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April 1st, 2010
Renesas Electronics Corporation

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User's Manual



QB-78K0MINI

On-Chip Debug Emulator

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Printed in Japan

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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 the USB interface cable, or target system connection was in an unsatisfactory state
- If the USB interface cable, Connection cable, or the like was bent or pulled excessively
- If the product got wet
- If the product and target system were connected while a potential difference existed between the GND of the product and the GND of the target system
- If a connector or cable was removed while the power was being supplied to the product
- If an excessive load was placed on a connector or socket

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**.

INTRODUCTION

Readers This manual is intended for engineers who will use the QB-78K0MINI for debugging. Engineers who read this manual are assumed to be familiar with device functions and uses and to have knowledge about debugging.

Purpose This manual is intended to give users an understanding of the basic specifications of the QB-78K0MINI.

Organization This manual mainly consists of the following sections.

- General
- Names of parts
- Hardware settings and functions
- Cautions on use of self-check board
- Restrictions

How to Read This Manual It is assumed that the reader of this manual has general knowledge in the fields of electrical engineering, logic circuits, and microcontrollers. This manual describes basic setup steps and switch settings.

To learn more about the basic specifications and use methods:

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

To learn more about the QB-78K0MINI's manipulation methods, command functions, and other software-based settings:

→ Refer to the user's manual of the debugger (supplied with the QB-78K0MINI) to be used.

The mark ★ shows major revised points.

Conventions

Note: Footnote for item marked with Note in the text

Caution: Information requiring particular attention

Remark: Supplementary information

Numeral representation: Binary ... xxxx or xxxxB

Decimal ... xxxx

Hexadecimal ... xxxxB

Prefix indicating power of 2 (address space, memory capacity)

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

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

Terminology

The following terms are used in this manual.

Target device	This is the device to be emulated.
Target system	This is the system to be debugged (user-specified system). It includes the target program and the user-specified hardware.
On-chip debug unit	This is a circuit in the device that is used for on-chip debugging.
MINICUBE™	Generic name for NEC Electronics' high-performance/compact on-chip debugging emulator.
Pseudo real-time RAM monitor functions	RAM Monitor. A function that reads memory contents during execution of a program.
DMM functions	Dynamic Memory Modification. A function that overwrites RAM contents during execution of a program.

Related Documents

When using this manual, also refer to the following manuals.

The related documents indicated in this publication may include preliminary versions.

However, preliminary versions are not marked as such.

Documents related to development tools (user's manuals)

Document Name		Document No.
QB-78K0MINI On-Chip Debug Emulator		This manual
QB-78K0KX1H-DA Debugging Adapter for QB-78K0MINI		U17402E
RA78K0 Assembler Package Ver.3.80	Operation	U17199E
	Language	U17198E
	Structured Assembly Language	U17197E
CC78K0 C Compiler Ver.3.70	Operation	U17201E
	Language	U17200E
ID78K0-QB Ver.2.90 Integrated Debugger		U17437E
PM plus Ver.5.20		U16934E

Caution The related documents listed above are subject to change without notice.
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CHAPTER 1 GENERAL

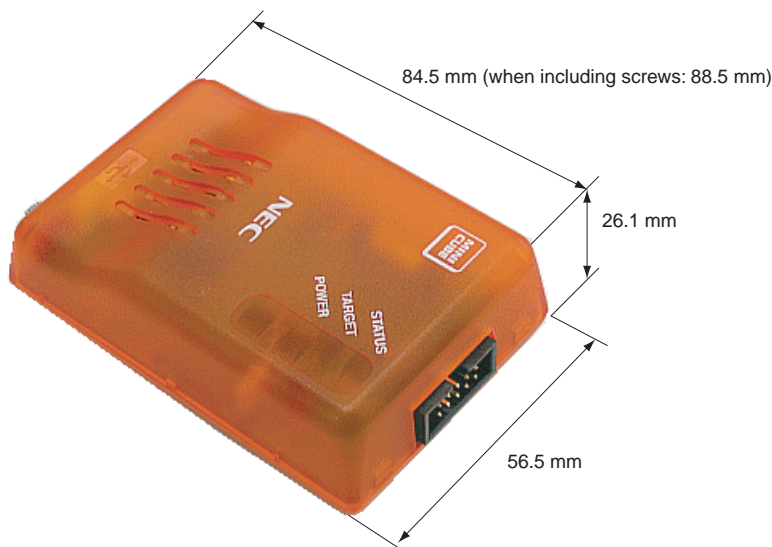
The QB-78K0MINI is an emulator that connects to a target device that includes an on-chip debug unit and is used to efficiently debug both hardware and software.

1.1 Features

- Enables general-purpose use on any microcontroller that includes a 78K/0 Series on-chip debug unit
- Enables debugging when mounted on a microcontroller installed on a system under development
- Communication method uses X1 and X2 (also enables communications that use port pins other than X1 and X2)
- Uses flash self-programming function to enable downloading of programs to flash memory
- Does not require an external power supply (power is supplied via the USB bus)
- Host interface is USB2.0 compliant
- Enables maintenance using auto diagnostic program and self-check board
- The QB-78K0MINI's shape dimensions are described below
- ★ ○ Pseudo real-time RAM monitor and DMM functions

Item		Value
External dimension	Height	26.1 mm
	Width	56.5 mm
	Depth	84.5 mm (when including screws: 88.5 mm)
Weight		Approximately 60 g

Figure 1-1. External Dimensions of QB-78K0MINI



1.2 Functional Specifications

Table 1-1. Product Specifications

Item	Specification
Operating power supply	5 V power supply via USB cable Maximum current consumption: 500 mA Since the maximum current consumption is 500 mA, be sure to use a self-powered hub when using a USB hub.
Target OS	Windows™ 98, Windows Me, Windows 2000, or Windows XP
Target host machine	PC-98NX Series, IBM PC/AT™ compatible
Host interface	Mini B connector for USB2.0 (USB1.1 compatible)
Target interface	Interface connector (10 pins) for QB-78K0MINI Connection cable for QB-78K0MINI Connector unit: HIF3BA-10D-2.54R (made by Hirose Electric) or equivalent product Wiring: FLEX-S4 (10) -7/0.127 2651P (made by Oki Electric) or equivalent product Recommended sockets on target device Straight: HIF3FC-10PA-2.54DSA (made by Hirose Electric Co., Ltd.) or equivalent product Right angle: HIF3FC-10PA-2.54DS (made by Hirose Electric Co., Ltd.) or equivalent product
Target interface power supply	Power is supplied from target device Standard current consumption: 8 mA (excludes power consumption by target circuit)
Supervisor	V850ES/KG1, 20 MHz operation
Temperature characteristics	0 to 40°C
Storage temperature	-15 to 60°C (no condensation)

Table 1-2. Target Interface Specifications

Item	Specification
Target device	78K/0 Series incorporating on-chip debug unit
Target system clock supply method	Can be supplied from an oscillator or oscillation circuit mounted on this product, or default 5 MHz clock can be supplied from within the emulator
Target system clock range	Same frequency as specified for the target device ^{Note 1}
Target interface voltage	2.0 to 5.5 V ^{Note 1}
Interface for flash programming	This is required when the target device contains flash memory. No. of interface signals: 1 Interface signal functions (in and out relative to direction from target device) • FLMD0 (in): Used when writing from the integrated debugger to flash memory
Interface for reset	No. of interface signals: 1 Interface signal functions (in and out relative to direction from target device) • RESET (in), RESET(out): System reset
Interface for detection of target power supply	Monitors target system's power supply Be sure to supply V _{DD} for on-chip debugging • V _{DD} (in): V _{DD} for on-chip debugging
Interface for mode setting and communications interface	Select X1 or X2, or select PORT A or B ^{Note 2}

- Notes**
1. The minimum operating frequency and minimum operating voltage for rewriting the flash memory are determined for each device. When using the 78K0/Kx1+, for example, at least a clock of 2 MHz and an operating voltage of 2.7 V must be supplied.
 2. The Port A and Port B pins vary according to the target device. When the target device is the 78K0/KF1+, these pins are P31 and P32.

★

Table 1-3. List of Debug Functions

Item	Specification
On-chip ROM/flash security functions	10 byte ID code authentication
Event-triggered break functions	One break before execution (zero if using a software break) One access break
Software break functions	2000 points
Forced break functions	Included
Execution functions	Continuous execution (free running), execution from cursor position, restart, and step execution
Slow motion	Included
Pseudo real-time RAM monitor functions	RAM area: 16 bytes (breaks can be set at up to 8 locations in 1-bit units, enabled by a temporary break)
DMM functions	Included (implemented as temporary break.)
Register manipulation functions	Included
Mask functions	Reset
SP setting overlook protection function	Yes
Execution time measurement	Not included
Trace functions	Not included

★ 1.3 System Configuration

Three possible system configurations when using the QB-78K0MINI are shown below.

