 10
- 11: Emulation probe QB-144-EP-02S
  - 12: Exchange adapter QB-100GC-EA-08T
  - 13: YQ connector QB-100GC-YQ-01T
  - 14: Target connector QB-100GC-NQ-01T

### Products supplied with QB-78K0RLX3-T80GC

- 1 to 10
- 11: Emulation probe QB-144-EP-02S
  - <R> 12: Exchange adapter QB-80GC-EA-09T
  - 13: YQ connector QB-80GC-YQ-01T
  - 14: Target connector QB-80GC-NQ-01T

### Products supplied with QB-78K0RLX3-T80GK

- 1 to 10
- 11: Emulation probe QB-144-EP-02S
  - <R> 12: Exchange adapter QB-80GK-EA-08T
  - 13: YQ connector QB-80GK-YQ-01T
  - 14: Target connector QB-80GK-NQ-01T

&lt;R&gt;

**1.6 AC Adapter for IECUBE**

The specifications of the AC adapter for IECUBE differ depending on the region of use. Be sure to use an AC adapter corresponding to the region of use.

The IECUBE is not provided with an AC adapter. It must be purchased separately.

**Table 1-5. Part Numbers of AC Adapter for IECUBE Classified by Region**

Product	Destination (Region) <sup>Notes 1,2</sup>	Part Number <sup>Note 3</sup>
AC adapter (sold separately)	Japan	QB-COMMON-PW-JP
	USA	QB-COMMON-PW-EA
	China	QB-COMMON-PW-CN
	Hong Kong	QB-COMMON-PW-HK
	South Korea	QB-COMMON-PW-KR
	Singapore	QB-COMMON-PW-SG
	Taiwan	QB-COMMON-PW-TW

