User's Manual

QB-RL78D1A2

In-Circuit Emulator

User's Manual

Target Devices

R5F10DSL R5F10DPL

R5F10DSK R5F10DPK

R5F10DSJ

Renesas Electronics
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- 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.**
- 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-RL78D1A2. 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-RL78D1A2.

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-RL78D1A2
→ Read this manual in the order of the **CONTENTS**.

To know the manipulations, command functions, and other software-related settings of the QB-RL78D1A2
→ See the user's manual of the debugger 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-RL78D1A2 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-RL78D1A2 is an in-circuit emulator for emulating “R5F10DSL, R5F10DSK, R5F10DSJ, R5F10DPL, R5F10DPK”. Hardware and software can be debugged efficiently in the development of systems in which “R5F10DSL, R5F10DSK, R5F10DSJ, R5F10DPL, R5F10DPK”used.

This manual descries basic setup procedures, hardware specifications, system specifications, and how to set switches.

1.1 Hardware Specifications

Table 1-1. QB-RL78D1A2 Hardware Specifications

Parameter			Specification
Target device			R5F10DSL,R5F10DSK,R5F10DSJ,R5F10DPL,R5F10DPK
Operating voltage			2.4V to 5.5V Note7
Operating frequency	Main system clock Note1	High-speed system clock oscillator	2.7V ≤ VDD ≤ 5.5V：1～20 MHz 2.4V ≤ VDD < 2.7 V：1～8 MHz
		High-speed on-chip oscillator	2.7V ≤ VDD ≤ 5.5V：4～32MHz 2.4V ≤ VDD < 2.7 V：4～24 MHz
	Low-speed on-chip oscillator		2.4 V ≤ VDD ≤ 5.5V: 15 KHz
	Subsystem clock oscillator Note2		2.4 V ≤ VDD ≤ 5.5V: 32.768 KHz
	PLL		2.7 V ≤ VDD ≤ 5.5V: 32MHz 2.4V ≤ VDD < 2.7 V：24 MHz
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		Current: approx. 55 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 ±0.004%. However, this does not apply to errors of the oscillator or clock system on the target board.

Note3 Does not include projection of power switch

Note4 Includes projection of screw that fixes rear space adapter

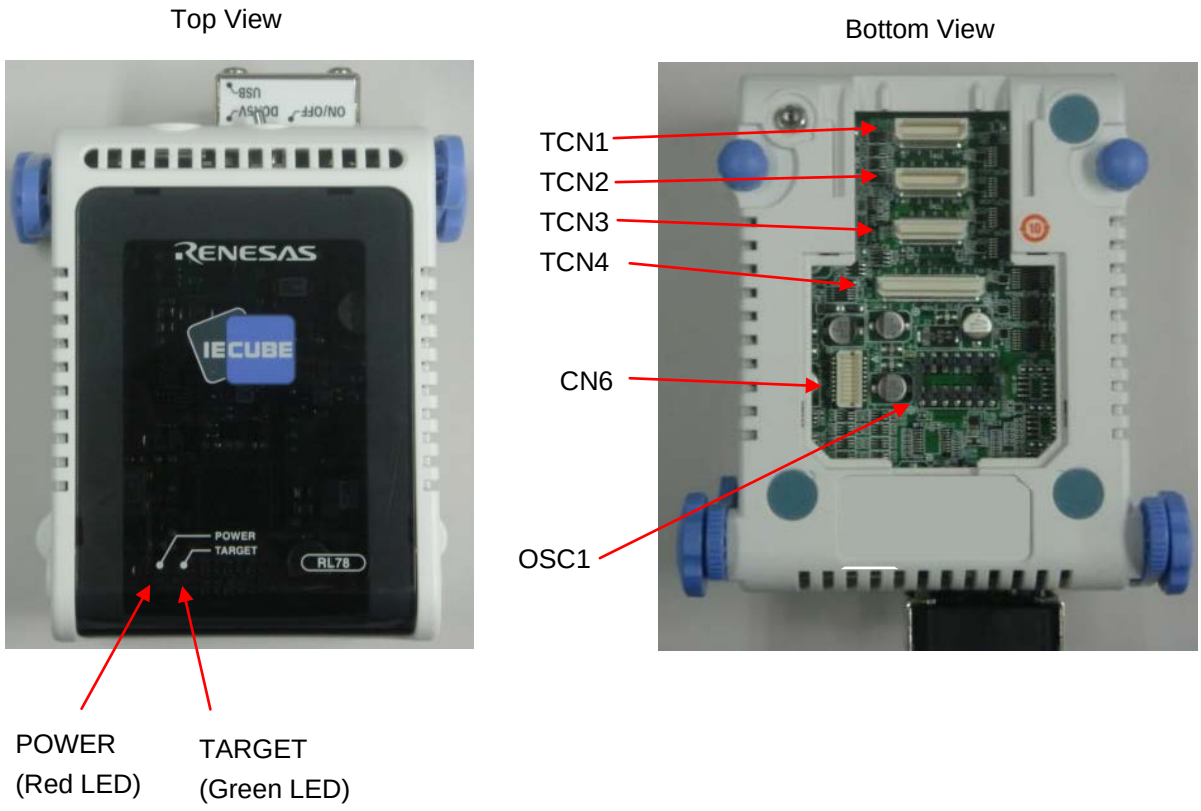
Note5 Rear space adapter can adjust the height from 30 mm (longest) to 0 mm (shortest)

