User's Manual

QB-RL78G1C

In-Circuit Emulator

User's Manual

Target Devices

RL78/G1C

Renesas Electronics
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(2012.4)

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 **2.3 Mounting and Connecting Connectors (When Using S Type) or 2.4 Mounting and Connecting Connectors (When Using T Type).**
- 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**.

How to Use This Manual

Readers

This manual is intended for users who wish to perform debugging using the QB-RL78G1C. 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-RL78G1C.

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-RL78G1C
→ 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-RL78G1C
→ See the user's manual of the debugger (supplied with the QB-RL78G1C) 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.
IECUBE ™	Generic name for Renesas 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-RL78G1C In-Circuit Emulator	This manual
RL78 family User's Manual :Software	R01US0015E

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.

CONTENTS

CHAPTER 1 GENERAL

The QB-RL78G1C is an in-circuit emulator for emulating the RL78/G1C.
Hardware and software can be debugged efficiently in the development of systems in which the RL78/G1C is used.
This manual descries basic setup procedures, hardware specifications, system specifications, and how to set switches.

1.1 Hardware Specifications

Table 1-1. QB-RL78G1C Hardware Specifications

Parameter			Specification
Target device			RL78/G1C
Operating voltage			2.4V to 5.5V
Operating frequency	Main system clock Note1	High-speed system clock	2.7 V ≤ VDD ≤ 5.5 V: 1 to 20 MHz 2.4 V ≤ VDD ≤ 2.7 V: 1 to 16 MHz
		High-speed on-chip oscillator clock	2.4 V ≤ VDD ≤ 5.5 V: 1 to 24 MHz
		External main system clock	2.7 V ≤ VDD ≤ 5.5 V: 1 to 20 MHz 2.4 V ≤ VDD ≤ 2.7 V: 1 to 16 MHz
	Low-speed on-chip oscillator clock		2.4 V ≤ VDD ≤ 5.5V: 15K Hz
	Subsystem clock Note2, Note3		2.4 V ≤ VDD ≤ 5.5V: 32.768 KHz
	PLL Note4		2.4 V ≤ VDD ≤ 5.5V: 48MHz
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	Target system power supply		Voltage: 2.4 to 5.5 V Current: approx. 150 mA MAX
Weight			Approx. 400 g
Host interface			USB interface (1.1, 2.0)

Note1 Errors are within ±0.05%. However, this does not apply to errors of the oscillator or clock system on the target board.

Note2 Errors are within ±0.005%. However, this does not apply to errors of the oscillator or clock system on the target board.

Note3 Errors are within ±0.005%. However, this does not apply to errors of the oscillator or clock system on the target board.

Note4 Errors are within ±0.005%. However, this does not apply to errors of the oscillator or clock system on the target board.

Note5 Does not include projection of power switch

Note6 Includes projection of screw that fixes rear space adapter

Note7 Rear space adapter can adjust the height from 30 mm (longest) to 0 mm (shortest)

Note8 Front space adapter can adjust the height from 20 mm (longest) to 5 mm (shortest)

1.2 Names and Functions of Hardware

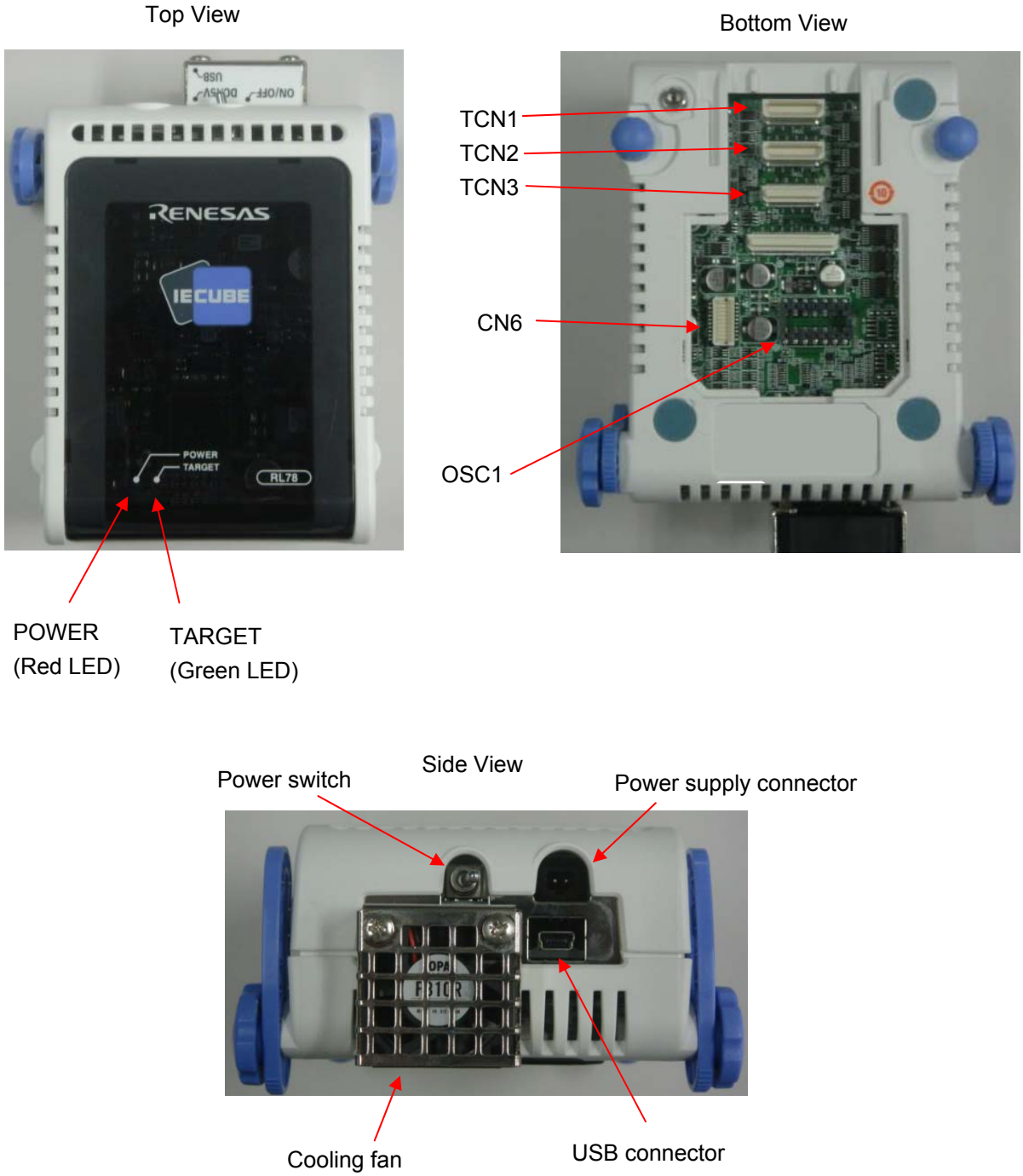


Figure 1-1. Names of Parts of QB-RL78G1C

(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-RL78G1C is switched on.