**Notes 1.** Products are shipped only on order from each region.

**2.** Contact a distributor or an NEC Electronics sales representative for information on regions other than the above.

**3.** Only the AC adapter usable in each region can be ordered.

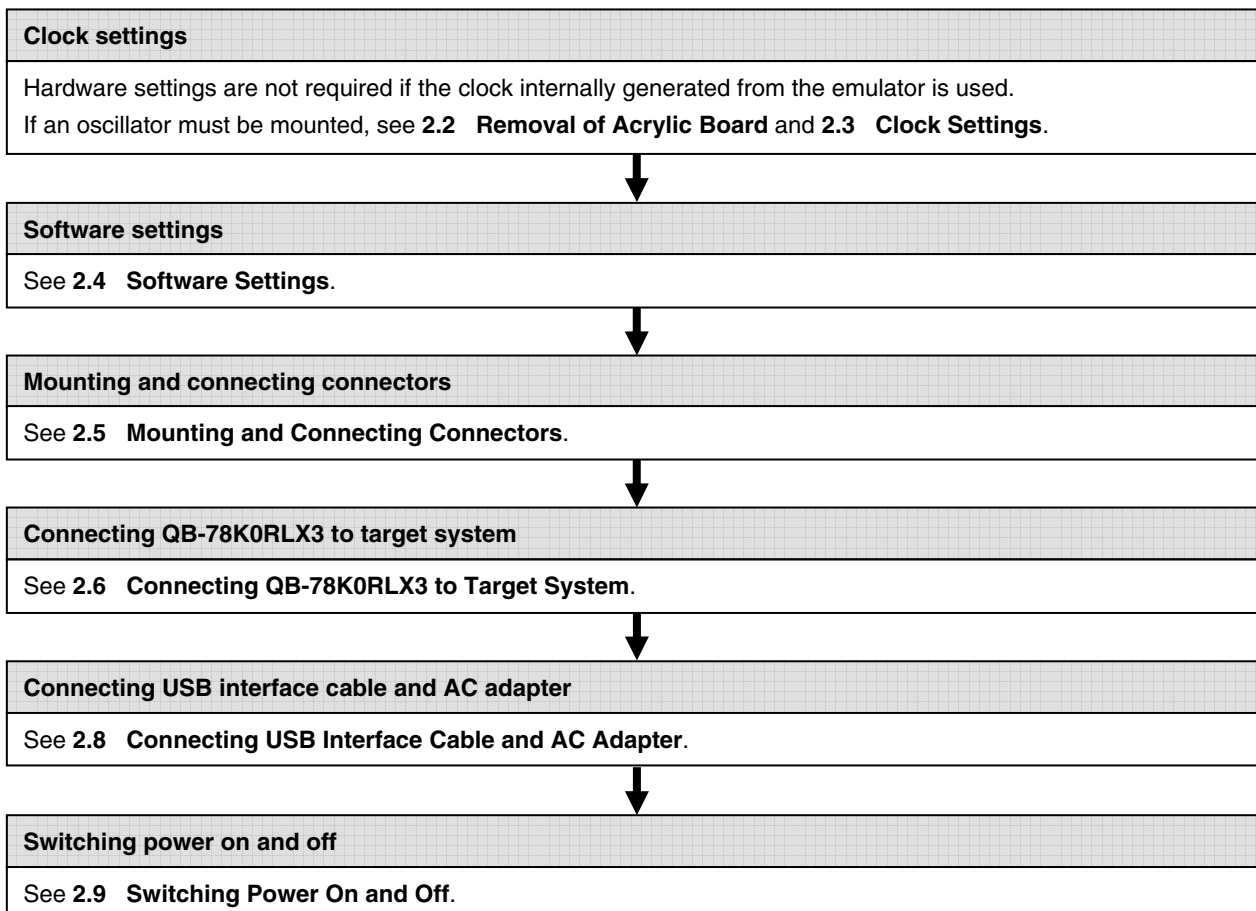
## CHAPTER 2 SETUP PROCEDURE

This chapter explains the QB-78K0RLX3 setup procedure.

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

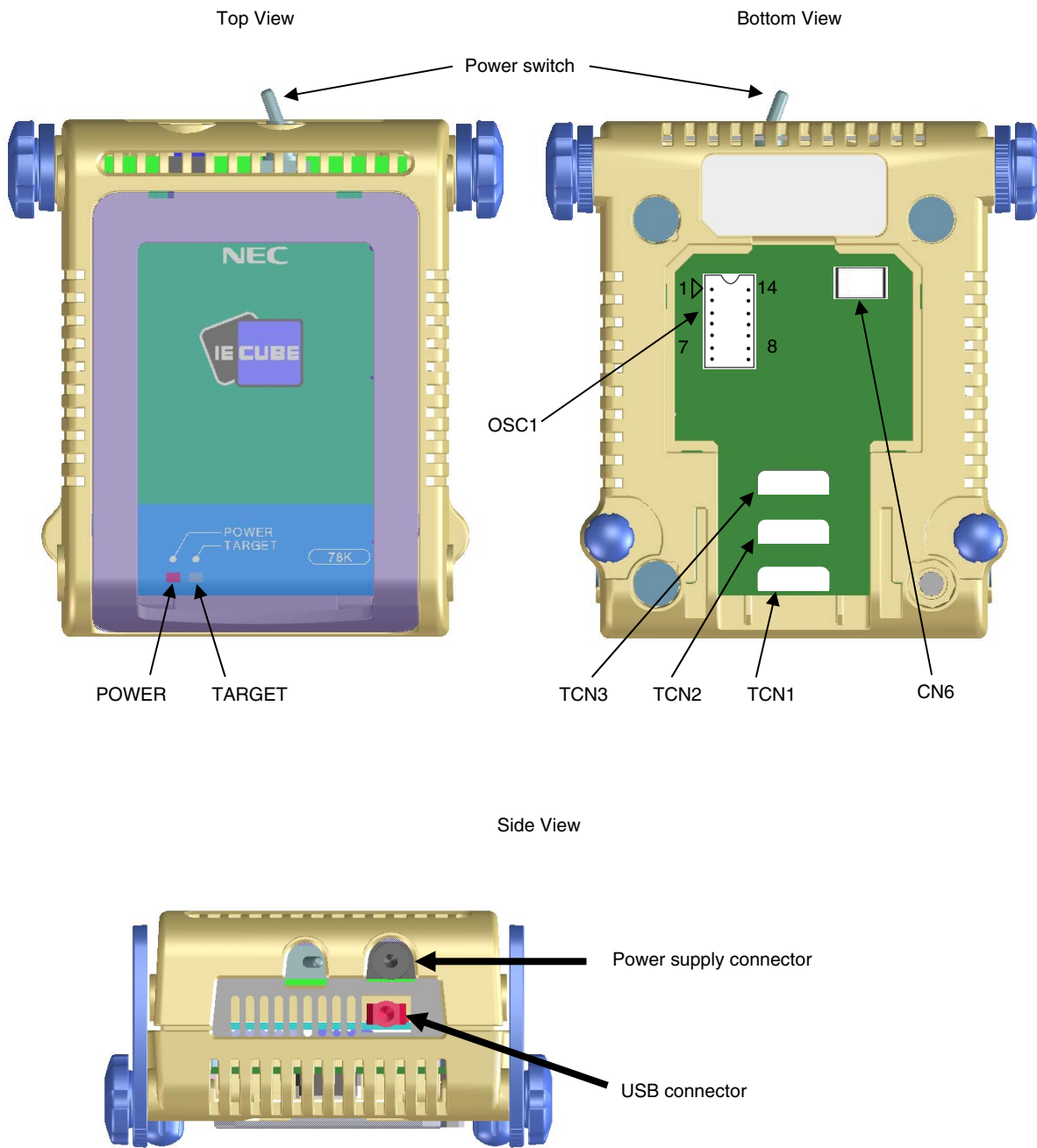
Perform setup along the lines of the following procedure.