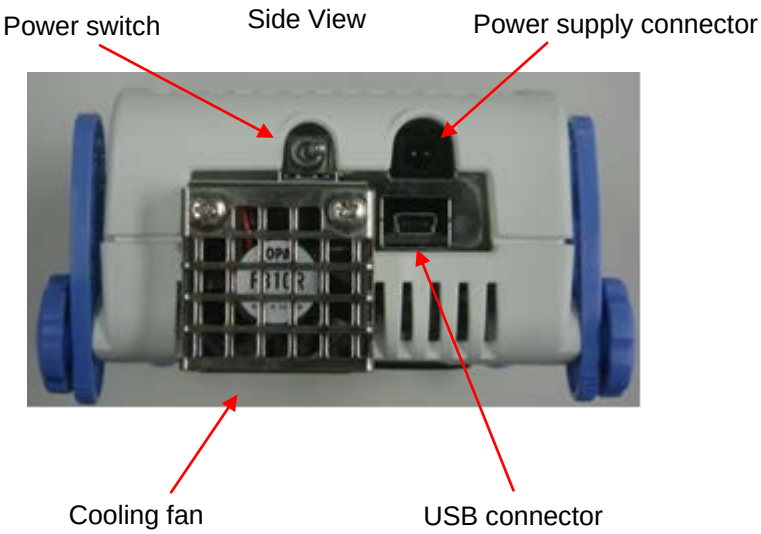
Note6 Front space adapter can adjust the height from 20 mm (longest) to 5 mm (shortest)

Note7 Use within voltage-range of the target device.

1.2 Names and Functions of Hardware

Figure 1-1. Names of Parts of QB-RL78D1A2





(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, TCN4

These are connectors for the shipment inspection. User does not need to use these connectors.

(4) POWER (Red LED)

This is an LED that shows whether the power supply of the QB-RL78D1A2 is switched on.

LED State	QB-RL78D1A2 State
Lit	Power switch ON
Not lit	Power switch OFF or AC adapter not connected to QB-RL78D1A2
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-RL78D1A2.

It is OFF at shipment.

(7) Cooling fun

This is the cooling fun of the QB-RL78D1A2.

It works when the power supply of the QB-RL78D1A2 is switched on.

1.3 System Specifications

This section shows the QB-RL78D1A2 system specifications.

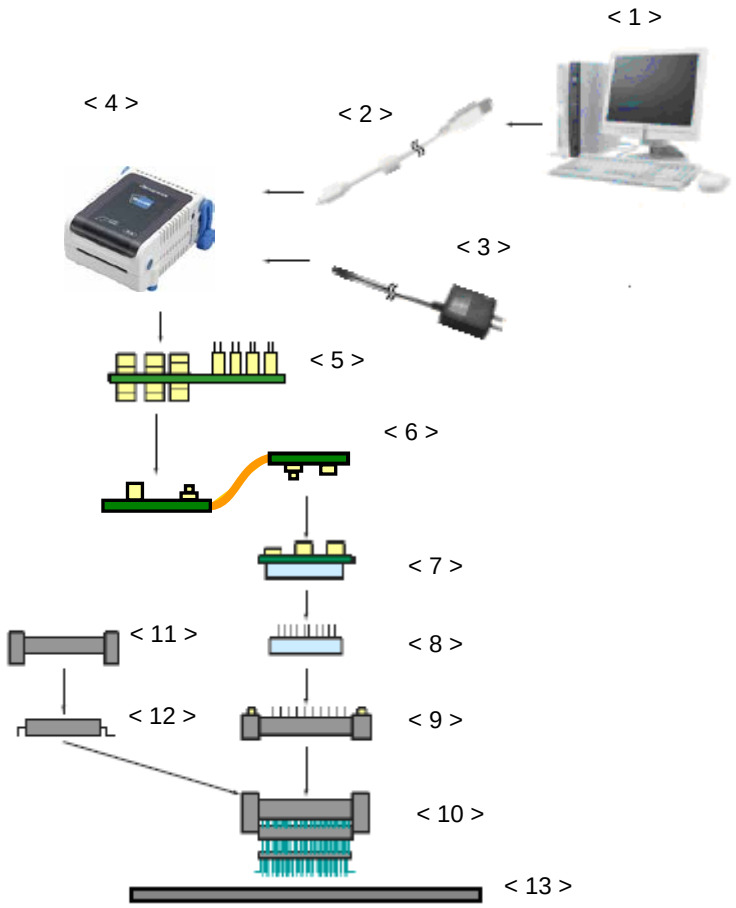
Table 1-2. QB-RL78D1A2 System Specifications

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-RL78D1A2 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> USB interface cable : Cable connecting QB-RL78D1A2 to host machine
<3> AC adapter : AC adapters classified by region
<4> QB-RL78D1A2 : This product
<5> Check pin adapter (optional) : Adapter used for monitoring waveforms with oscilloscope
<6> Emulation probe : High-characteristic FPC type emulation probe
<7> Exchange adapter : Adapter that performs pin conversion
<8> Space adapter (optional) : Adapter used for height adjustment
<9> YQ connector : Connector that connects exchange adapter to target connector
<10> Target connector : Connector soldered to target system
<11> Mount adapter (optional) : Adapter used for mounting target device into socket
<12> Device : Target device
<13> 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**.

3. The part number of <3> 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 Adapter and Probe** for the part numbers of <5> and <6>.

5. The combination of <7>, <8>, <9>, <10>, and <11> varies depending on the emulation device. See **Table 1-3 Adapters and Connectors for Each Target Device** for the combinations.

1.5 System Configuration for Each Target Device

The following table lists the system configuration for each target device of the QB-RL78D1A2.
The adapter and connector for each device, and common probe and adapter are sold separately.

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
R5F10DPL, R5F10DPK	100FB	QB-100FB-EA-02T	QB-100FB-YS-01T	QB-100FB-YQ-01T	QB-100FB-NQ-01T	QB-100FB-HQ-01T
R5F10DSL, R5F10DSK, R5F10DSJ	128FB	QB-128FB-EA-02T	QB-128FB-YS-01T	QB-128FB-YQ-01T	QB-128FB-NQ-01T	QB-128FB-HQ-01T

Table 1-4. Common Adapter and Probe

Name	Part Number	Target Device
Check pin adapter	QB-144-CA-01	RL78/D1A all products
Emulation probe	QB-144-EP-02S	RL78/D1A all products

1.6 Package Contents

The included products are described for each order product name.