LED State	QB-RL78G1C State
Lit	Power switch ON
Not lit	Power switch OFF or AC adapter not connected to QB-RL78G1C
Blinking	Internal error occurred (Contact an Renesas 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-RL78G1C.

It is OFF at shipment.

(7) Cooling fun

This is the cooling fun of the QB-RL78G1C.

It works when the power supply of the QB-RL78G1C is switched on.

1.3 System Specifications

This section shows the QB-RL78G1C system specifications.

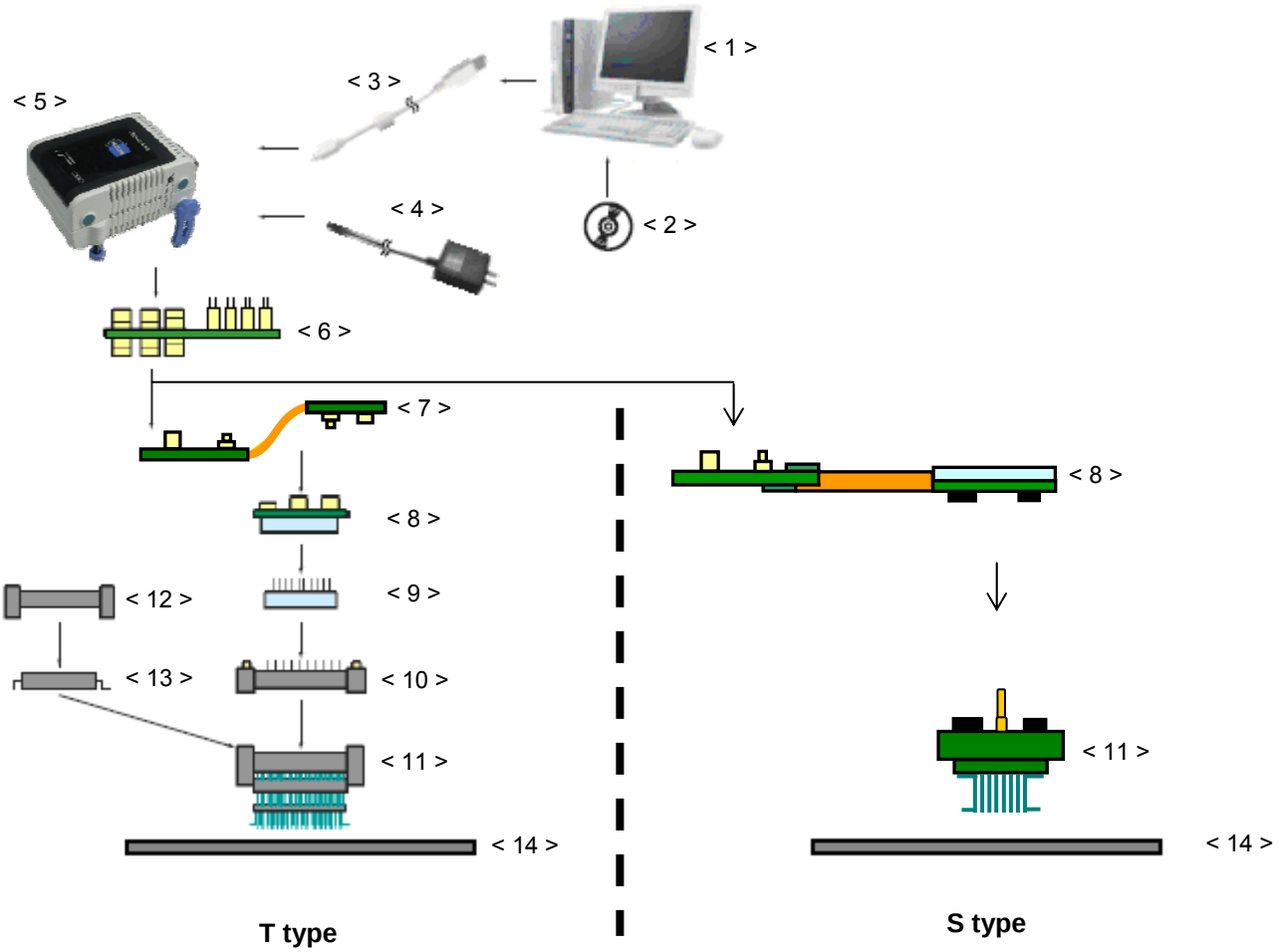
Table 1-2. QB-RL78G1C System Specifications

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, Slow motion, 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 points
	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	120 MHz
	Measurement objects	Start through end of program execution Start event through end event
	Maximum measurement time	Approx. 40 hours and 43 minutes
	Minimum resolution	8ns
	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

1.4 System Configuration

This section shows the system configuration when using the QB-RL78G1C connected to a PC (Windows™ PC, PC/AT™ compatible). Connection is possible even without optional products.

Figure 1-2. System Configuration



<1> Host machine : Windows PC, IBM PC/AT compatible can be used
<2> Accessory Disk : Manual, etc.
<3> USB interface cable : Cable connecting QB-RL78G1C to host machine
<4> AC adapter : AC adapters classified by region
<5> QB-RL78G1C : This product
<6> Check pin adapter (optional) : Adapter used for monitoring waveforms with oscilloscope
<7> Emulation probe : High-characteristic FPC type 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. Refer to **1.6 Package Contents** for the purchase forms of the above products.

2. As for handling of connectors, refer to **2.3 Mounting and Connecting Connectors (When Using S Type) or 2.4 Mounting and Connecting Connectors (When Using T Type)**.

3. 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.

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

5. 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.

6. To determine the T Type socket or the S Type socket, check for "T" or "S" at the end of the socket product name.

Example:

QB-64FB-EA-01T -> T Type

QB-48NA-EA-02S -> S Type

1.5 System Configuration for Each Target Device

The following table lists the system configuration for each target device of the QB-RL78G1C.
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 **1.6 Package Contents.**

Remark For the package drawings of the connector, adapter and probe, refer to the following URL.

http://www.renesas.com/iecube/rl78

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

Target Device	Package	Exchange Adaptor	Space Adaptor	YQ Connector	Target Connector	Mount Adaptor
R5F10JG	48FB	QB-48FB-EA-01T	QB-48FB-YS-01T	QB-48FB-YQ-01T	QB-48FB-NQ-01T	QB-48FB-HQ-01T
	48NA	QB-48NA-EA-01S	—	—	QB-48NA-TC-01S	—
R5F10JB	32NA	QB-32NA-EA-04S	—	—	QB-32NA-TC-01S	—
	32FP	QB-32FP-EA-03T	QB-32FP-YS-01T	QB-32FP-YQ-01T	QB-32FP-NQ-01T	QB-32FP-HQ-01T

Table 1-4. Common Probe and Adapter

Name	Part Number	Target Device
Check pin adapter	QB-144-CA-01	RL78/G1C
Emulation probe	QB-80-EP-01T	RL78/G1C

1.6 Package Contents

The included products are described for each order product name.