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-78K0RLX3



(1) TCN1, TCN2, TCN3

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

(2) OSC1

This is a socket for mounting the oscillator.

(3) CN6

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-78K0RLX3 is switched on.

LED State	QB-78K0RLX3 State
Lit	Power switch ON
Not lit	Power switch OFF or AC adapter not connected to QB-78K0RLX3
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

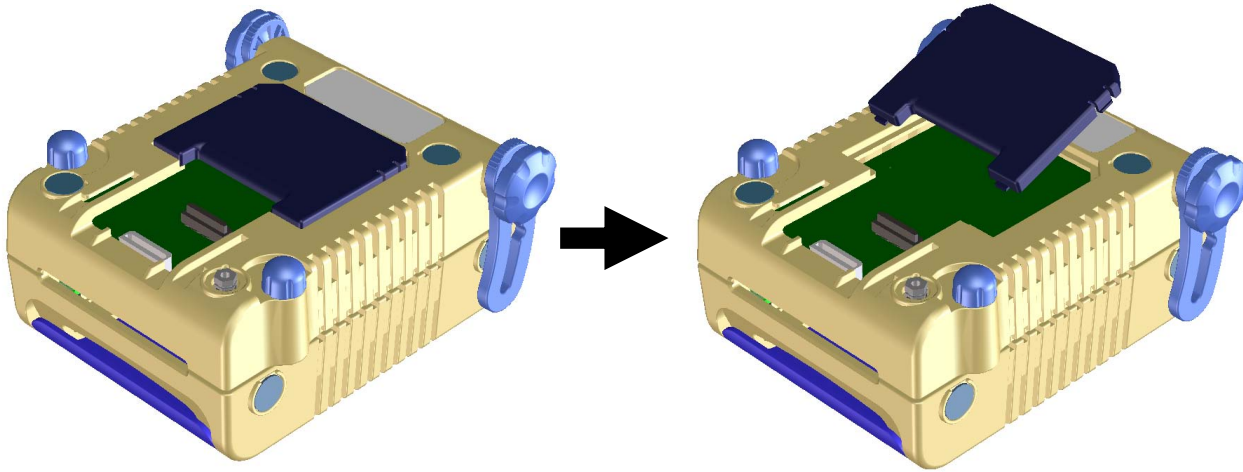
This is the power switch of the QB-78K0RLX3.

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-78K0RLX3 must be removed. The acrylic board can be removed by lifting it up.

Figure 2-2. Acrylic Board Removal Method



## 2.3 Clock Settings

The following four 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 <sup>Note 1</sup> (X1 oscillator or External input)	(a) When the clock generated within the emulator is used	System
	(b) When the clock is supplied from the target system	External
	(c) When the oscillator (OSC1) mounted onto the emulator is used	Clock Socket
(2) Internal high-speed oscillation clock	Uses the clock internally generated from the emulator	–
(3) Subsystem clock <sup>Note 2</sup> (XT1 oscillator)	(a) When the clock generated within the emulator is used	System
	(b) When the clock is supplied from the target system	External