Figure 1-2. System Configuration 1

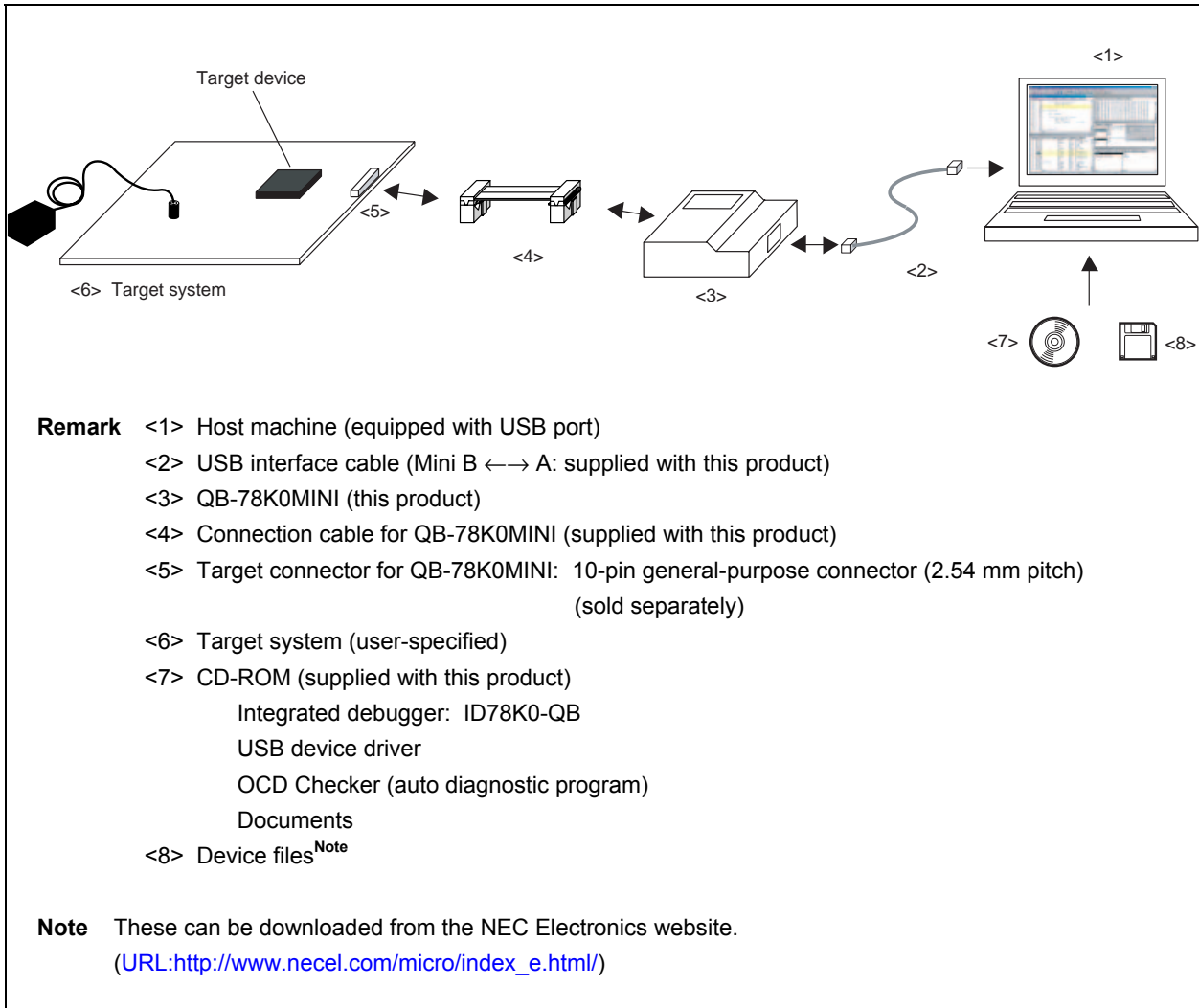
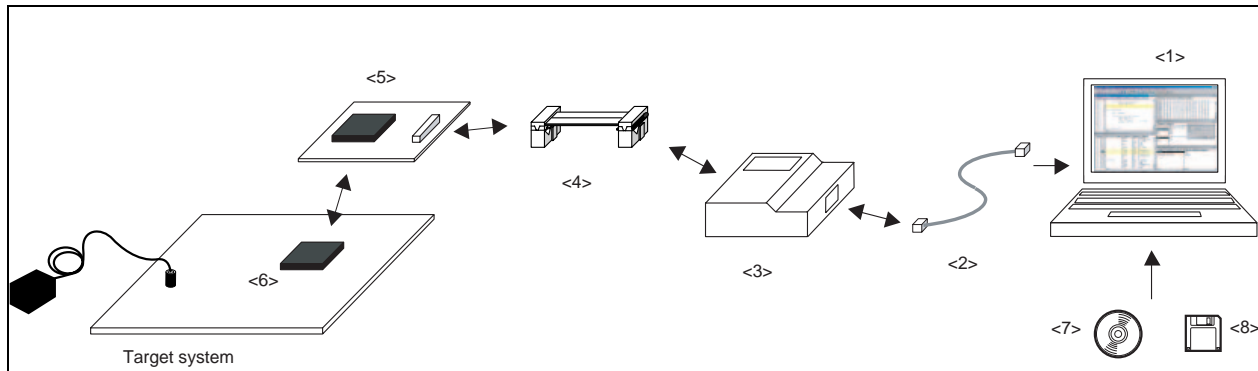


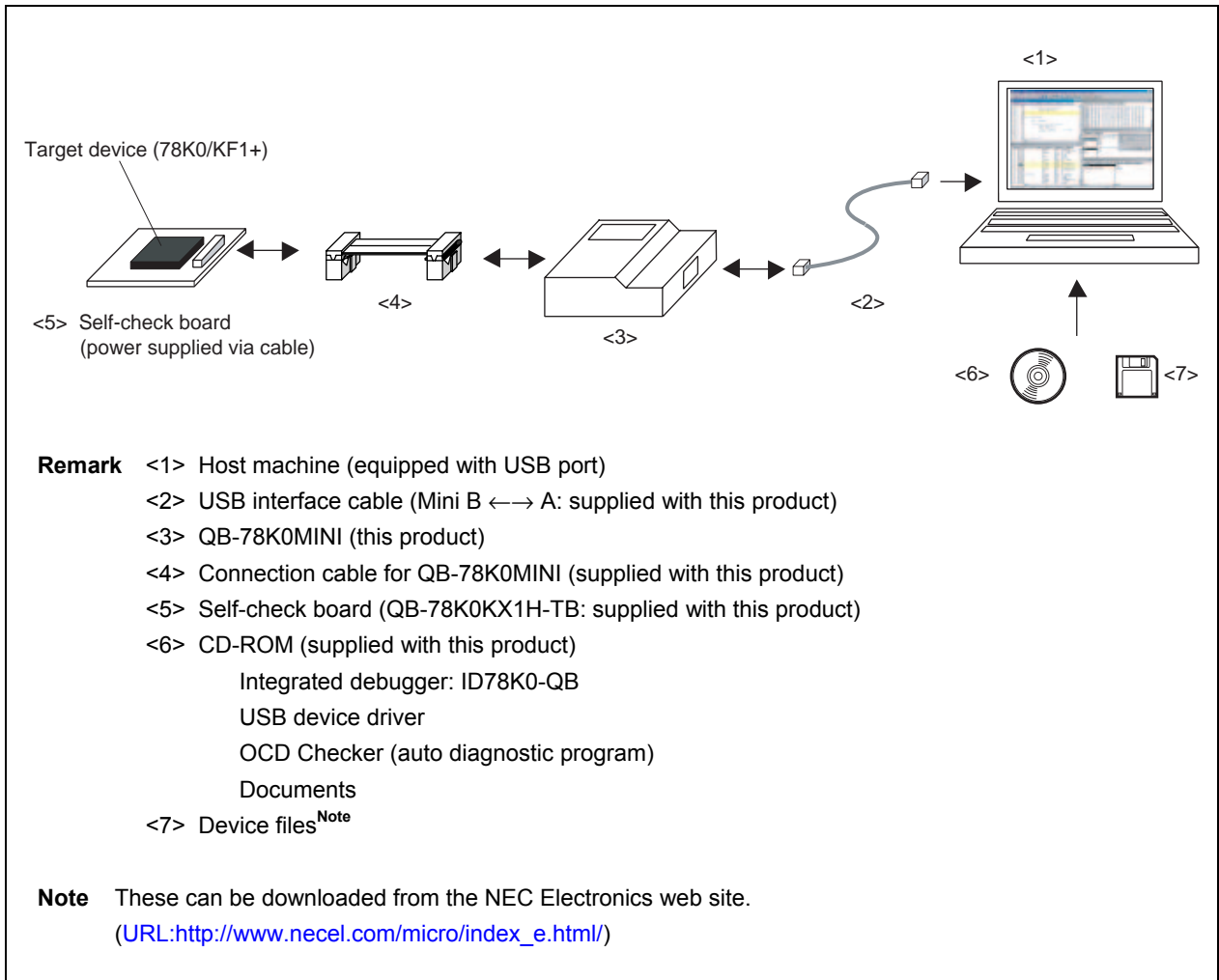
Figure 1-3. System Configuration 2



- Remark**
- <1> Host machine (equipped with USB port)
 - <2> USB interface cable (Mini B ←→ A: supplied with this product)
 - <3> QB-78K0MINI (this product)
 - <4> Connection cable for QB-78K0MINI (supplied with this product)
 - <5> QB-78K0KX1H-DA (sold separately)
(78K0/KF1+ device that includes an on-chip debug macro)
 - <6> QB-30MC-YQ-01T^{Note 1} or QB-30MC-NQ-01T^{Note 1} (sold separately)
 - <7> CD-ROM (supplied with this product)
Integrated debugger: ID78K0-QB
USB device driver
OCD Checker (auto diagnostic program)
Documents
 - <8> Device files^{Note 2}

- Notes**
1. QB-30MC-YQ-01T is equivalent to YSPACK30BK + YQGUIDE-S3.
QB-30MC-NQ-01T is equivalent to NSPACK30BK.
YSPACK30BK, YQGUIDE-S3, and NSPACK30BK are products of Tokyo Eletech Corp.
Contact Daimaru Kogyo Co., Ltd. For further information
Tokyo Electronics Department (TEL +81-3-3820-7112)
Osaka Electronics Department (TEL +81-6-6244-6672)
 2. These can be downloaded from the NEC Electronics web site.
(URL:http://www.necel.com/micro/index_e.html/)