Products supplied with QB-RL78D1A2-ZZZ

1: QB-RL78D1A2
2: USB interface cable (2 meters)
3: Online user registration card (warranty card and software contract in one)
4: Probe holder
5: List of Package
6: Safety Precautions (IECUBE) information (document)
7: EMC regulation (FCC) (document)
8: Table of Toxic and Hazardous Substance and elements

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 Number
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
	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.

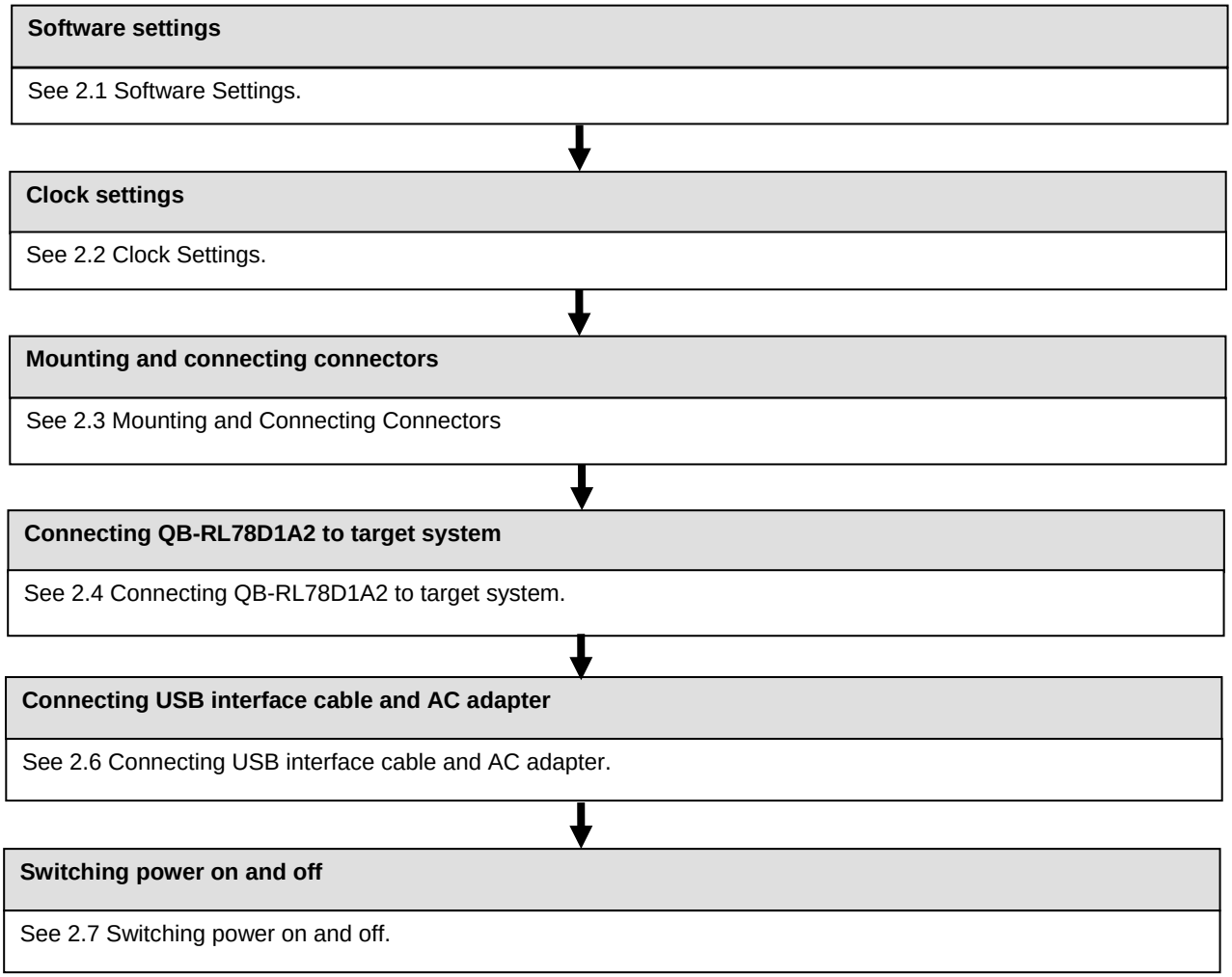
CHAPTER 2 SETUP PROCEDURE

This chapter explains the QB-RL78D1A2 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-RL78D1A2 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-RL78D1A2 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) Internal high-speed oscillation clock	Uses the clock internally generated from the emulator
(3) Internal low-speed oscillation clock	Uses the clock internally generated from the emulator
(4) 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 OSC1 socket.

(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-RL78D1A2 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.

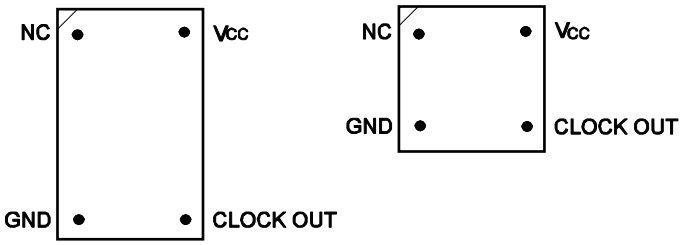
Figure 2-1. Acrylic Board Removal Method

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

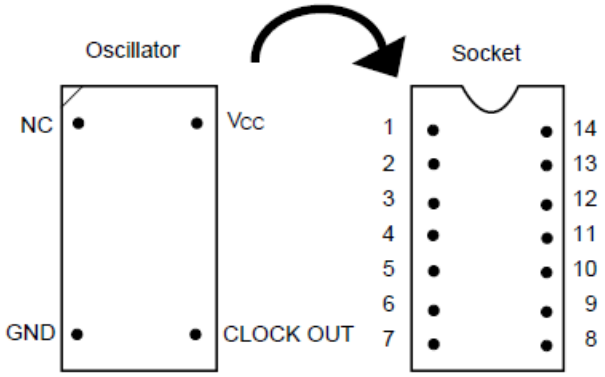
Note An oscillation circuit that uses a resonator cannot be used.