Products supplied with QB-RL78G1C-ZZZ

1: QB-RL78G1C
2: USB interface cable (2 meters)
3: Online user registration card (warranty card and software contract in one)
4: Probe holder (For QB-144-EP-02S. This product is not used.)
5: Packing list

Products supplied with QB-RL78G1C-T48FB

1 to 5
6: Emulation probe QB-80-EP-01T
7: Exchange adapter QB-48FB-EA-01T
8: YQ connector QB-64FB-YQ-01T
9: Target connector QB-48FB-NQ-01T

Products supplied with QB-RL78G1C-S48NA

1 to 5
6: Emulation probe QB-80-EP-01T
7: Exchange adapter QB-48NA-EA-01S
8: Target connector QB-48NA-TC-01S

Products supplied with QB-RL78G1C-S32NA

1 to 5
6: Emulation probe QB-80-EP-01T
7: Exchange adapter QB-32NA-EA-04S
8: Target connector QB-32NA-TC-01S

Products supplied with QB-RL78G1C-T32FP

1 to 5
6: Emulation probe QB-80-EP-01T
7: Exchange adapter QB-32FP-EA-03T
8: YQ connector QB-32FP-YQ-01T
9: Target connector QB-32FP-NQ-01T

1.7 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.

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

Product	Destination (Region)Notes 1, 2	Part NumberNote 3
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 a Renesas Electronics sales representative for information on regions other than the above.

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

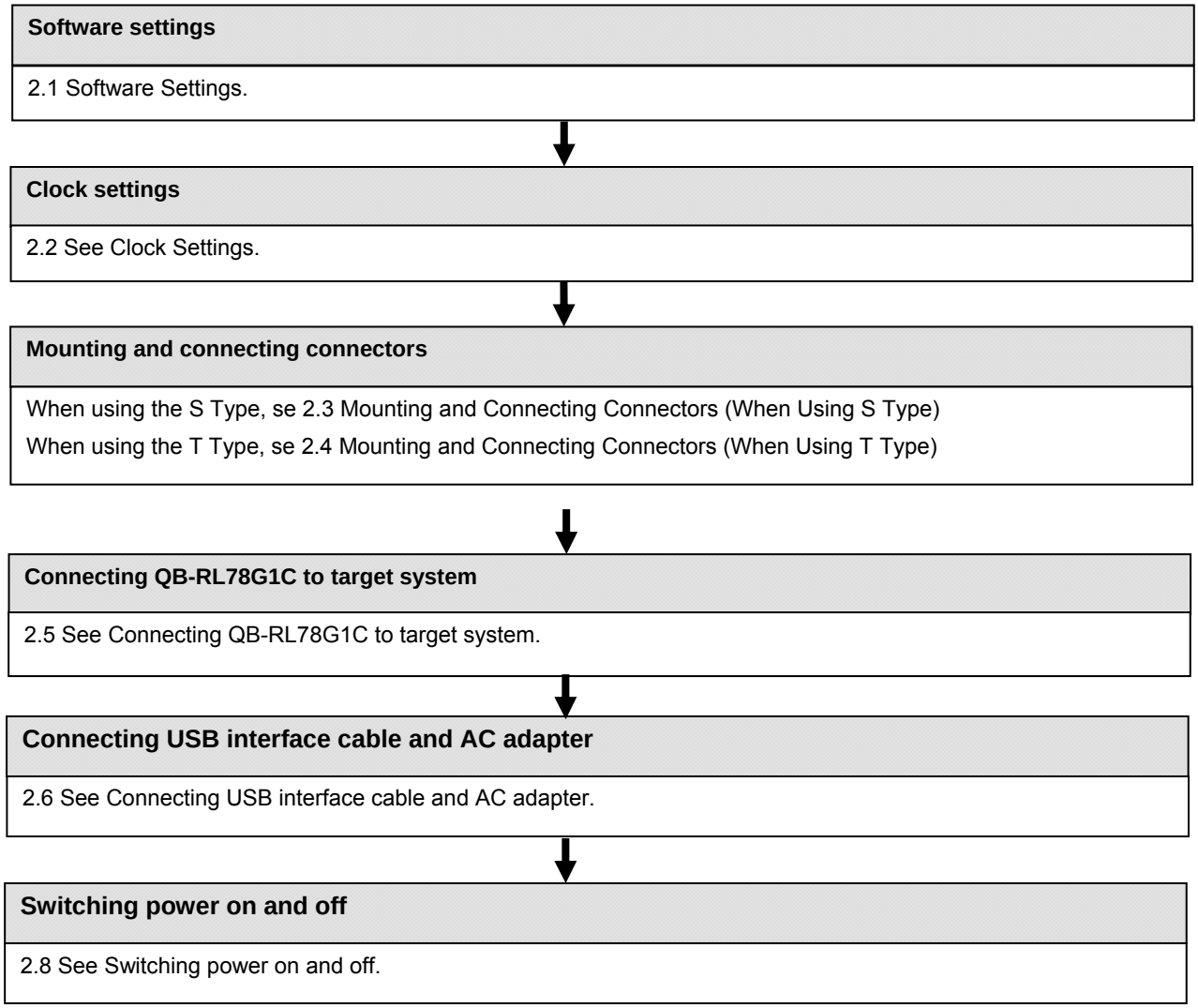
CHAPTER 2 SETUP PROCEDURE

This chapter explains the QB-RL78G1C 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 1.2 Names and Functions of Hardware for clock positions.



2.1 Software Settings

Check the user's manual for the debugger that will be used.

2.2 Clock Settings

The QB-RL78G1C clock must be set to the clock used by the target device. For details about how to set the clock, check the user's manual for the debugger that will be used.

QB-RL78G1C clock settings for the clock used by the target device are shown below.

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.

Table 2-1. List of clock settings

Clock Used	Clock Supply
(1) High-speed system clock (X1 oscillator or External input)	(a) When the clock generated within the emulator is used
	(b) When the clock (a square wave) is supplied from the target system
	(c) When the oscillator (OSC1) mounted onto the emulator is used
(2) High-speed system clock when using PLL (X1 oscillator or External input)	(a) When the clock generated within the emulator is used
	(b) When the clock (a square wave) is supplied from the target system
	(c) When the oscillator (OSC1) mounted onto the emulator is used
(3) Internal high-speed oscillation clock	Uses the clock internally generated from the emulator
(4) Internal low-speed oscillation clock	Uses the clock internally generated from the emulator
(5) Subsystem clock (XT1 oscillator or External input)	(a) When the clock generated within the emulator is used
	(b) When the clock (a square wave) is supplied from the target system

(1) High-speed system clock

The clock settings are listed below.

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

Type of Clock to Be Used	OSC1
(a) When the clock generated within the emulator is used	–
(b) When the clock (a square wave) is supplied from the target system[Note]	–
(c) When the oscillator (OSC1) mounted onto the emulator is used	Oscillator mounted

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

This method uses the clock generated inside the emulator.