Figure 1-4. System Configuration 3



1.4 Contents in Carton

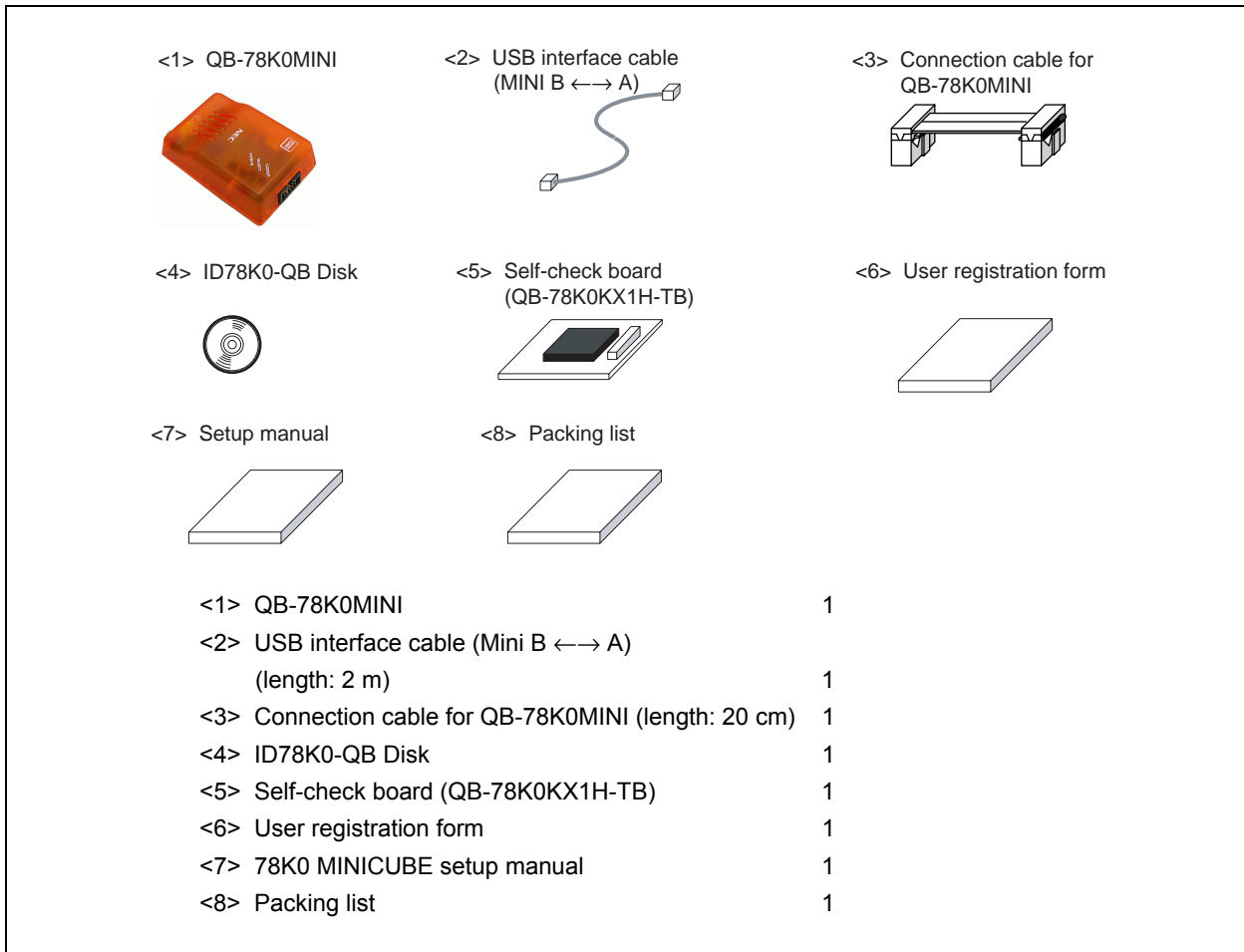
The following packaging is used with the QB-78K0MINI.

Make sure all of these items are included. If any items are missing or damaged, please contact an NEC Electronics sales representative or a distributor.

Also, be sure to fill out and return enclosed user registration form.

★

Figure 1-5. Package Contents



CHAPTER 2 NAMES OF PARTS

This chapter provides the names of the QB-78K0MINI's parts.

2.1 Names of Parts in Main Unit

Figure 2-1. Main Unit (Top View)

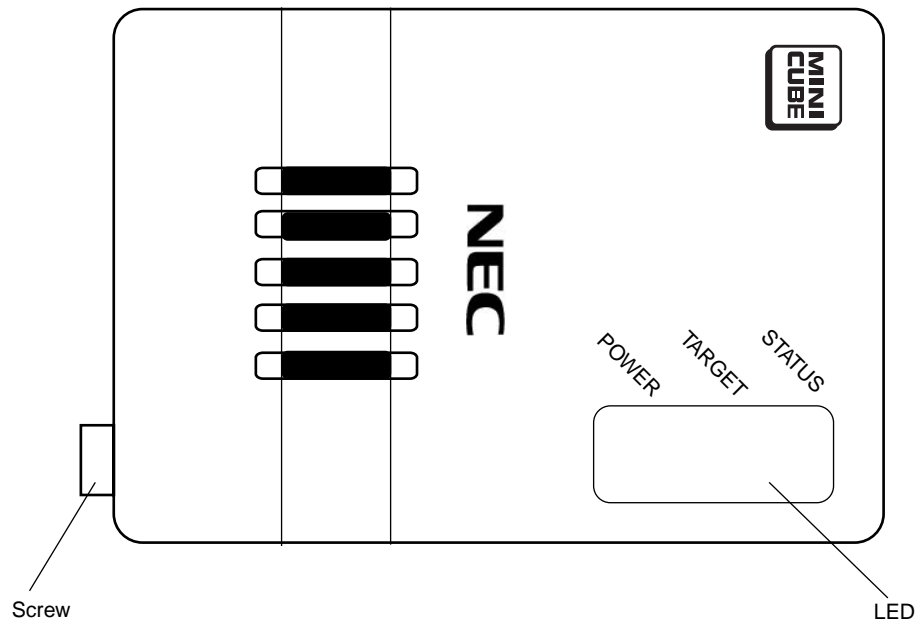


Figure 2-2. Main Unit (Side Views)

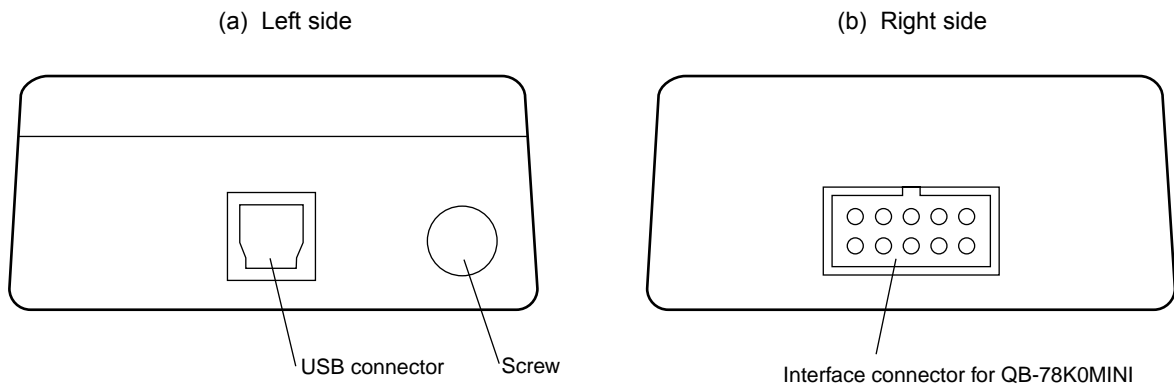
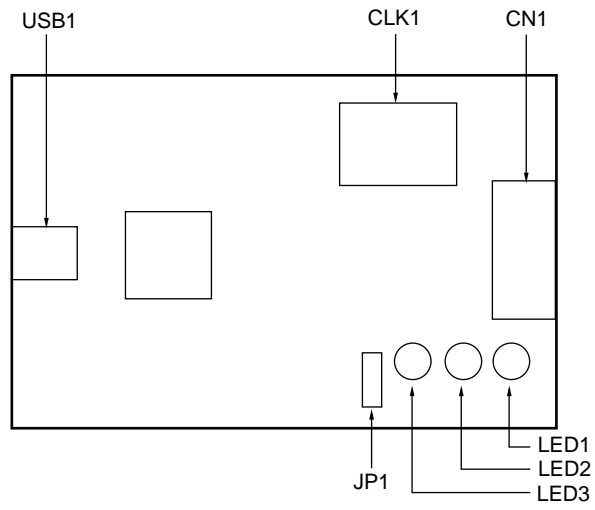


Figure 2-3. External View of Board



CHAPTER 3 HARDWARE SETTINGS AND FUNCTIONS

In order to connect the QB-78K0MINI to the target system for debugging, a circuit for connecting the QB-78K0MINI to the target system must be created.

For details, see the target device's user's manual.

Remark Since the environment used for on-chip debugging is the same as the actual debugging environment, debugging is performed with the microcontroller installed in a system.
The debugging environment is built by connecting the on-chip debug unit and the on-chip debug emulator.

3.1 Hardware

3.1.1 USB connector

A USB2.0 compliant MINI-B type connector (UX60A-MB-5ST: Hirose Electric Co., Ltd.) is used.

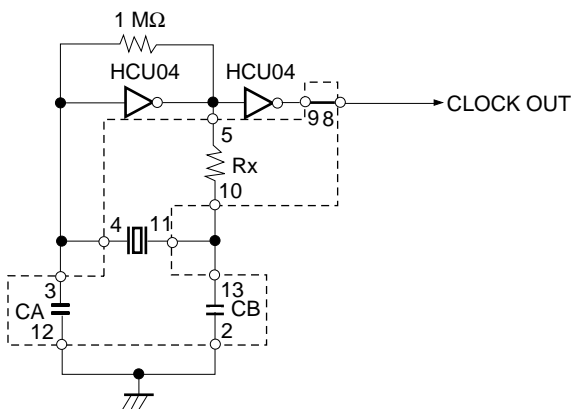
3.1.2 Clock socket for target device

For clock supply to the target device, a 14-pin DIP socket is implemented as CLK1. A 14-pin type oscillator (5 V) or a parts board that can configure an oscillation circuit can be mounted on the 14-pin DIP socket. The socket specifications are listed as (a) to (d) below. Also, a parts board mounted as CLK1 is shown in (e) below.

A parts board such as the 160-90-314 (manufactured by PRECI-DIP) can be used with this socket to configure oscillation circuit. Be sure to use the manufacturer's recommended values for constants of the capacitors and resistors to be mounted.

★ **Caution** Be sure to turn off the QB-78K0MINI's power supply before mounting or removing a clock in the clock socket for the target device. In addition, do not mount a clock in the clock socket when "System" is selected in the "Main Clock" field in the Configuration dialog box of the debugger.