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) 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.

(3) 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.

(4) Subsystem clock

The clock settings are listed below.

Table 2-3. 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

This section describes the methods of connecting the QB-RL78D1A2 and target system.
Make connections with both the QB-RL78D1A2 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

2.3.1 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.

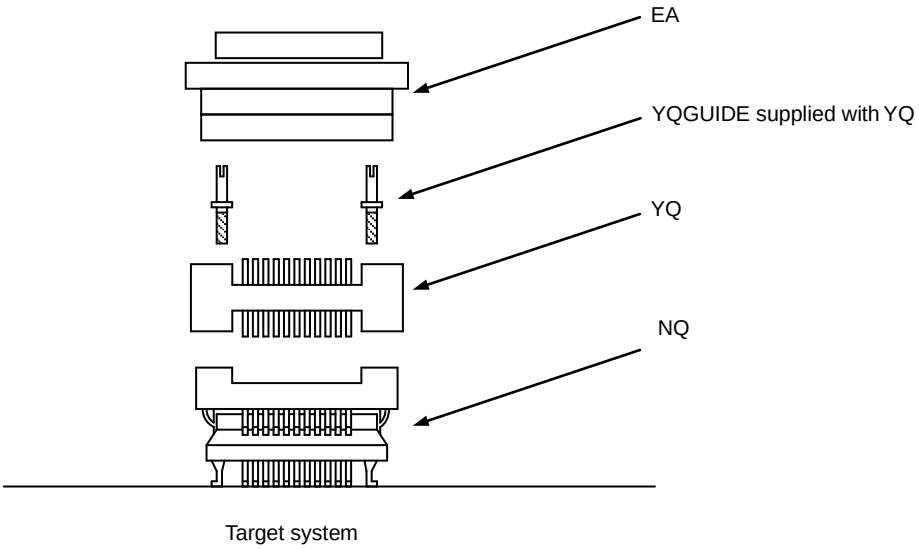
(4) Take away the guide pins.

2.3.2 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.
Four screws for fitting to the MA (M2 x 10 mm / 4 units) are also included with the YQ.

Figure 2-4. Mounting of EA, YQ and NQ



2.3.3 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.

2.3.4 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 over tightened, 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 possibility of YQ pins being bent or broken when prying and wiggling, remove them gradually using a flat-bladed 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 flat-bladed screwdriver and then connect it to the SA. Fix the torque at 0.054 Nm (MAX.). If even one place is over tightened, it may cause poor contact.

(5) For the NQ, YQ, and SA, since there is a possibility 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.

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

2.3.5 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 a device has been left for a long time, starting up may be late or not do. In this case, loosen the screws slightly and then retighten them.

(6) If starting up may be late or not do 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.

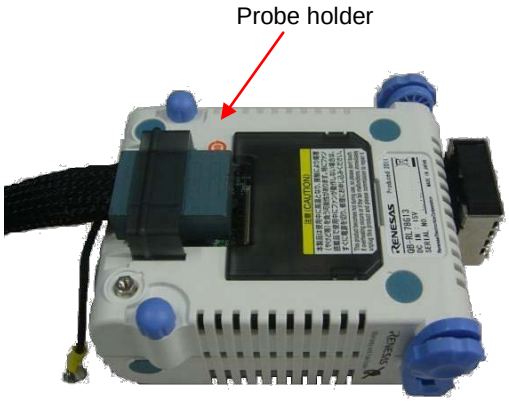
2.4 Connecting QB-RL78D1A2 to Target System

If connecting the emulation probe (QB-144-EP-02S), connect it to the QB-RL78D1A2 and the target system by the following procedure.

(a) Connect the QB-RL78D1A2 to the probe.

Connect the emulation probe to the QB-RL78D1A2, as shown below.
Insert CN1, CN2 and CN3 of the probe into TCN1, TCN2 and TCN3 of the QB-RL78D1A2.
Insert the probe holder into QB-RL78D1A2 as below.

Figure 2-5. Connect the QB-RL78D1A2 to the probe



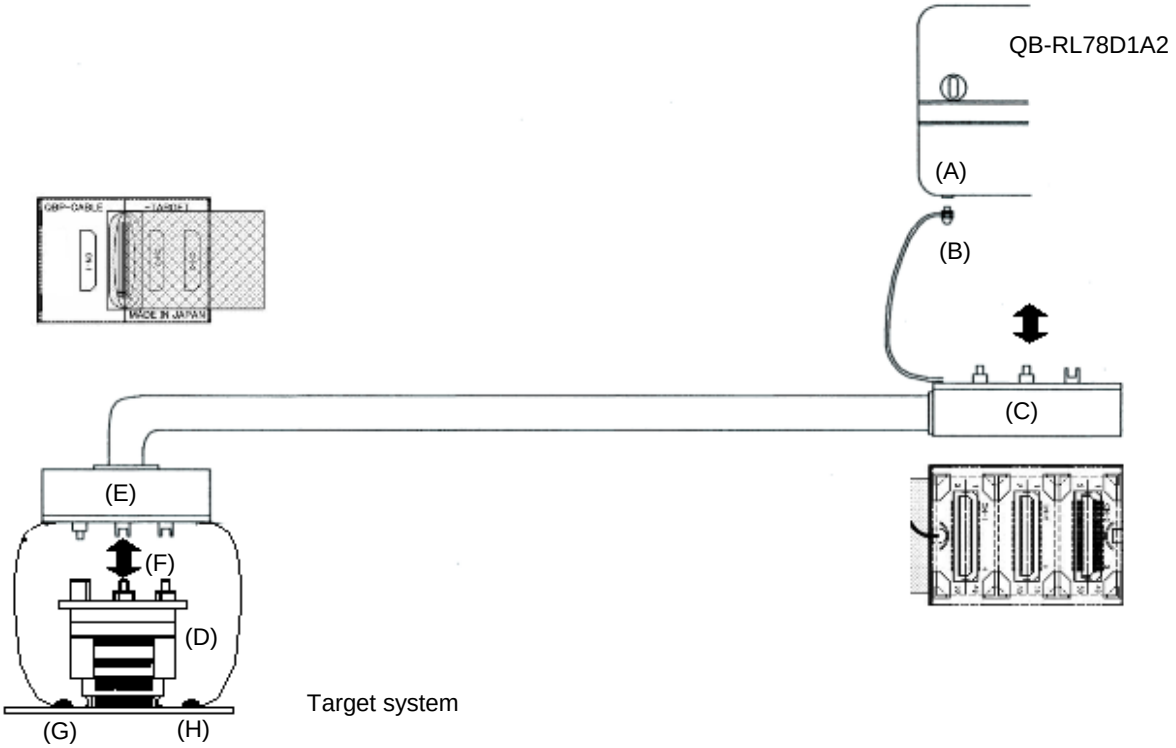
(b) Connection of emulation probe GND wire