The oscillation frequency that will be used must be set in the debugger. For details about how to set the oscillation frequency, check the user's manual for the debugger that will be used.

(b) When the clock (a square wave) is supplied from the target system

The clock input from the target system is then used.

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 (VDD). Inputting the inverted signal to X1 is not necessary.

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

For debugger settings, check the user's manual for the debugger that will be used. Oscillation by a resonator in the target system is not supported.

(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.

To modify the clock setting, the acrylic board on the bottom of the QB-RL78G1C must be removed.

The acrylic board can be removed by lifting it up.

For debugger settings, check the user's manual for the debugger that will be used.

Figure 2-1. Acrylic Board Removal Method

As an oscillator[Note] to be mounted in the OSC1 socket in the emulator, use the one that satisfies the following specifications.

- Supply voltage: 5.0 V
- Output level: CMOS

Note An oscillation circuit that uses a resonator cannot be used.

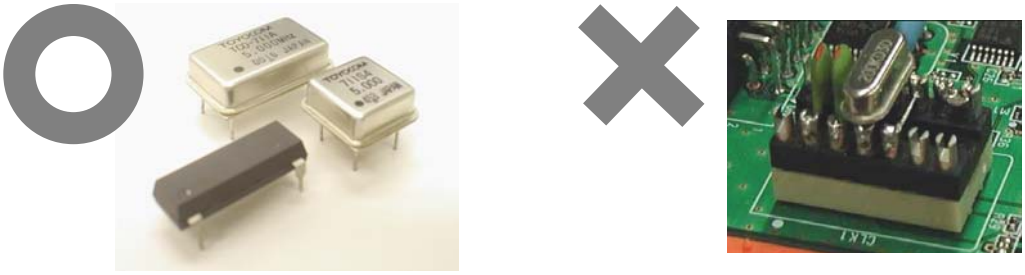
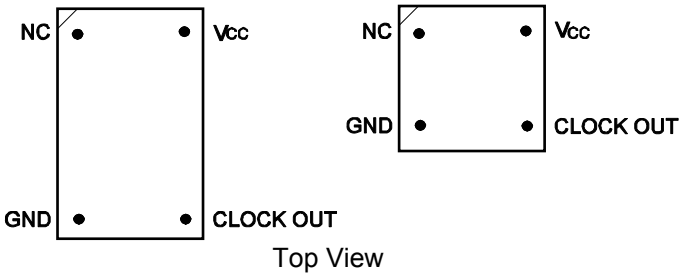
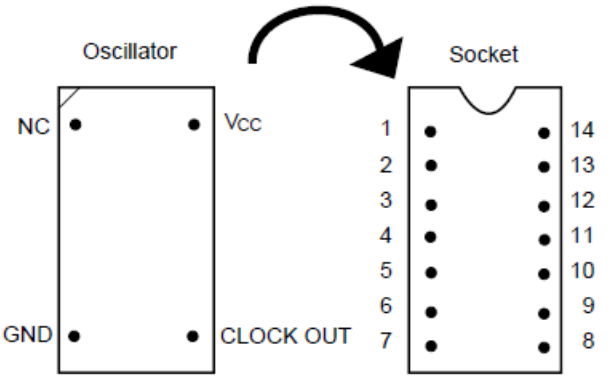


Figure 2-2. Oscillator Shape



Top View

Figure 2-3. Mapping of Oscillator to Socket



Oscillator	OSC1 Pin Number
NC	1
GND	4
	7
CLOCK OUT	8
	11
Vcc	14

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

(2) High-speed system clock when using PLL

The clock settings are listed below.

QB-RL78G1C generates 48MHz clock as PLL oscillation frequency (f_{PLL}) by setting the DSFRDIV bit used as PLL reference clock divider setting and the DSCM bit used as PLL multiplication setting. If a setting other than the below table is set on debugger, QB-RL78G1C generates 1MHz clock as PLL oscillation frequency (f_{PLL}).

Table 2-3. Settings for High-Speed System Clock when using PLL

High-Speed System Clock Frequency	Type of Clock to Be Used	OSC1	Clock frequency setting of debugger
16MHz	(a) When the clock generated within the emulator is used	–	8MHz
12MHz	(a) When the clock generated within the emulator is used	–	6MHz
8MHz	(a) When the clock generated within the emulator is used	–	8MHz
	(b) When the clock (a square wave) is supplied from the target system**Note**	–	–
	(c) When the oscillator (OSC1) mounted onto the emulator is used	Oscillator mounted	
6MHz	(a) When the clock generated within the emulator is used	–	6MHz
	(b) When the clock (a square wave) is supplied from the target systemNote	–	–
	(c) When the oscillator (OSC1) mounted onto the emulator is used	Oscillator mounted	–

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

This method uses the clock generated by the emulator.

The oscillation frequency used must be set in the debugger.

Select the 8MHz in the debugger when using 16MHz or 8MHz as High-speed system clock.

Select the 6MHz in the debugger when using 12MHz or 6MHz as High-speed system clock.

Refer to the user's manual of the debugger used for setting method of the oscillation frequency.

(b) When the clock (a square wave) is supplied from the target system

The clock input from the target system is then used.

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 (VDD). Inputting the inverted signal to X1 is not necessary.

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

For debugger settings, check the user's manual for the debugger that will be used. Oscillation by a resonator in the target system is not supported.

(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.

To modify the clock setting, the acrylic board on the bottom of the QB-RL78G1C must be removed.

The acrylic board can be removed by lifting it up.

For debugger settings, check the user's manual for the debugger that will be used.

Figure 2-4. Acrylic Board Removal Method

As an oscillator[Note] to be mounted in the OSC1 socket in the emulator, use the one that satisfies the following specifications.

- Supply voltage: 5.0 V
- Output level: CMOS

Note An oscillation circuit that uses a resonator cannot be used.