(a) Equivalent circuit

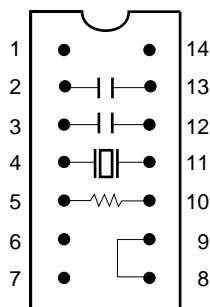


(b) Mounted parts

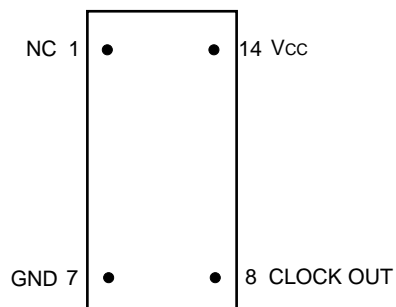
Pin No.	Connection
2 to 13	Capacitor CB
3 to 12	Capacitor CA
4 to 11	Ceramic resonator/crystal resonator
5 to 10	Resistor Rx
8, 9	Shorted

(c) Parts board (oscillation circuit parts) mount example

(d) Pin positions in corresponding clock module



Top View



Top View

(e) Parts board mounted in CLK1 socket

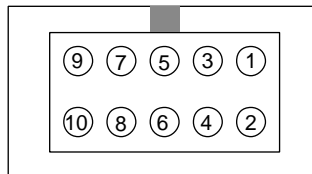


3.1.3 Connectors for QB-78K0MINI

The QB-78K0MINI's connector CN1 (a two-row 2.54 pitch type connector, with reverse-insertion blocker) is described below.

Pin No.	Name	IN/OUT ^{Note}	Remark
1	RESET_IN	IN	Target reset input
2	RESET_OUT	OUT	Target CPU reset output
3	FLMD0	OUT	
4	V _{DD} _IN	IN	Target power supply detection
5	X2	IN/OUT	N-CH connection (for TXD and RXD)
6	GND	–	
7	X1	OUT	Clock supply
8	GND	–	
9	RESERVED	–	
10	5 V_CHK	–	Power supply for self-check board only

Note The I/O information is shown from the QB-78K0MINI's perspective.

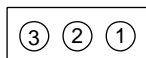


Pin layout (top view)

3.1.4 Jumper settings

The jumper JP1 settings are as follows.

Name	Status
JP1	1-2 shorted (factory setting (fixed))



Pin layout (top view)

3.1.5 Display devices

Three LEDs are included as status display devices.

Name	Display Function		Remark
LED1	STATUS (RUN, BREAK, DOWNLOAD)		RUN: Blinking (slow) After break or debugger start: ON DOWNLOAD: Blinking (fast) Before starting debugger: OFF
LED2	TARGET	Before starting debugger	When target voltage is 1.8 V or higher: ON When target voltage is lower than 1.8 V: OFF
		After starting debugger	When target voltage is POC voltage or higher: ON When target voltage is lower than POC voltage: OFF
LED3	POWER		With power supplied from host machine: ON Without power supplied from host machine: OFF

3.2 Signal Functions of Target Interface

(1) **RESET_IN**

This is the target's reset input signal.

(2) **$\overline{\text{RESET_OUT}}$**

This is a reset signal output to the target device.

(3) **V_{DD}_IN**

An interface output signal is generated when the target system's V_{DD} voltage is detected.

(4) **X1 pin**

This is an output signal that is used to supply the clock.

(5) **X2 pin**

This is a bidirectional signal used for data communications.

(6) **FLMD0**

This is an output signal used to overwrite the target device's flash memory.

(7) **5 V_CHK**

This is a power supply pin for the self-check board only.

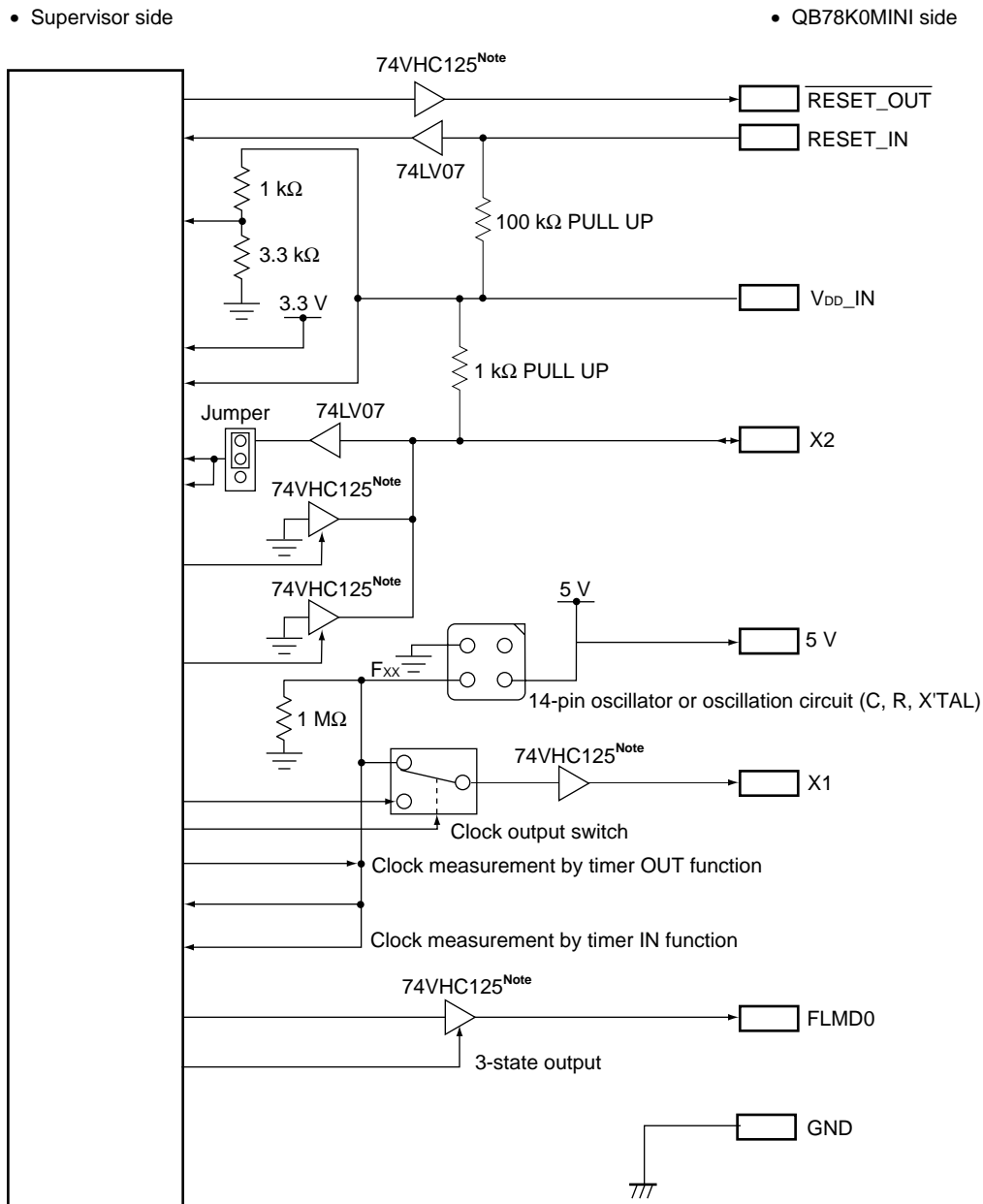
Up to 50 mA can be supplied via this pin. However, since power is being supplied via the USB bus, a voltage drop occurs when voltage is drawn via this pin. Therefore, do not supply voltage to the target device from this pin.

(8) **GND**

This is a GND pin.

3.2.1 QB-78K0MINI equivalent circuit

Figure 3-1. Equivalent Circuit



Note The target output buffer's power supply is provided via the target system's VDD pin, and an interface for voltage values from 2.0 to 5.5 V is enabled when a voltage is detected on the target system side.

3.3 Target Reset Processing

The target reset processing differs depending on whether or not this product is connected to the target device. Both types of processing are described below.

(1) **When using jumper**

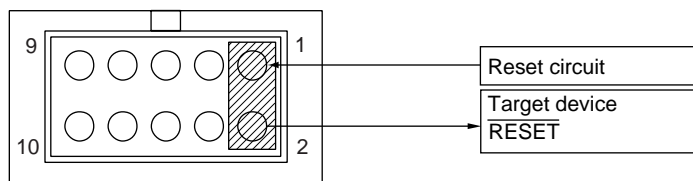
(a) **With QB-78K0MINI**

Connect using the connection cable for QB-78K0MINI.

(b) **With this chip**

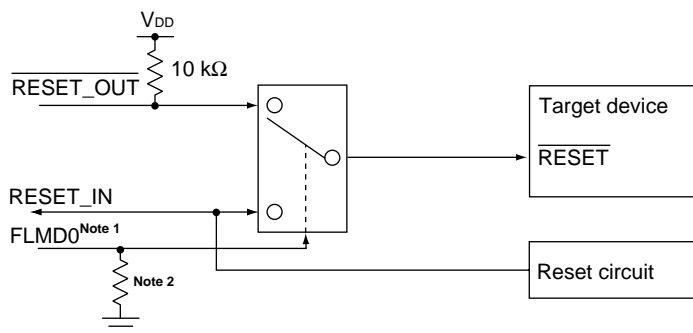
Short pins 1 and 2 (target connector for QB-78K0MINI) as is shown in Figure 3-2.

Figure 3-2. Jumper Setting



(2) **When using selector logic (auto switch)**

Figure 3-3. When Using Selector Logic



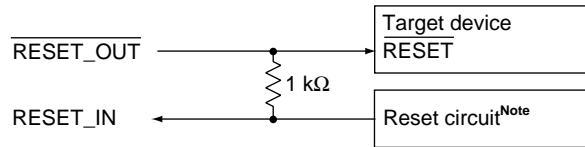
Notes 1. When QB-78K0MINI is connected FLMD0 is at high level, and when it is not connected FLMD0 is pulled down.

★ 2. Connect a pull-down resistor of 470 Ω or higher.

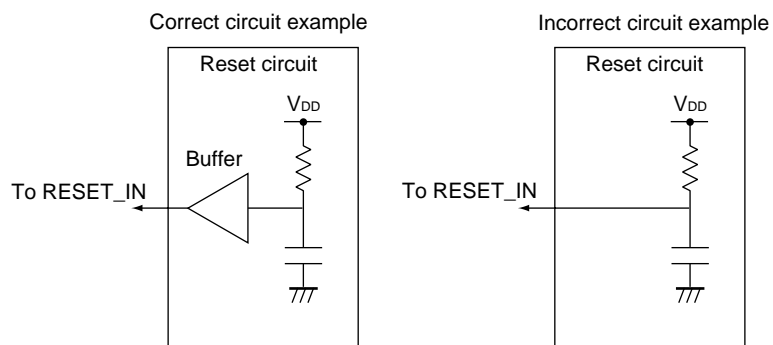
Remark All constants shown in this circuit are reference values.