There are three GND wires in the emulation probe. Connect them to the QB-RL78D1A2 and target system.

<1> Fasten the GND wire on the QB-RL78D1A2 side of the emulation probe to the nut on the bottom of the QB-RL78D1A2 using a #0 or #1 Phillips precision screwdriver (connection of B to A in Figure 2-6).

<2> Next insert the connector on the top of the emulation probe into the connector at the opening on the bottom of the QB-RL78D1A2 from below being careful of the insertion direction (connection of C in Figure 2-6 to QB-RL78D1A2).

Figure 2-6. GND Wire



<3> Connect the YQ connector and the exchange adapter to the target connector (D in Figure 2-6).

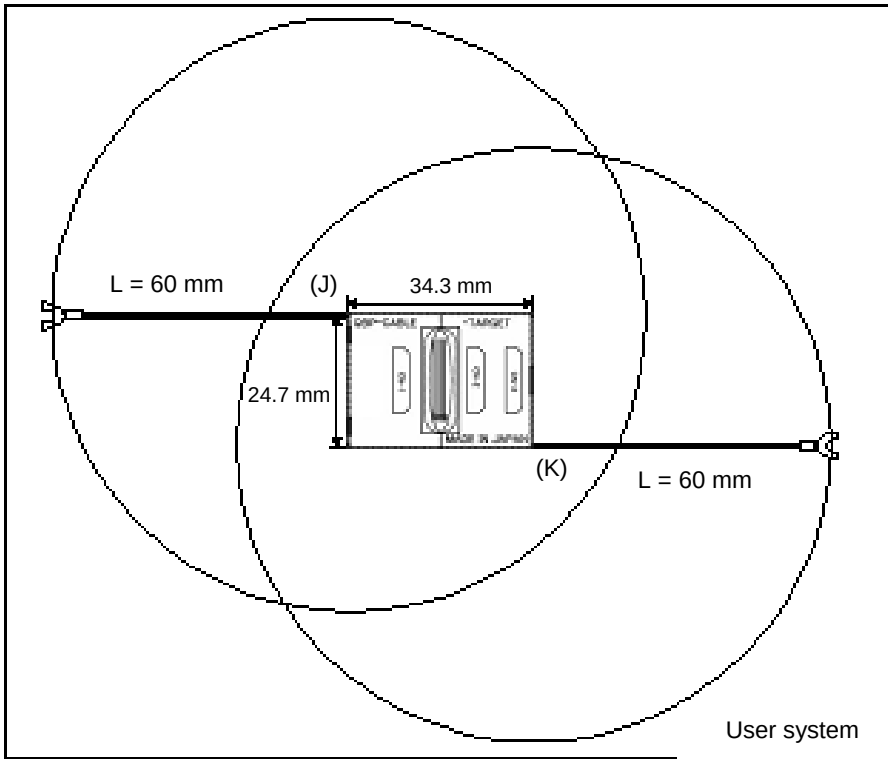
<4> Connect the emulation probe to the exchange adapter (connection of E to F in Figure 2-6).

<5> Connect the two 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 (G 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 (H in Figure 2-6)
(recommended soldering iron temperature setting: 300°C).

<6> If the target system has only one GND, connect only one of the GND wires of the emulation probe. Cut off the other GND wires with a nipper or leave it as is without removing the pin cover.

<7> Since the length of the GND wire below the head (insulated part) is approximately 60 mm, there must be at least 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 2-7. The GND wire of the emulation probe is soldered to positions J and K in Figure 2-7.

Figure 2-7 Where GND Wire Can Be Connected



(c) Ensuring isolation

Adjust the height of the QB-RL78D1A2 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-RL78D1A2 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.

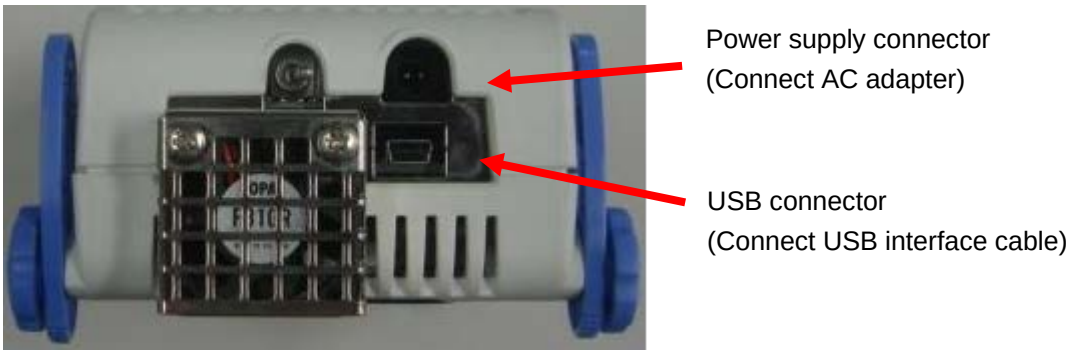
2.5 Notes on Power Supply and GND Pin Connection

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

2.6 Connecting USB Interface Cable and AC Adapter

Plug the USB interface cable supplied with the QB-RL78D1A2 into the USB connector of the host machine, and plug the other side into the USB connector on the rear of the QB-RL78D1A2.
Plug the AC adapter into the power supply connector on the rear of the QB-RL78D1A2 and plug the other side into a receptacle.
For QB-RL78D1A2 connector positions, see Figure 2-8.