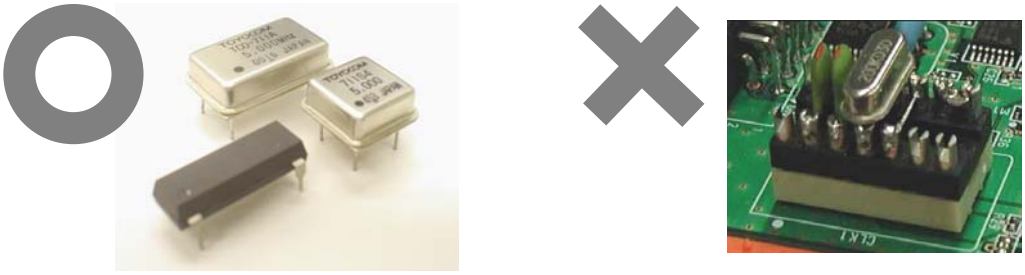
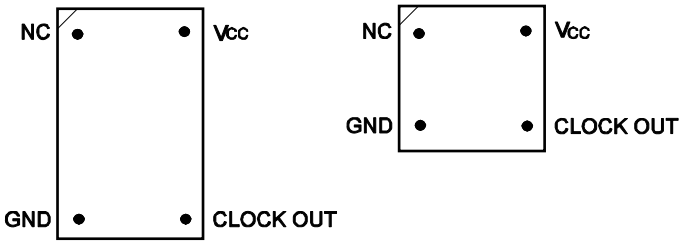
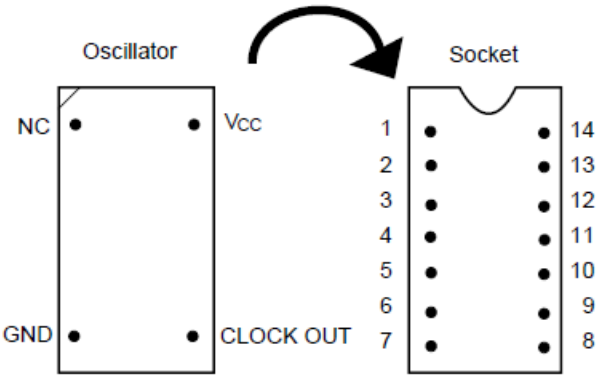


Figure 2-5. Oscillator Shape



Top View

Figure 2-6. Mapping of Oscillator to Socket



Oscillator	OSC1 Pin Number
NC	1
GND	4
	7
CLOCK OUT	8
	11
Vcc	14

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

(3) Internal high-speed oscillation clock

This method uses the clock inside the emulator by configuring the use of the high-speed oscillation clock in the user program.

(4) Internal low-speed oscillation clock

This method uses the clock inside the emulator by configuring the use of the low-speed oscillation clock in the user program.

(5) Subsystem clock

The clock settings are listed below.

Table 2-4. Settings for Subsystem Clock

Type of Clock to Be Used
(a) When the clock generated within the emulator is used
(b) When the clock (a square wave) is supplied from the target system

(a) When the clock generated within the emulator is used

This method uses the clock inside the emulator by configuring the use of the subsystem clock in the user program. For debugger settings, check the user's manual for the debugger that will be used.

(b) When the clock (a square wave) is supplied from the target system

The clock input from the target system is then used.

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 (VDD). Inputting the inverted signal to XT1 is not necessary.

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

For debugger settings, check the user's manual for the debugger that will be used. Oscillation by a resonator in the target system is not supported.

2.3 Mounting and Connecting Connectors (When Using S Type)

This section describes the methods of connecting the QB-RL78G1C and target system.
Make connections with both the QB-RL78G1C and target system powered OFF.
The following abbreviations are used in this section:

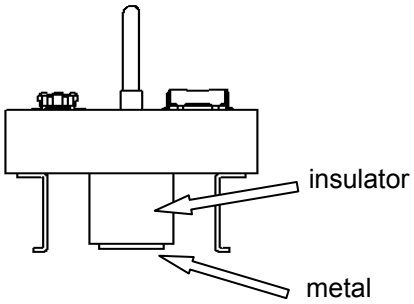
- TC: Target connector
- EA: Exchange adapter
- CA: Check pin adapter

2.3.1 Mounting TC to target system

(1) Apply cream solder to the foot pattern of the target system for mounting an IC

(2) There is a circular protrusion (Figure2-7) in middle of the bottom of the TC. The center of this cylinder is a metallic component (metal plated) for the GND connection. In the same manner as the IC pad, the TC GND is connected to the target board GND by applying cream solder to the pad in the center of the recommended IC foot pattern and then reflow soldering.

Figure 2-7. TC protrusion



(3) Soldering condition of TC
(a) Reflow soldering
At 235°C for amaximum of 10 seconds (main heating)
(b) Manual soldering
At 320°C for a maximum of 5 seconds (per pin)

(4) Precautions on flux splatter
If the solder flux splatters when the connector is soldered, faulty contact may occur. Be sure to cover the upper part of the connector with aluminum foil. Do not clean the connector because the flux solvent may remain inside the connector.

2.3.2 Mating theTC to EA

Mate the TC and EA by following the procedure below.

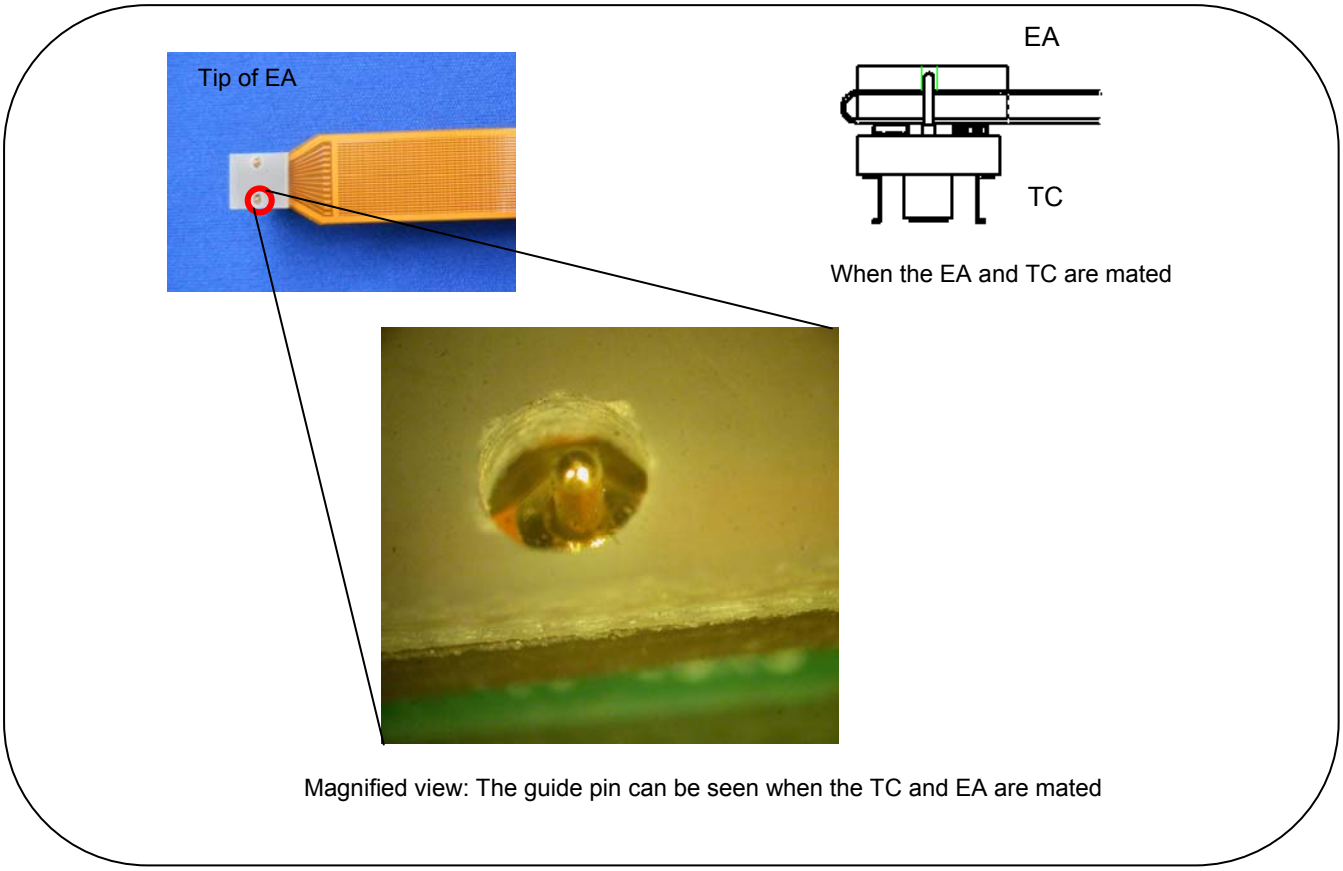
(1) Check the orientation of pin 1, align the TC guide pin to the guide hole at the tip of the EA flexible printed circuit (FPC), and then insert it. (See Figure 2-8)