(3) When using resistors (auto switch)

Figure 3-4. When Using Resistors



Note Be sure to insert a buffer when connecting via resistors. In particular, if a power-on reset circuit is connected directly, the time constant may become invalid due to $\overline{\text{RESET_OUT}}$ output from the QB-78K0MINI, in which case a lack of drive capacity in the circuit where the reset occurs may prevent proper detection of the reset. A reset circuit example is shown below.



Caution The reset is driven from the QB-78K0MINI when a resistor is connected between $\overline{\text{RESET_OUT}}$ and RESET_IN and the QB-78K0MINI is connected. When the QB-78K0MINI is not connected, the reset is driven via the resistor and from within the target device.

Remark All constants shown in this circuit are reference values.

3.4 Target Connectors

The QB-78K0MINI's target connector (a two-row 2.54 pitch type connector, with reverse-insertion blocker) is described below.

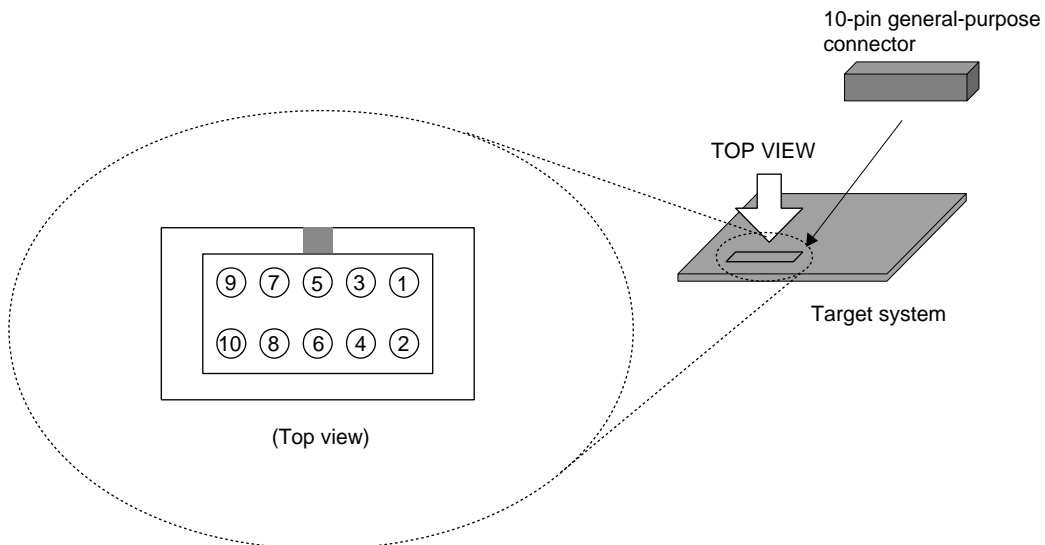
Pins 9 and 10 should be left open on the target.

- Recommended connectors: (straight) HIF3FC-10PA-2.54DSA (manufactured by Hirose Electric Co., Ltd.)
(right angle) HIF3FC-10PA-2.54DS (manufactured by Hirose Electric Co., Ltd.)

Pin No.	Name	IN/OUT	Remark
1	RESET_IN	IN	Target reset input signal
2	RESET_OUT	OUT	Reset signal output to target device
3	FLMD0	OUT	Output signal ^{Note} used to control on-chip debugging functions
4	V _{DD} _IN	IN	This signal is used to generate an interface output signal when the target system's V _{DD} is detected.
5	X2	IN/OUT	Bidirectional signal used for data communications
6	GND	–	Connected to GND.
7	X1	OUT	Output signal used for clock supply
8	GND	–	Connected to GND.
9	RESERVED	–	Open
10	RESERVED	–	Open

Note FLMD0 is at high level during on-chip debugging.

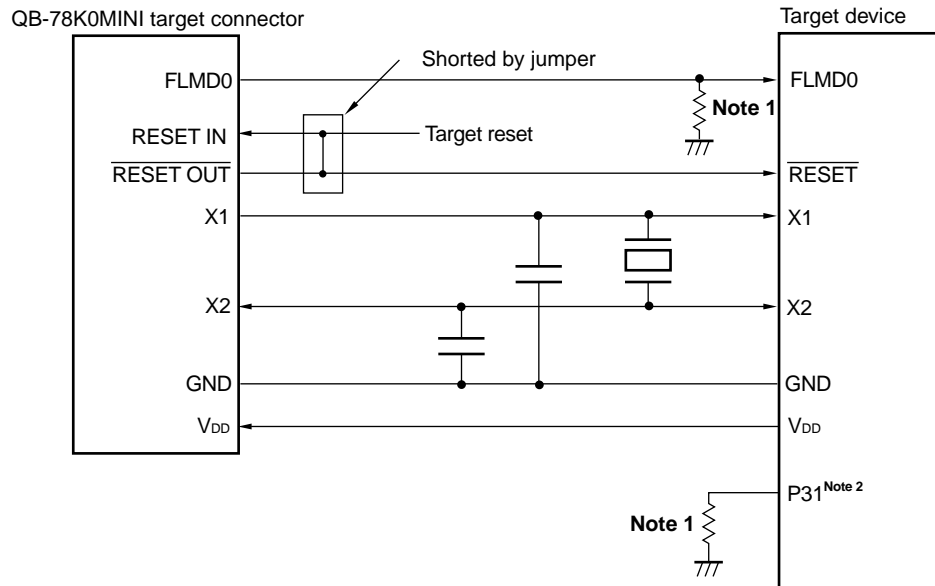
Figure 3-5. Connector Pin Layout



3.5 Connection Circuit Examples

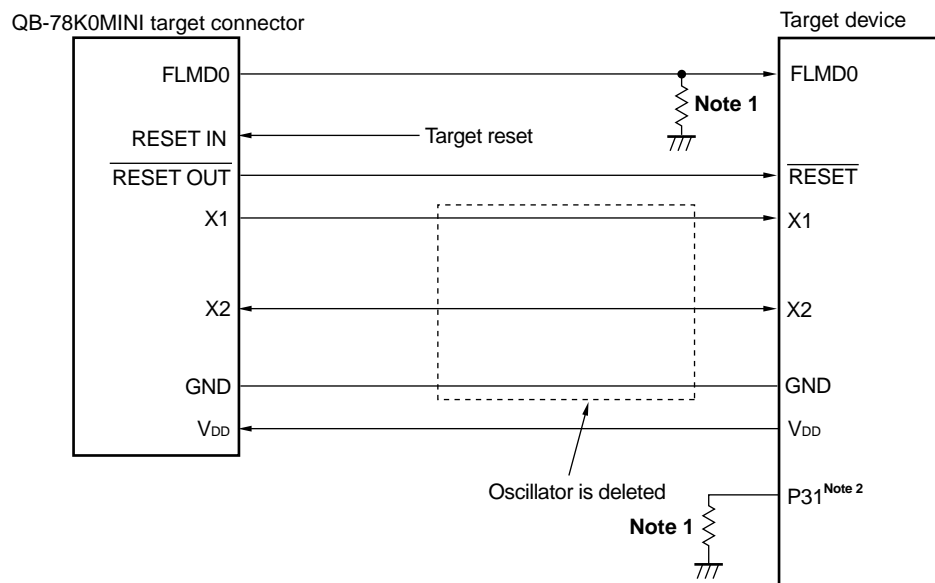
The following are examples of circuits required when connecting the QB-78K0MINI to the target system. For details, see the target device's user's manual.

Figure 3-6. Connection Circuit Example (When QB-78K0MINI Is Not Used)



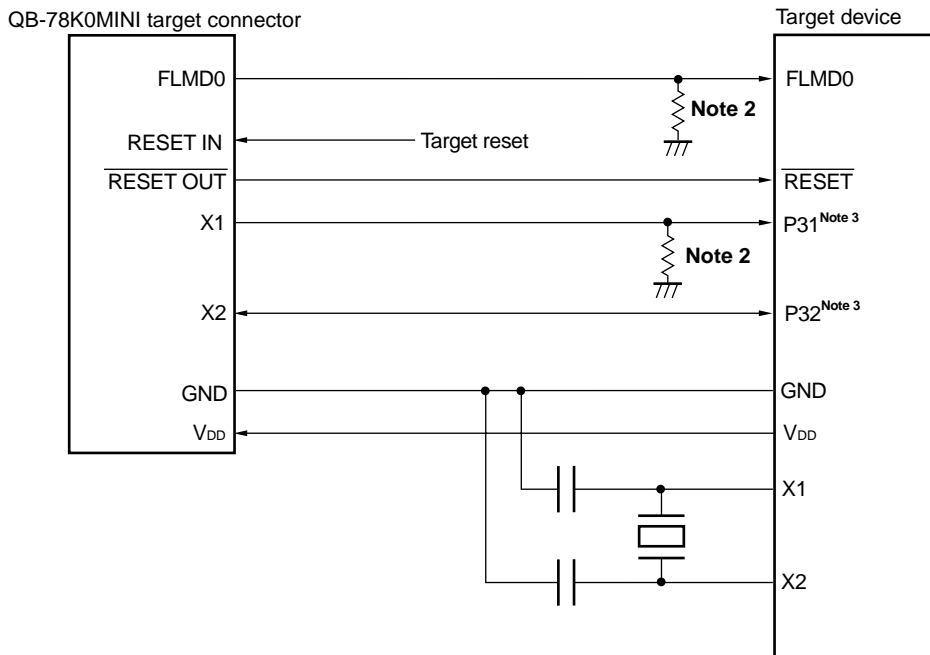
- ★ **Notes** 1. Connect a pull-down resistor of 470 Ω or higher.
- 2. When using the 78K0/KF1+

Figure 3-7. Connection Circuit Example (When Using QB-78K0MINI: X1 and X2 Are Used)



- ★ **Notes** 1. Connect a pull-down resistor of 470 Ω or higher.
- 2. When using the 78K0/KF1+

Figure 3-8. Connection Circuit Example (When Using QB-78K0MINI: Ports A and B^{Note 1} Are Used)



- Notes**
1. The port A and port B pins differ according to the target device.
 2. Connect a pull-down resistor of 470 Ω or higher.
 3. When using the 78K0/KF1+

★

3.6 Connections and Startup Procedure

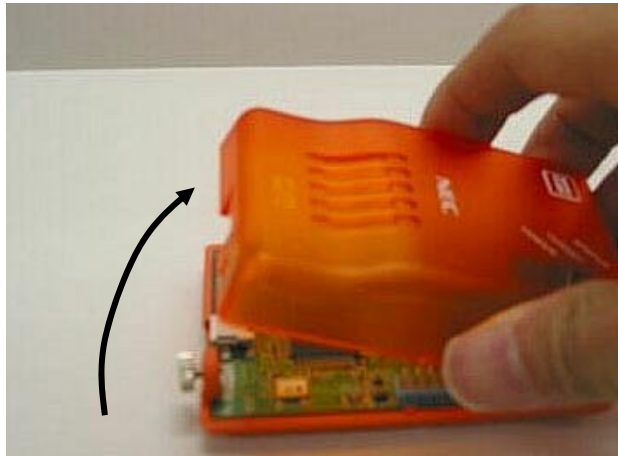
3.6.1 Mounting clock

The following describes mounting the clock to be supplied to the target system in the QB-78K0MINI.