Figure 2-8. Connector Positions



2.7 Switching Power On and Off

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

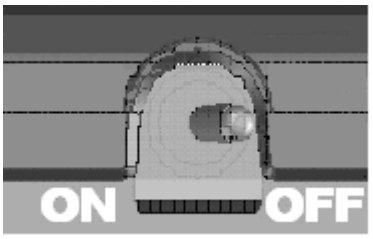
- Switching power on	- Switching power off
<1> QB-RL78D1A2 power on	<1> Debugger termination
<2> Target system power on[Note]	<2> Target system power off[Note]
<3> Debugger startup	<3> QB-RL78D1A2 power off

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-RL78D1A2 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 QB-RL78D1A2

When debugging is performed by connecting the QB-RL78D1A2 to the target system, the QB-RL78D1A2 emulates the target device as if it operates in the target system. However, the target device and the QB-RL78D1A2 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-RL78D1A2.

- On-chip debug function

The on-chip debug function cannot be emulated.

- Oscillator

The QB-RL78D1A2 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-RL78D1A2 is connected.

- Pin characteristics

The pin characteristics of the QB-RL78D1A2 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-RL78D1A2 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-RL78D1A2 differs from that of the target device.

The maximum current consumption is around 55 mA. In the same manner, the current consumption in standby mode also differs from that of the target device.

- 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-RL78D1A2

ADM2 register (value after change)		stabilization wait time	
ADREFP1	ADREFP0	Target devices RL78/D1A	QB-RL78D1A2
1	0	1µs	200µs
0	0	No	6µs
0	1	No	6µs

- Characteristic of Target interface

Please refer to APPENDIX A.

- Power-on-reset (POR) voltage value

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

Table 4-2. Power-on-reset (POR) voltage value

Item		MIN.	TYP.	MAX.
Target device	POR	1.45 V	1.51 V	1.57V
	PDR	1.44 V	1.50 V	1.56V
QB-RL78D1A2	POR	–	1.54 V	–
	PDR	–	1.47 V	–

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

LVD detection voltage differs from that of the target device.

.

Table 4-3. The detection voltage

Target device RL78/D1A		QB-RL78D1A2	
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

PLL is emulated by choosing fixed clock. The PLL input clock frequency (fPLLI) is only 0MHz, 4MHz, and 8MHz. The PLL output clock frequency (fPLL) become 1MHz if the combination between PLL input clock frequency and setting of PLLDIV is wrong.

(e.g. fPLLI =4MHz PLLDIV =1 => fPLL :1MHz)

- Pull-up

There is a time lag (max 185ns) to work pull up register after setting PUx register.

- LCD controller/driver behavior

When executing STOP instruction or an instruction which stops the main system clock (fMAIN) with setting the main system clock (fMAIN) to an operation clock of LCD controller/driver, LCD controller/driver stops execution on target device. On the other hand, it continues execution on QB-RL78D1A2.

- LCD

There is a time lag (max 1ms) to change LCD waveform after the LCD function register setting.

4.2 Note of Debugging

- 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-RL78D1A2, 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.

- Forced break function.
- Step execution of the standby instruction (Stops user program after executing instruction)
- Pseudo real-time RAM monitor function (Break When Readout)
- Pseudo Dynamic Memory Modification function (Break When Write)
- Breakpoint setting during 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-RL78D1A2 : Fail-safe break