(2) Check conductivity between the TC and EA at this time.

(3) Solder the TC to the guide locking pad that can be seen from the FPC tip flexible guide hole using a soldering iron with a tip radius of ϕ1.0 mm or smaller. (Once soldered, the TC and EA cannot be removed from each other.)

(4) Use extreme care so that the EA (FPC cable) does not apply stress to the TC. If the EA applies even a small amount of stress to the TC, we recommend securing the section soldered to the TC board with adhesive.

Figure 2-8 Magnified guide hole view when TC and EA are mated & mating diagram.



2.3.3 General Precautions when Using the EA, TC

(1) Causes of connector conductivity problems

(a) When flux gets inside the connector when mounting the TC

Since flux easily rises into the connector, if it gets into the connector, completely wash it out using a solvent such as alcohol. Wash it at least five or six times. If conductivity is unstable, repeatedly wash it.

(b) Debris gets inside the connector

If debris such as fuzz gets inside the connector, it will cause conductivity problems. Clear out the debris with a brush.

(c) Precautions when using the CA

When using the CA, while minor, signal propagation delay and capacitance occurs by inserting each adapter. Connect the CA to the target system and fully evaluate it before use.

(2) 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 URL.

http://japan.renesas.com/qb_144_ca_01

2.4 Mounting and Connecting Connectors (When Using T Type)

This section describes the methods of connecting the QB-RL78G1C and target system.
Make connections with both the QB-RL78G1C and target system powered OFF.
The following abbreviations are used in this section:

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

2.4.1 Mounting NQ 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 NQ and adhere the NQ to the user board (clean the surface of the target system board using alcohol or the like). If alignment of target system pads to NQ leads is difficult, align them as in (2).

(2) Align by inserting the guide pins for alignment for the NQ (NQGUIDE) through the pin holes on the top of the NQ. Accessory holes are ϕ1.0 mm non-through holes in two or three places.
(For hole positions, see the particular NQ drawing.)

(3) Solder after fitting the MA to the NQ. This is to prevent troubles such as flux or solder splashing and adhering to the NQ 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.

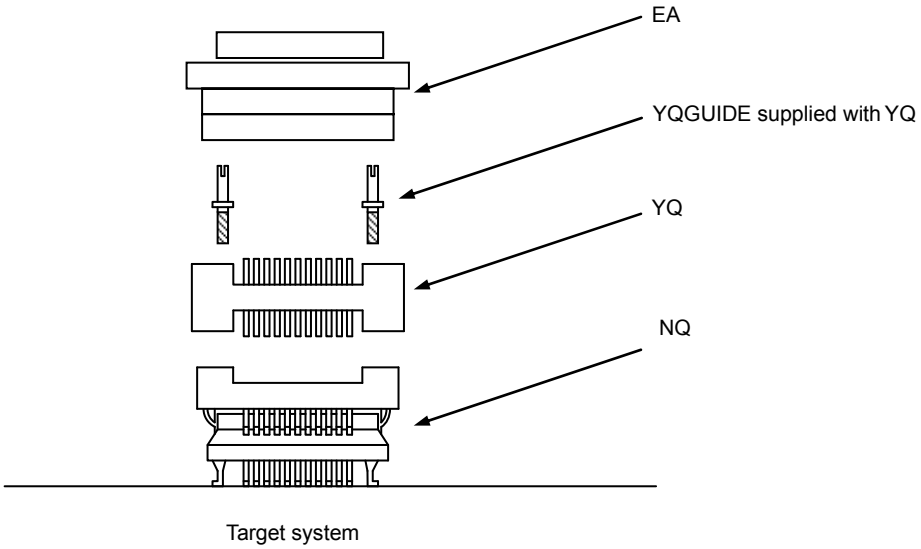
(4) Take away the guide pins.

2.4.2 Mounting YQ to NQ

(1) After confirming that there are no broken or bent YQ contact pins, fit the YQ in the NQ 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.

(2) Fasten YQ to the NQ 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 the YQGUIDE is 0.054 Nm (MAX.). Too great tightening causes bad connections.
However, four screws for fitting to the NQ (M2 x 10 mm / 4 units) are included with the YQ.

Figure 2-9. Mounting of EA, YQ and NQ



2.4.3 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 NQ, YQ, and SA with a finger so that there is no force on the NQ.
- 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.

2.4.4 Precautions for handling NQ, YQ, SA, and CA

(1) When taking the NQ 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 NQ, confirm that there are no bent pins.

(3) When screwing a YQ soldered to a board to the NQ, 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: ϕ2.3 mm or ϕ3.3 mm). The ϕ3.8 mm or ϕ4.3 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 NQ 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 NQ, YQ, and SA, since there is a danger that washing fluid on the structure will remain in the connector, do not perform washing.

(6) NQ, IC, and YQ cannot be used in combination.

(7) A NQ/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 NQ, 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 URL.

http://www.renesas.com/qb_144_ca_01

2.4.5 Precautions for mounting IC using NQ 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 NQ 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 NQ. 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 NQ, do not perform cleaning by flux immersion or vapor.

2.5 Connecting QB-RL78G1C to Target System

If connecting the emulation probe (QB-80-EP-01T), connect it to the QB-RL78G1C and the target system by the following procedure.

(a) Connect the QB-RL78G1C to the probe.

Connect the emulation probe to the QB-RL78G1C, as shown below.
Insert CN1 and CN2 of the probe into TCN1 and TCN3 of the QB-RL78G1C.