- (1) Loosen the QB-78K0MINI's screw.

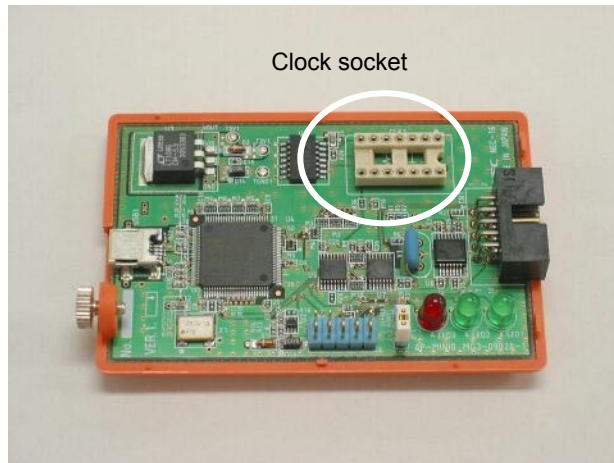


- (2) Remove the cover.



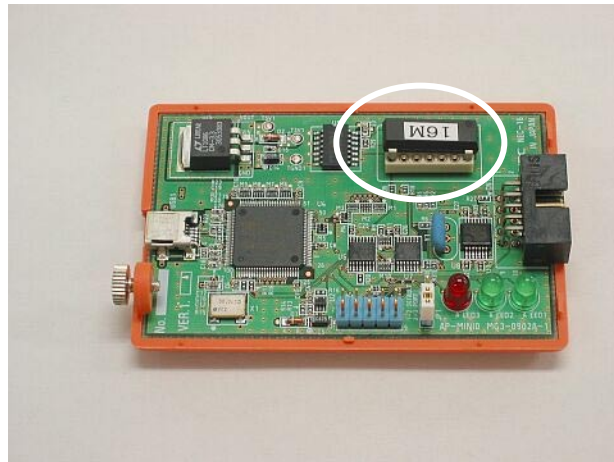
Use the interface connector side as a reference point when lifting the USB connector side.

The product appears as shown below when the cover has been removed.



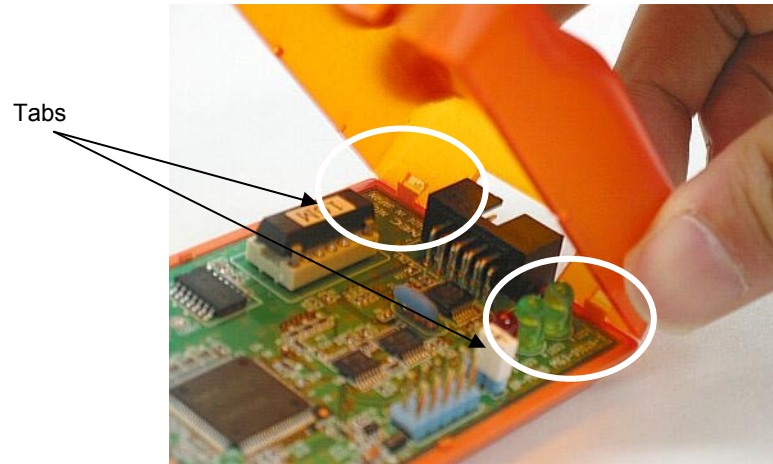
(3) Insert an oscillator or oscillation circuit.

Insert an oscillator or oscillation circuit for the clock to be supplied to the target system into the clock socket.



- (4) Replace the cover.

Make sure that the cover is aligned with the two tabs on the interface connector side.



- (5) Close the cover and tighten the screw.



This completes the clock mounting procedure.

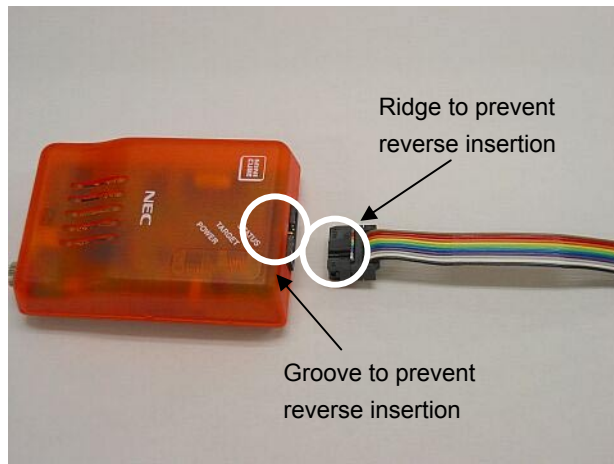
3.6.2 Connecting QB-78K0MINI to related devices

Follow the steps described below when connecting the QB-78K0MINI to other related devices.

Caution Before connecting to any related device, be sure to install the integrated debugger (ID78K0-QB), USB driver, OCD Checker, and device files in the host machine.

(1) Attach the QB-78K0MINI connection cable (QB-78K0MINI side)

Align the ridge in the QB-78K0MINI connection cable socket with the groove in the QB-78K0MINI's interface connector for preventing reverse insertion and insert the socket into the connector.

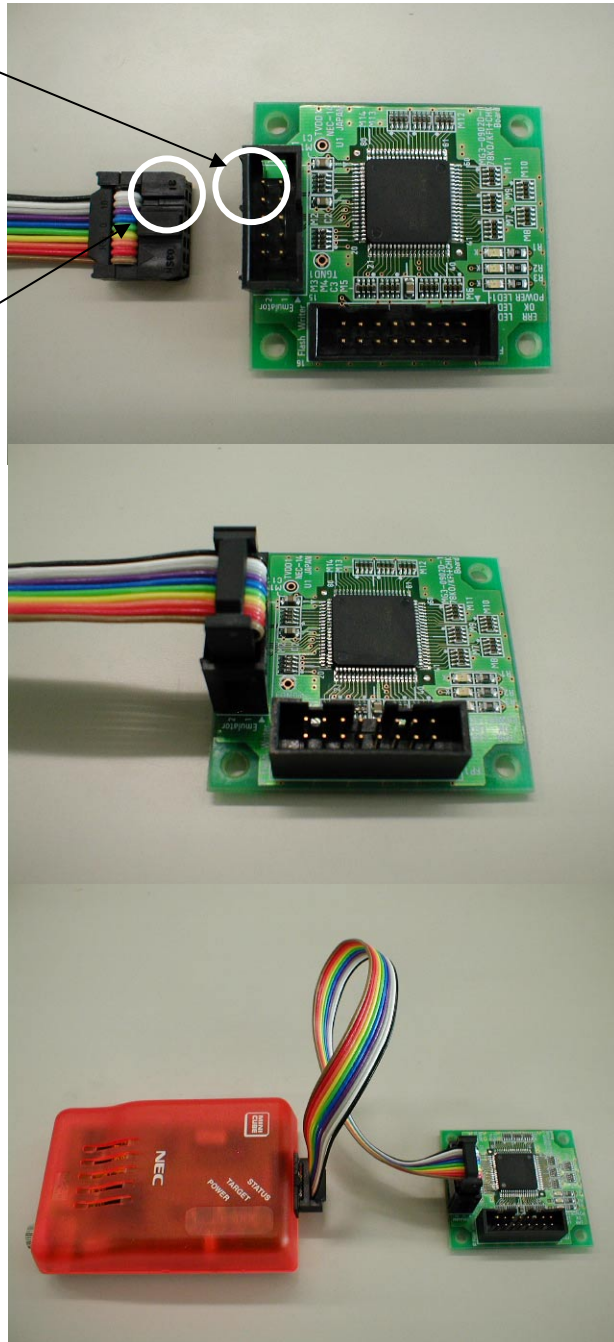


(2) Attach the QB-78K0MINI connection cable (self-check board or target system side)

Align the ridge in the QB-78K0MINI connection cable's socket with the groove in the target connector on the self-check board or target system side for preventing reverse insertion and insert the socket into the connector.

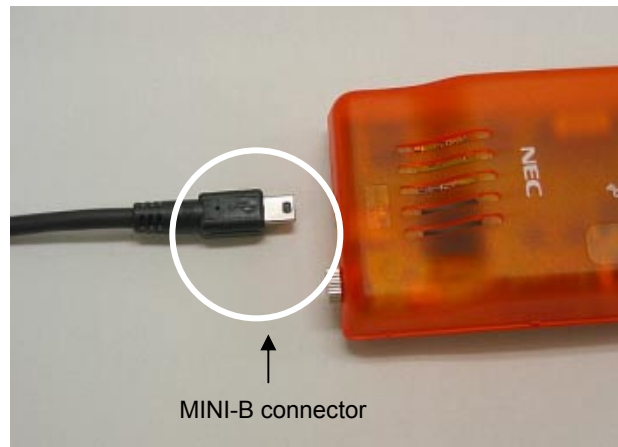
Groove to prevent reverse insertion

Ridge to prevent reverse insertion



(3) USB interface cable connection (QB-78K0MINI side)

Connect the USB interface cable's MINI-B connector to the QB-78K0MINI's USB connector.