- Notes**
- First, select “System” in the debugger settings (refer to (a) When the clock generated within the emulator is used, in (1) High-speed system clock).  
If there is no clock that can be selected, follow the descriptions below.
    - If the target system clock can supply a square wave for the emulator:  
Select “External” in the debugger settings (refer to (b) When the clock is supplied from the target system, in (1) High-speed system clock).
    - If the target system clock cannot supply a square wave for the emulator:  
Mount onto the emulator the oscillator of the clock to be used and select “Clock Socket” in the debugger settings (refer to (c) When the oscillator (OSC1) mounted onto the emulator is used, in (1) High-speed system clock).
  - First, select “System” in the debugger settings (refer to (a) When the clock generated within the emulator is used, in (3) Subsystem clock).  
If there is no clock that can be selected, it can be supplied from the target system clock. A square wave, however, must be supplied (refer to (b) When the clock is supplied from the target system, in (3) Subsystem clock).

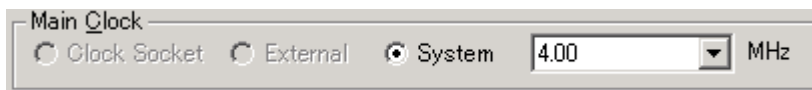
Oscillation with the resonator on the target system is not supported. Therefore, the in-circuit emulator cannot emulate the oscillation operation of the clock on the target system.



- (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) When the clock generated within the emulator is used	–	System
(b) When the clock is supplied from the target system <sup>Note</sup>	–	External
(c) When the oscillator (OSC1) mounted onto the emulator is used	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) When the clock generated within the emulator is used

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, 12.00, 16.00, 20.00 [MHz]

- (b) When the clock is supplied 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) When the oscillator (OSC1) mounted onto the emulator is used

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.

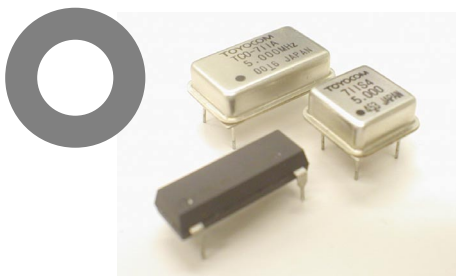


Figure 2-3. Oscillator Shape

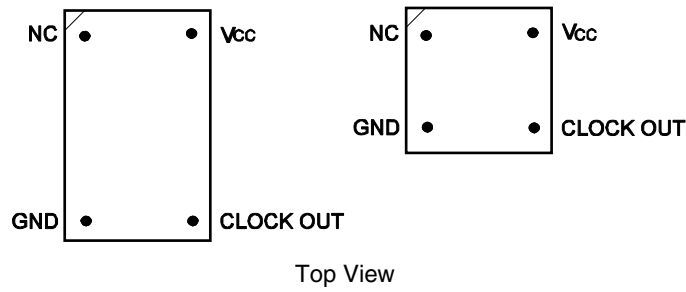
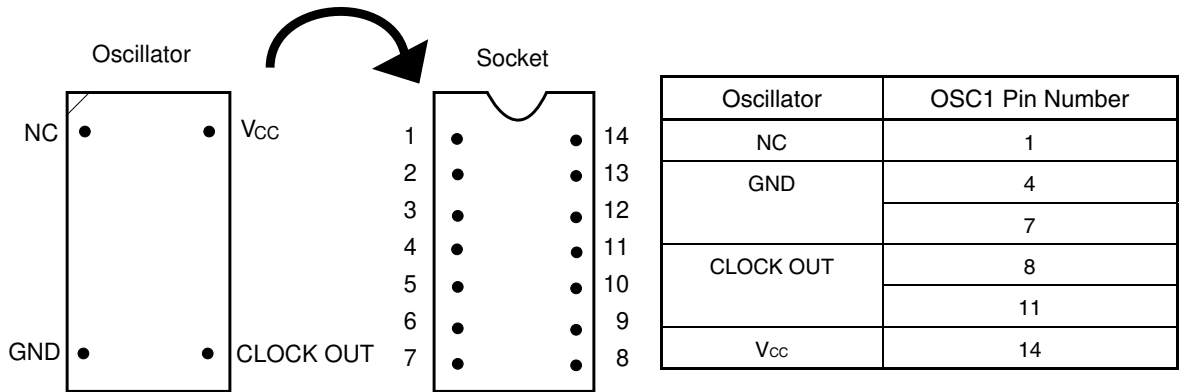


Figure 2-4. Mapping of Oscillator to Socket



**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.