Figure 2-10. Connect the QB-RL78G1C to the probe

QB-80-EP-01T

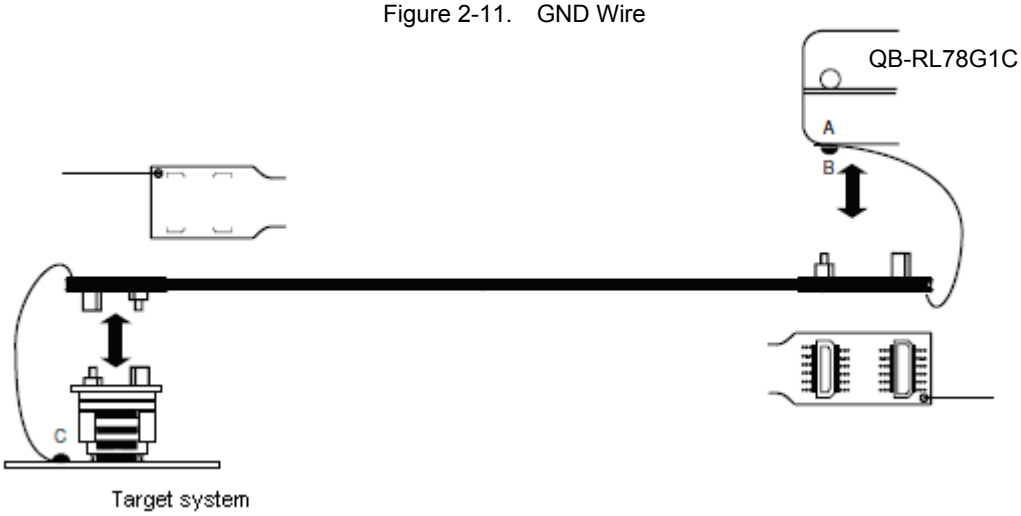
(b) Connection of emulation probe GND wire

There are three GND wires in the emulation probe. Connect them to the QB-RL78G1C and target system.

<1> Fasten the GND wire on the QB-RL78G1C side of the emulation probe to the nut on the bottom of the QB-RL78G1C using a #0 or #1 Phillips precision screwdriver (connection of B to A in Figure 2-8).

<2> Next insert the connector on the top of the emulation probe into the connector at the opening on the bottom of the QB-RL78G1C from below being careful of the insertion direction.

Figure 2-11. GND Wire

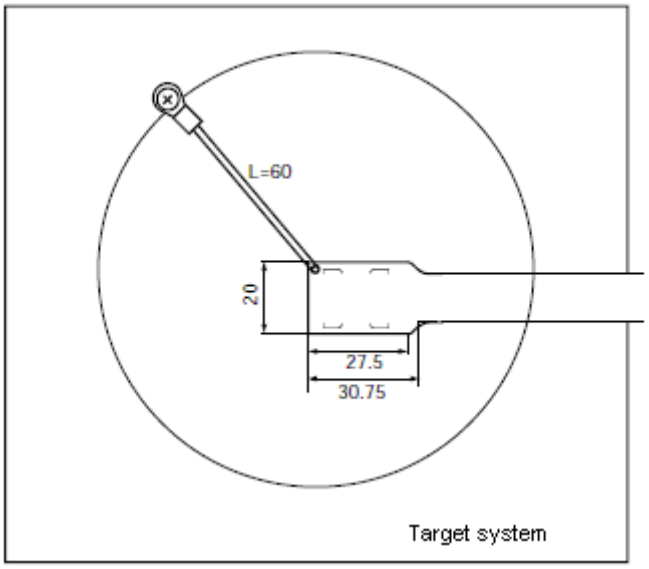


<3> Connect the exchange adapter and emulation probe to the target connector.

<4> Connect the GND wires 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 2-11). 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 the two approximately 60 mm radius sections of the target system for connecting the emulation probe, as shown in Figure 2-9.

Figure 2-12 Where GND Wire Can Be Connected



(c) Ensuring isolation

Adjust the height of the QB-RL78G1C with the front space adapter and the rear space adapter and ensure isolation from the target system.

(d) Precautions related to 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-RL78G1C and the target system. If it cannot be connected, the impedance of the cable is unstable and could bring about lowering of signal transmission characteristics or distortion of the output waveform for an input waveform.

2.6 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.

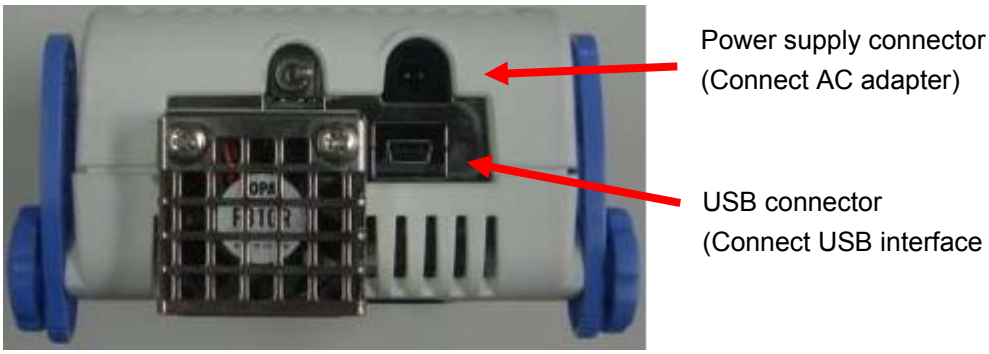
2.7 Connecting USB Interface Cable and AC Adapter

Plug the USB interface cable supplied with the QB-RL78G1C into the USB connector of the host machine, and plug the other side into the USB connector on the rear of the QB-RL78G1C.

Plug the AC adapter supplied with the QB-RL78G1C into a receptacle and plug the other side into the power supply connector on the rear of the QB-RL78G1C.

For QB-RL78G1C connector positions, see Figure 2-13.

Figure 2-13. Connector Positions



2.8 Switching Power On and Off

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

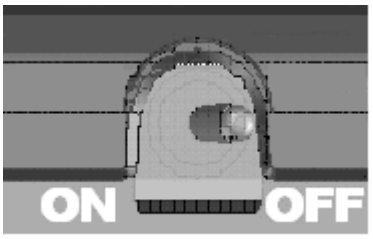
- Switching power on	- Switching power off
<1> QB-RL78G1C power on	<1> Debugger termination
<2> Target system power on[Note]	<2> Target system power off[Note]
<3> Debugger startup	<3> QB-RL78G1C power off

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-RL78G1C may fail

CHAPTER 3 SETTINGS AT PRODUCT SHIPMENT

Table 3-1. Settings at Shipment

Item	Setting	Remarks
OSC1	Not mounted	Oscillator can be mounted[Note].
Power switch		Set to OFF at shipment.

Note The oscillation circuit using an oscillation cannot be used.

CHAPTER 4 CAUTIONS

4.1 Cautions Regarding Differences Between Target Device and Emulator

When debugging is performed by connecting the QB-RL78G1C to the target system, the QB-RL78G1C emulates the target device as if it operates in the target system. However, the target device and the QB-RL78G1C operate differently in the following ways. Consequently, the target device should be used for final evaluation before launching mass production, and the customer is to be responsible for judging the appropriateness of applying the QB-RL78G1C.