(4) USB interface cable connection (host machine side)

Connect the USB interface cable's A connector to the host machine's USB port.

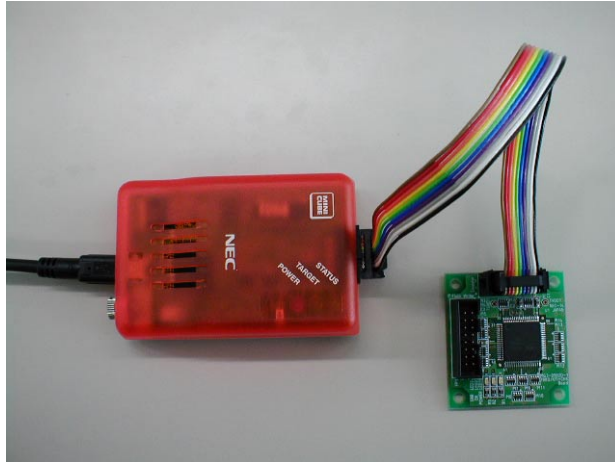


(5) Power-on

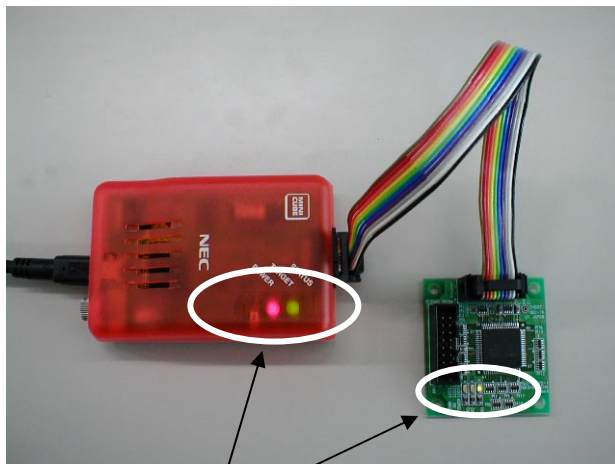
(a) When using a self-check board

After connecting the USB interface cable to the host machine, turn on the power to the QB-78K0MINI and the self-check board (the QB-78K0MINI's TARGET and POWER LEDs are ON and the self-check board's LED1 is ON).

<Before connecting>



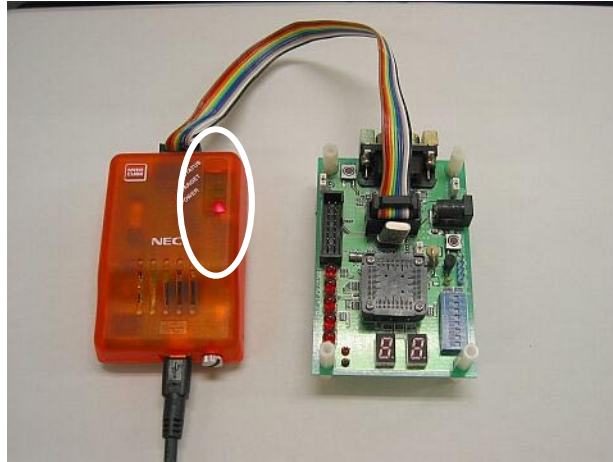
<After connecting>



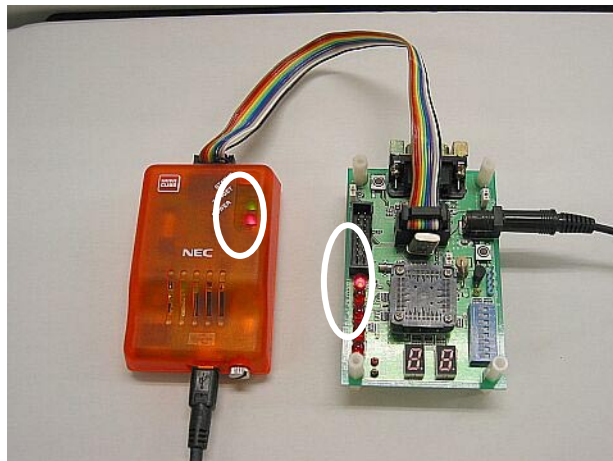
LEDs are ON

(b) When using a target system

When the USB interface cable is connected to the host machine, only the QB-78K0MINI's POWER LED is ON (the QB-78K0MINI's power is ON and the target system's power is OFF).



When turning on the power to the target system, POWER LED is ON (the QB-78K0MINI's power is ON and the target system's power is ON).

**(6) ID78K0-QB startup**

After making sure the power is supplied to the QB-78K0MINI and either the self-check board or the target system, start up the ID78K0-QB.

3.6.3 Disconnecting QB-78K0MINI from related devices

Follow the steps described below when disconnecting the QB-78K0MINI from other related devices.

- (1) Close the ID78K0-QB.
- (2) Turn off the power to the target system (if using a target system).
- (3) Remove the USB interface cable from the QB-78K0MINI and the host machine.
- (4) Remove the QB-78K0MINI connection cable from the QB-78K0MINI and from either the target system or the self-check board.

3.7 Pin Statuses at Power-on

Table 3-1 lists the statuses of pins at power-on.

However, when the USB interface cable is not connected, if the target voltage does not start up right away ($V_{DD} =$ less than 2 V), the device may be degraded, so do not turn on the target's power until after the USB interface cable has been connected.

Table 3-1. Pin Statuses

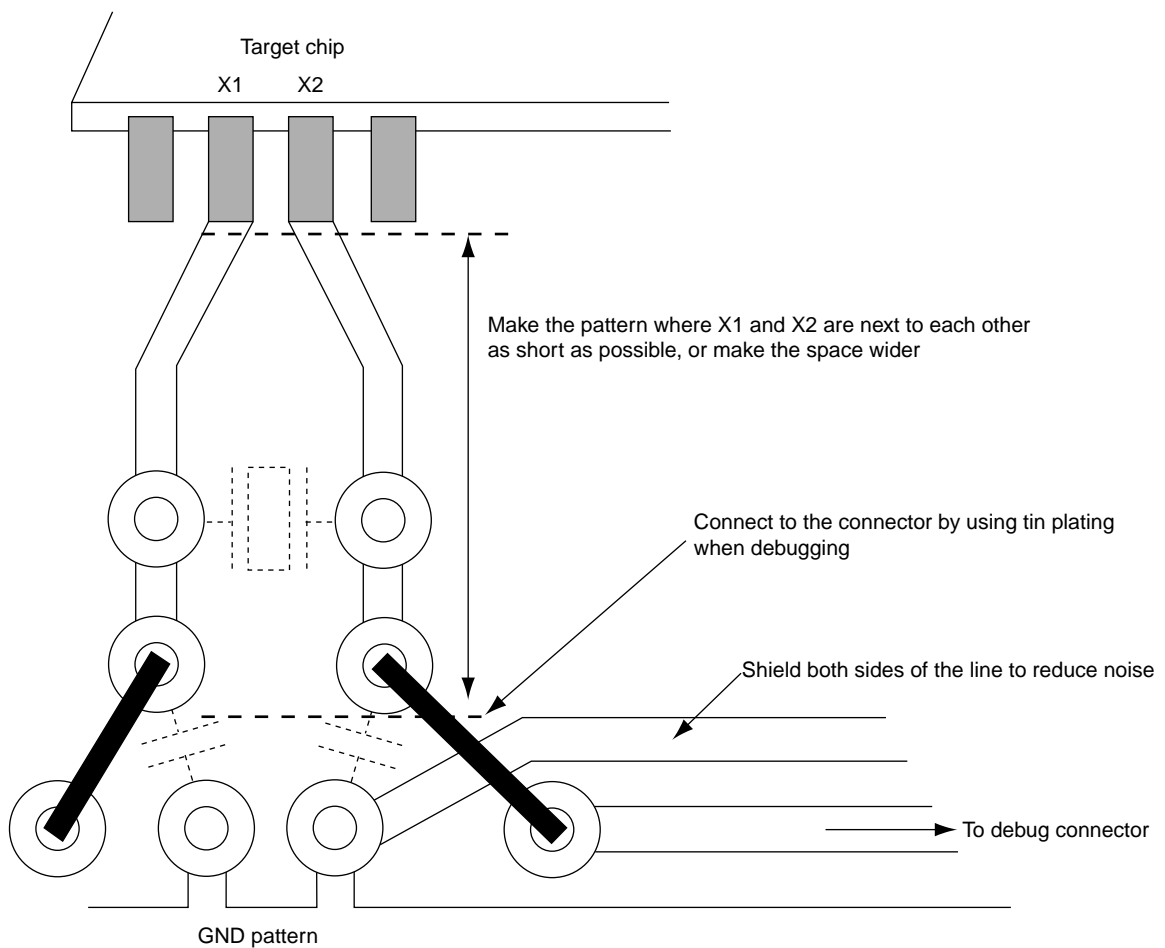
Power-on Mode		Status of Target Interface Pin	
USB Cable	Target Power Supply	Output Pin	Input Pin
Not connected	ON	All pins at low level	All pins at high impedance
Not connected	OFF	All pins at high impedance	All pins at high impedance
Connected	ON	Normal operation	Normal operation
Connected	OFF	All pins at high impedance	All pins at high impedance

3.8 Cautions on Creating Target System

Be sure to note the following cautions when creating the target system.

- Do not place X1 and X2 next to each other on the target board. If the layout requires this, they should be made as short as possible.
- Make the distance to the target connector as short as possible.
- Since the X1 and X2 lines are used for clock supply, be sure to shield them, such as with a GND pattern.
- Before shipping the product, use jumpers or other means to physically separate the X1 and X2 pins from the target connector in order to ensure normal clock oscillation.
- When debugging, remove capacitors, feedback resistors, and other elements for the resonator in order to prevent signal degradation due to the load placed on the X1 and X2 pins.

Figure 3-9. Reference Example of Target System



CHAPTER 4 CAUTIONS ON USE OF SELF-CHECK BOARD

4.1 Functions of Self-check Board

(1) Self check

The OCD Checker can be used to perform self checking of the QB-78KOMINI.