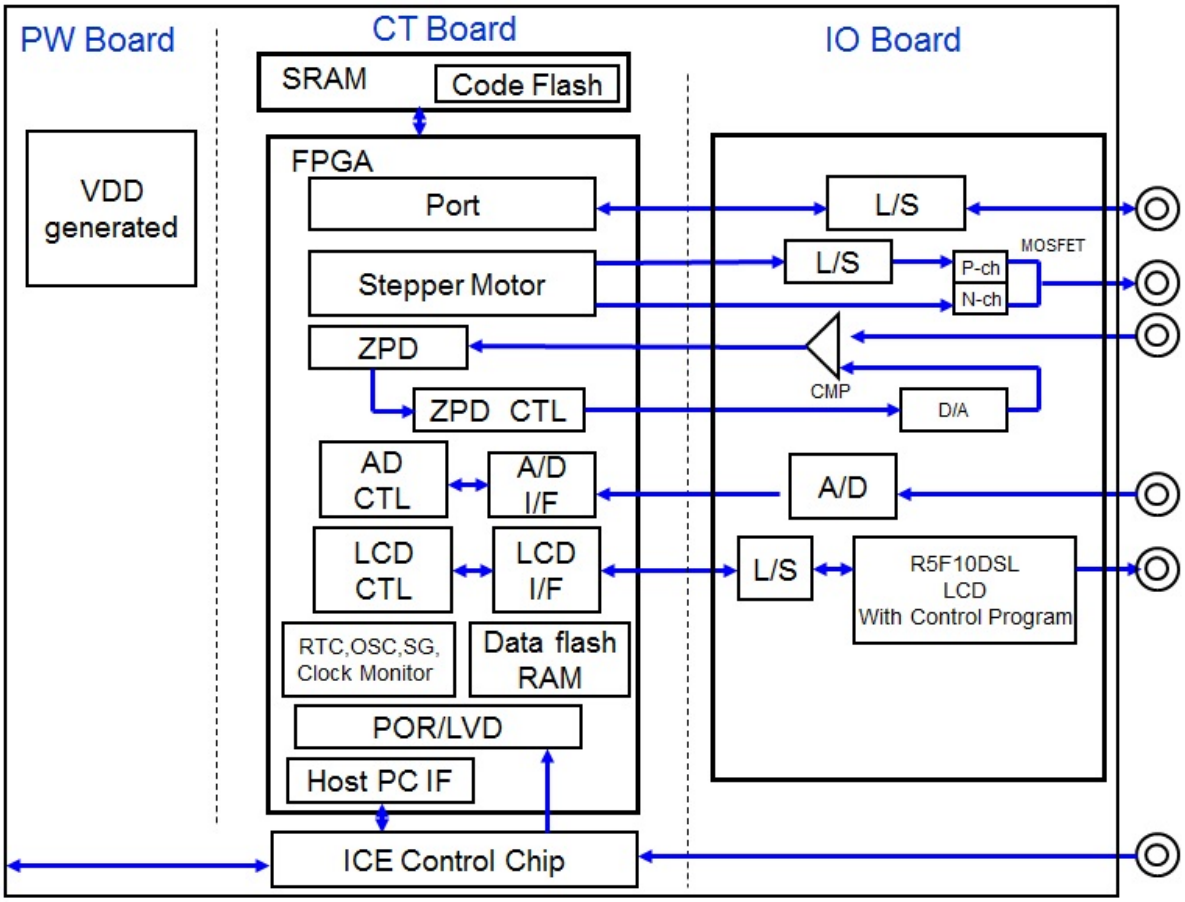
- CRC calculation function

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

APPENDIX A CHARCTERISTICS OF TARGET INTERFACE

The target interface (signals connecting the in-circuit emulator and target system) operate, in terms of function, as if an actual device were connected. The characteristics, however, may be different from those of the actual device.
QB-RL78D1A2 emulates the target interface by FPGA and some additional devices. The characteristics of target interface depend on their device characteristics. For the devices using in each target interface, please refer to the following.

Figure A-1. Overview of QB-RL78D1A2 Block diagram



- Port

Port function is emulated by FPGA and additional Level Shifter.

Following devices are used.

Level Shifter: UPD7886, SN74LVC1T45

QB-RL78D1A2 does not support the function of changing pin input mode by PIMx register.

Table A-1. Characteristics of PORT

PIN	INPUT	OUTPUT	Etc.
P122	SN74LVC1T45	-	P122: Pull-Down(1M ohm)
P80-P87,P90-P97	UPD7886	UPA679TB	For Stepper Motor
Others	UPD7886	UPD7886	P124,RESET, P20-P27,P150-P152 : Pull-Down(1M ohm) P137:Input only P130:output only

- A/D Converter

A/D Converter function is emulated by FPGA and additional ADC device.

Following devices are used:

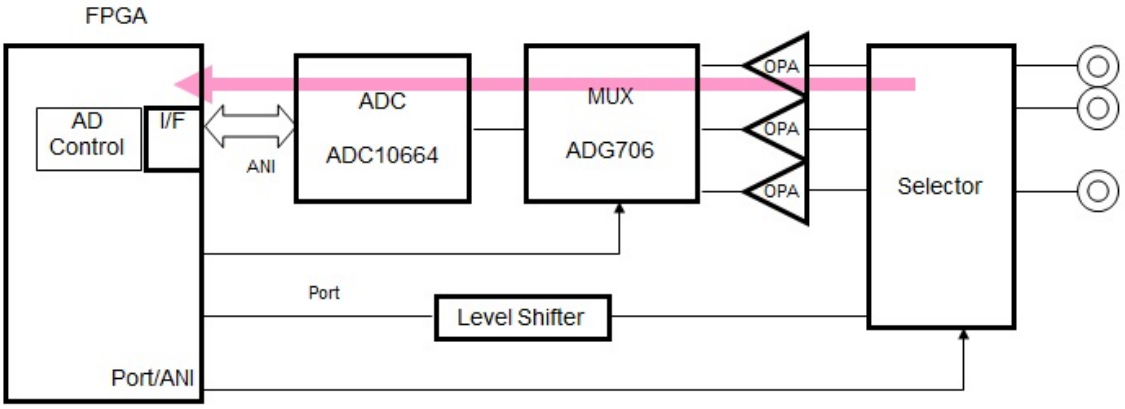
ADC: ADC10664

Selector: PI5A4684

MUX: ADG706

OPAMP: AD8034

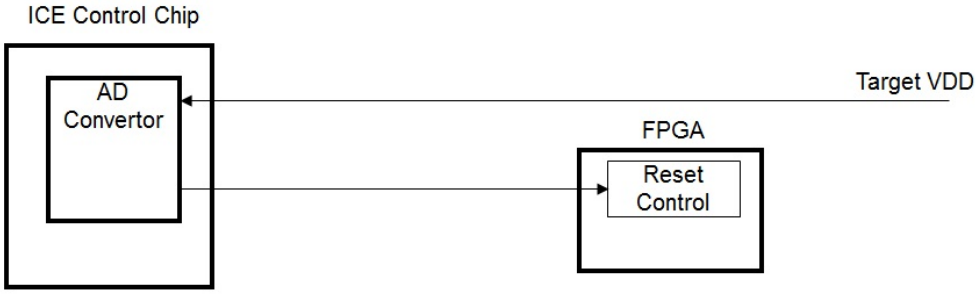
Figure A-2. A/D Block diagram



- POR/LVD

POR/LVD function is emulated by FPGA and additional ICE Control chip. The ICE Control chip sense the target VDD with its AD converter.
Following device is used:
ICE Control chip: V850ES/SG3