- On-chip debug function

The on-chip debug function cannot be emulated.

- Oscillator

The QB-RL78G1C does not support clock input by an oscillator in the target system. Consequently, the operation clock frequency when the target device is mounted in the target system may differ from the operation clock frequency when the QB-RL78G1C is connected.

- Pin characteristics

The pin characteristics of the QB-RL78G1C slightly differ when the target device is mounted to the target system, because a connector, adapter, emulation probe, and circuit board exist between the QB-RL78G1C and the target system. In particular, note that the A/D converter conversion results are commonly-affected.

- Current consumption

The current consumption of the QB-RL78G1C differs from that of the target device.

The maximum current consumption is around 150 mA. In the same manner, the current consumption in standby mode also differs from that of the target device.

- Pull-up function of P17, P30, P50

Pull-up function of the below pins cannot be used on QB-RL78G1C.

Target pins : P17, P30, P51

- A/D conversion error around 0[V] and 5.5[V]

A/D conversion error around 0[V] and 5.5[V] on QB-RL78G1C is big.

Use on-chip debugging or actual equipment for checking A/D conversion in 0.1[V] and under, or 5.36[V] and over.

- Change the positive reference voltage on the A/D converter

When change the positive reference voltage, after setting ADREFP1 and ADREFP0, stabilization wait time of emulator is different from that of the target device.

Table 4-1 Target devices and stabilization wait time of QB-RL78G1C

ADM2 register (value after change)		stabilization wait time	
ADREFP1	ADREFP0	Target devices	QB-RL78G1C
1	0	1μs	400μs
0	0	No	400μs
0	1	No	400μs

- P122 input characteristics

The P122 input characteristics differ between the target device and the emulator.

Table 4-2. Input Characteristics of P122 Pins

Item	Input Characteristics of P122 Pins	
Target device	VIH MIN	0.8VDD
	VIL MAX	0.2VDD
QB-RL78G1C	VIH MIN	0.7VDD（2.7V ≤ VDD ≤ 5.5V） 0.8VDD（2.4V ≤ VDD < 2.7V）
	VIL MAX	0.3V（2.7V ≤ VDD ≤ 5.5V） 0.2VDD（2.4V ≤ VDD < 2.7V）

- Power-on-reset (POR) voltage value

The power-on-reset (POR) voltage value differs from that of the target device.

Table 4-3. Power-on-reset (POR) voltage value

Item		MIN.	TYP.	MAX.
Target device	POR	1.48 V	1.51 V	1.54 V
	PDR	1.47 V	1.50 V	1.53 V
QB-RL78G1C	POR	−	1.54 V	−
	PDR	−	1.47 V	−

- TTL input buffer characteristics

If the port input mode register (PIM) is used to set the input of a pin that can be set for the TTL buffer to the TTL level, the high-level input voltage characteristics differ between the target device and emulator. See Table 4-3 for details. The following pins can be set for the TTL buffer.

Table 4-4. Input Characteristics of TTL

Item		Conditions
Target device	VIH MIN	2.2V（4.0 V ≤ VDD ≤ 5.5 V） 2.0V（2.4 V ≤ VDD < 2.7 V） 1.5V（2.4 V ≤ VDD < 2.7 V）
	VIL MAX	0.8V （4.0 V ≤ VDD ≤ 5.5 V） 0.5V （2.7 V ≤ VDD < 4.0 V） 0.32V （2.4 V ≤ VDD < 2.7 V）
QB-RL78G1C	VIH MIN	2.0V（3.3 V ≤ VDD ≤ 5.5 V） 1.17V（2.4 V ≤ VDD < 3.3 V）
	VIL MAX	0.8V（3.3 V ≤ VDD ≤ 5.5 V） 0.63V（2.4 V ≤ VDD < 3.3 V）

- The detection voltage value of the voltage detector (LVD)

LVD detection voltage differs between the target device and the emulator.

.

Table 4-5. The detection voltage

Target device		QB-RL78G1C	
Rising edge	Failing edge	Rising edge	Failing edge
2.50V	2.45V	2.46V	
2.61V	2.55V	2.56V	
2.71V	2.65V	2.66V	
2.81V	2.75V	2.76V	
2.92V	2.86V	2.87V	
3.02V	2.96V	2.97V	
3.13V	3.06V	3.07V	
3.75V	3.67V	3.68V	
4.06V	3.98V	3.99V	

- PLL clock

If there is mismatch on the High-speed system clock frequency (f_{MX}) setting and the PLL operation register (DSCCTL) setting, QB-RL78G1C generates 1MHz as PLL oscillation frequency (f_{PLL}).

Refer to the device user's manual regarding a High-speed system clock frequency for USB clock and register setting of PLL.

- D+/D- pull-up operation when using USB function module

D+/D- pull-up operation on QB-RL78G1C differs from the target device.

Target device:

- D+ pull-up is enabled when bit 4 of the system configuration control register is "1" (DPRPU = "1")
- D- pull-up is enabled when bit 3 of the system configuration control register is "1" (DMRPU = "1")

QB-RL78G1C:

Either bit 4 (DPRPU) or bit 3 (DMRPU) of the system configuration control register is made "1", D- or D+ is pulled up as follows.

- D+ pull-up is enabled when using the full-speed operation.
- D- pull-up is enabled when using the low-speed operation.

- Operating voltage of USB battery charging detection

Operation voltage of USB battery charging detection on QB-RL78G1C differs from the target device.

Target device:

Operation voltage is proportional to UVBUS voltage levels because it is generated by the supply voltage of UVBUS pin.

QB-RL78G1C:

Operation voltage is 5V because it is generated by QB-RL78G1C internal power supply (5V).

- UVDD pin voltage levels when supplying power from the internal power supply for the USB to USB function module

UVDD pin voltage level on QB-RL78G1C differs from the target device when supplying power from the internal power supply for USB to the USB function module.

. Target device : 3.3V (TYP)
QB-RL78G1C : 0V

4.2 Debugging Note

- Operation after target system power application

After power application, a program will be executed for the target device mounted in the target system when reset is released. However, with the QB-RL78G1C, the program does not start until an operation to start execution is performed after the program is downloaded using the debugger.

- Relation between Standby function and Break function

The break is interrupt function of CPU. The standby mode is released by the break for using the following debug function.

- Stops execution of the user program.
- Step execution of the standby instruction (Stops user program after execution instruction)
- Pseudo real-time RAM monitor function (Break When Readout)
- Pseudo Dynamic Memory Modification (Break When Write)
- Breakpoint setting executing of the user program.

- Invalid memory access detection function (IAW)

The behavior when detecting an invalid memory access is different between target device and emulator.

Target device : Reset

QB-RL78G1C : Fail-safe break

- CRC calculation function

When using the CRC calculation function, do not set software breaks. Differing calculation results will be output.

REVISION HISTORY	QB-RL78G1C In-Circuit Emulator User's Manual

Rev.	Date	Description	
		Page	Summary
1.00	July 12, 2013	—	First Edition issued

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