Figure A-3. POR/LVD Block diagram

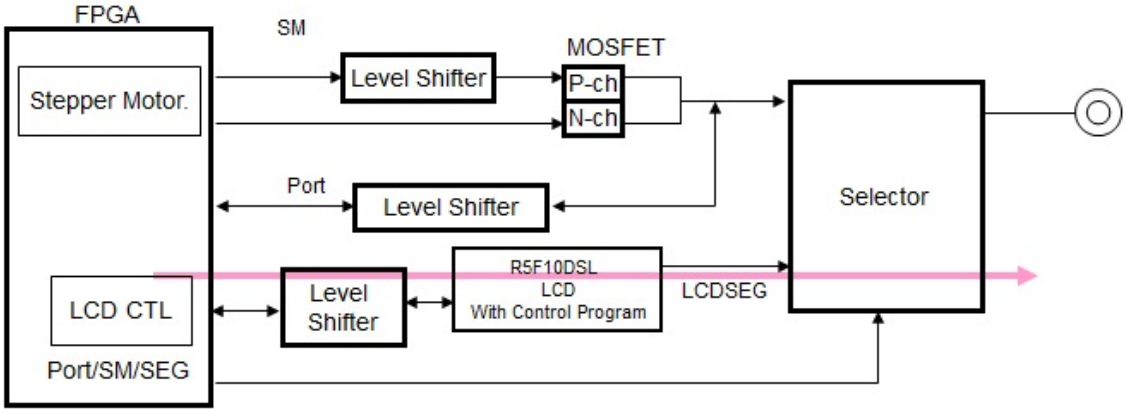


- LCD Controller/Driver

LCD function is emulated by FPGA and additional LCD driver.
Following device is used:
LCD driver: RL78/D1A (R5F10DSL :same as the target device)

LCD function is emulated by following operation.
Register setting of LCD are accepted by LCD Controller in the FPGA. LCD CTL write to the LCD register of R5F10DSL on IO board using parallel command interface between FPGA and R5F10DSL on IO board. R5F10DSL on IO board contains original program that receive the command from FPGA then write data to own register.
There is a time lag to output LCD waveform outputs after setting LCD's SFR.
Clock cannot be stopped.

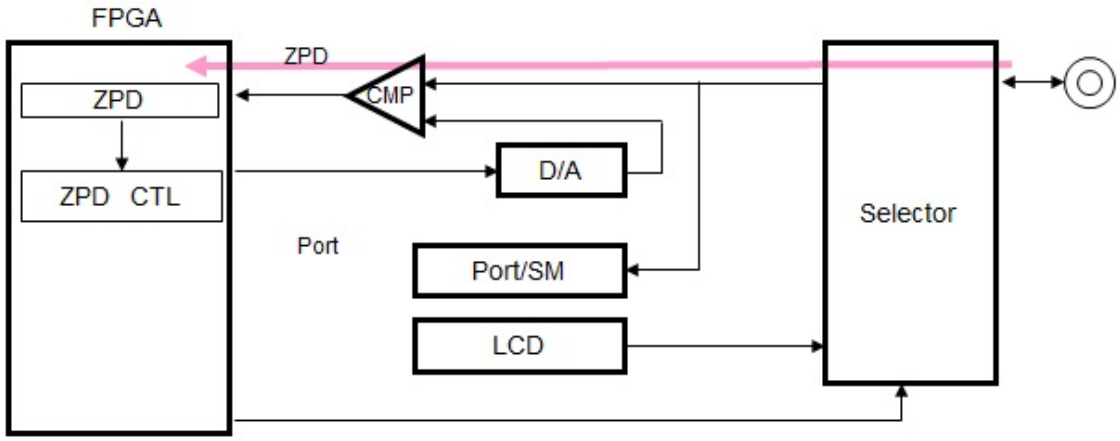
Figure A-4. LCD Block diagram



- ZPD

ZPD function is emulated by FPGA and additional CMP and DAC device.
Following devices are used:
Selector: PI5A4684
CMP: TC75W57FK
DAC: AD7305BRUZ

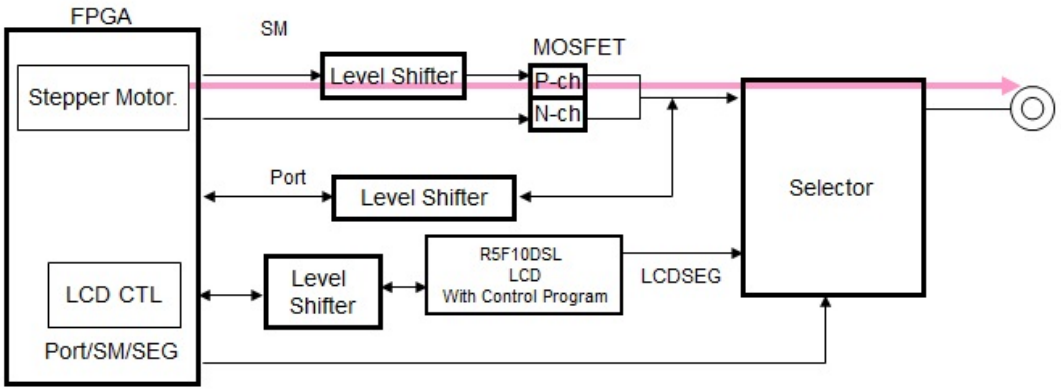
Figure A-5. ZPD Block diagram



- Stepper Motor Controller/Driver

Stepper-Motor function is emulated by FPGA and additional Level Shifter and MOSFET.
Following devices are used:
Selector: PI5A4684
MOSFET: UPA679TB
Level Shifter: UPD7886,SN74LVC1T45

Figure A-6. Stepper Motor Block diagram



REVISION HISTORY	QB-RL78D1A2 In-Circuit Emulator User's Manual

Rev.	Date	Description	
		Page	Summary
1.00	Oct 31, 2014	—	New.
1.01	Nov 28, 2014	14 15	The order including attachments of an adapter and a probe was deleted.

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