(2) Operation check

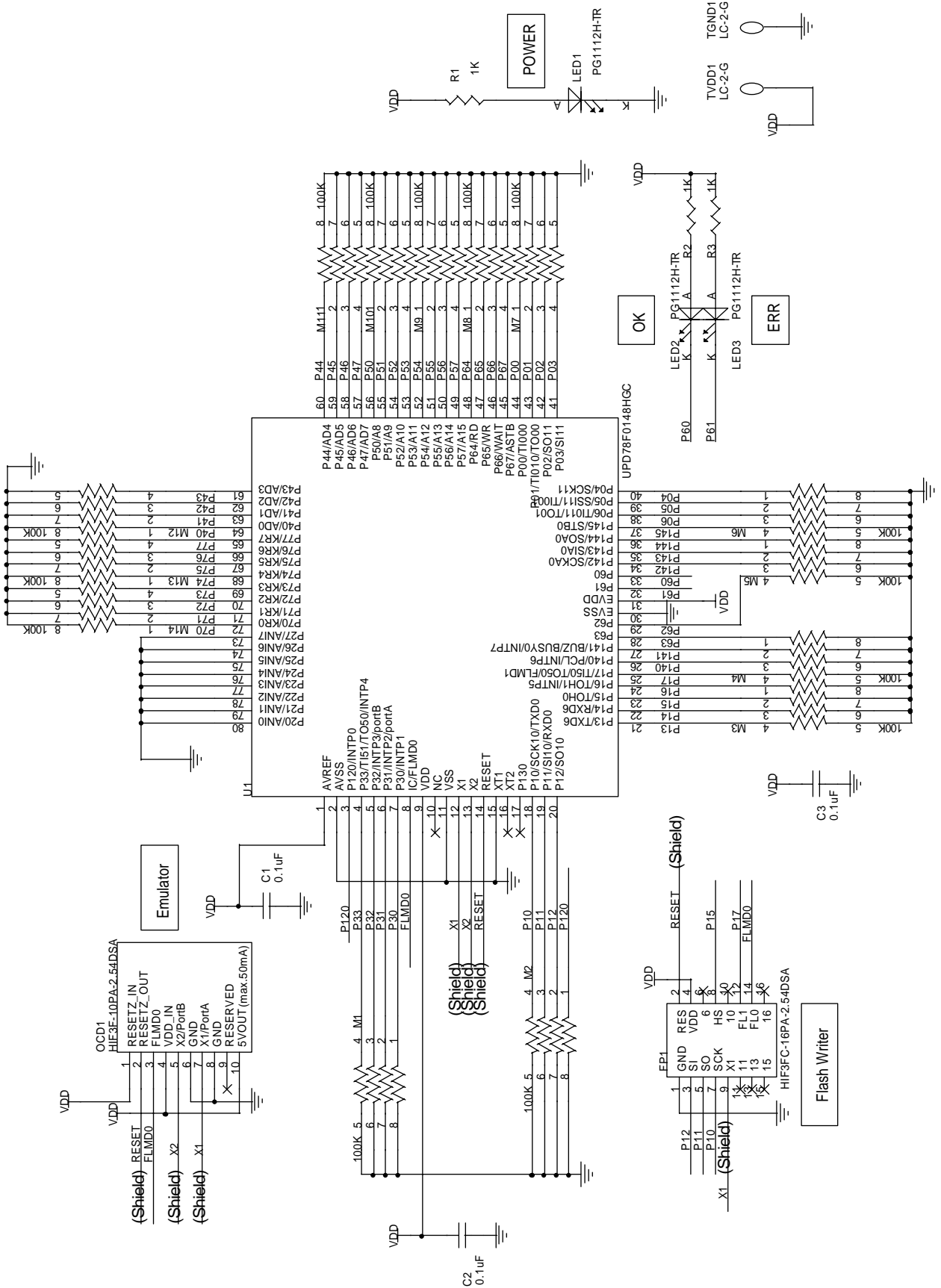
Start the integrated debugger and download the user program, then check the operation.

When checking operation in this way, be sure to refer to the self-check board circuit diagram shown in Figure 4-1.

When downloading user programs, if any of the restrictions described below in chapter 5 have been violated, preventing startup of the OCD Checker or the integrated debugger, recover using the self-check board recovery methods described in 4.2 below.

Caution The OCD Checker is not supported except for use in self checking. Also, there are no plans for additional specifications or other version upgrades.

Figure 4-1. Circuit Diagram of Self-check Board



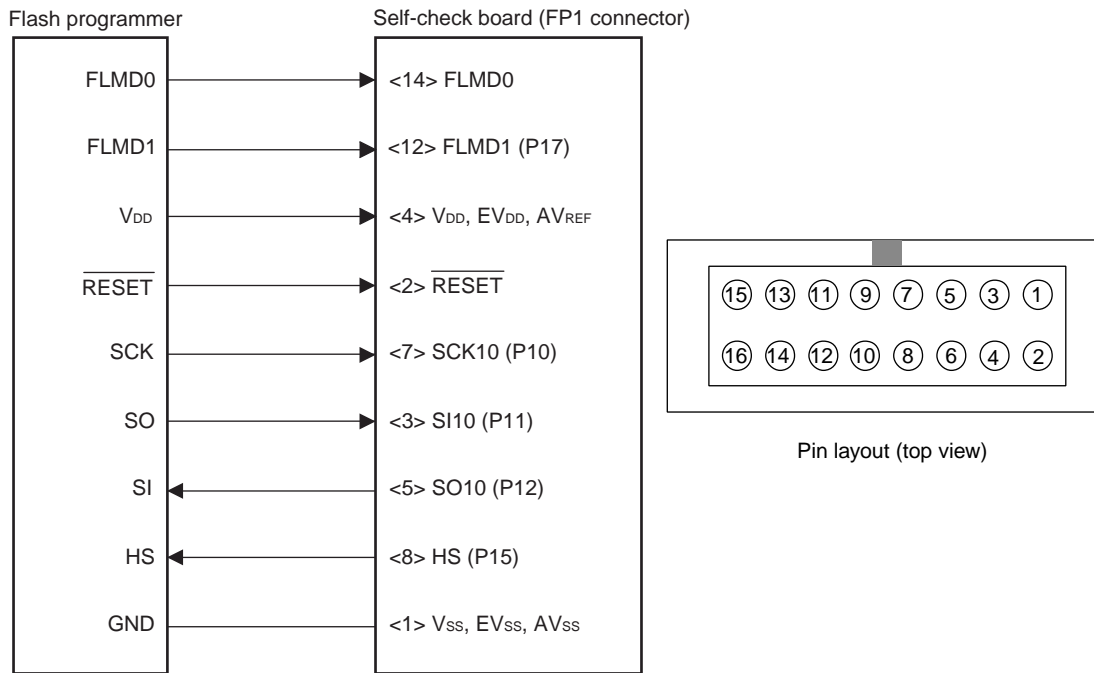
4.2 Self-check Board Recovery

Perform the following steps to recover in cases where the integrated debugger or the OCD Checker operate abnormally, such as when the self-check board's embedded ID code is uncertain, or when an area (at address 0x84) reserved for use by the QB-78K0MINI has been set as a use-prohibited area.

- (1) Connect the flash programmer to the self-check board.

Figure 4-2 shows the connection between the flash programmer and the self-check board (FP1 connector). It is assumed that a PG-FP4 target cable (type A) is used to connect on the flash programmer side.

Figure 4-2. 3-Wire Serial I/O Type (With Handshaking)



Recommended settings for programmer

Target operating voltage: 5 V (supplied from programmer)

Target operating frequency: 10 MHz (supplied from programmer)

Write ports: 3-wire handshake mode or 3-wire (SIO-ch0) mode

Serial transfer rate: 625 kHz

- Cautions**
1. To avoid signal conflicts, do not connect the flash programmer to the QB-78K0MINI.
 2. When connecting the flash programmer, connect the programmer's cable to the FP1 connector. Board faults may occur if this cable is attached to a different connector.

- (2) Enter the settings for the flash programmer.

Figure 4-3. Example of Settings for PG-FP4

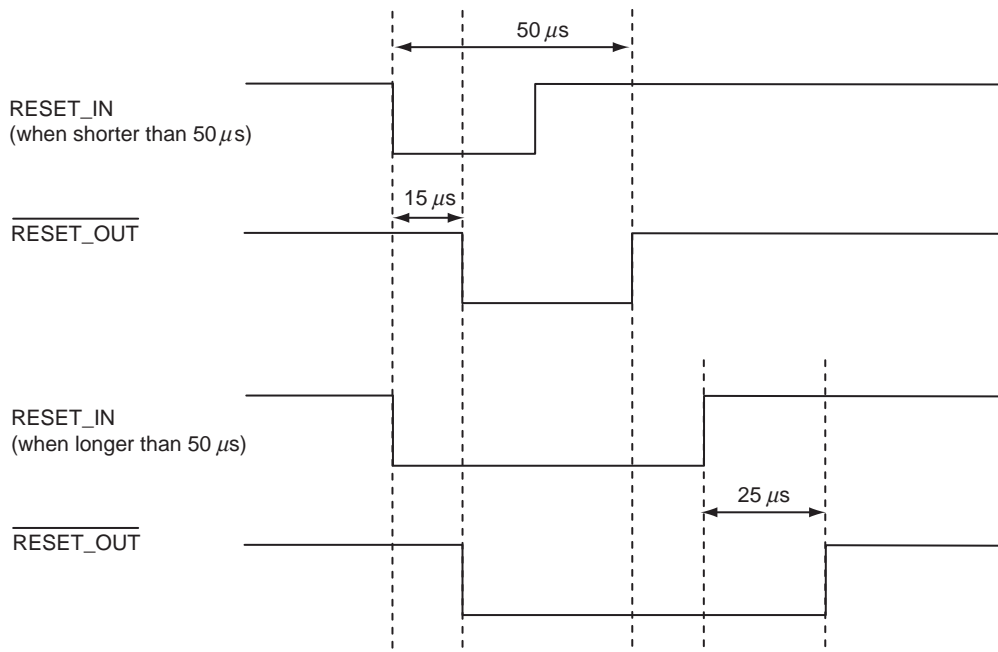
- (3) Perform a chip erase operation.

CHAPTER 5 RESTRICTIONS

The restrictions are described below.

- A delay period of about $50\ \mu\text{s}$ from cancellation of a target reset ($\overline{\text{RESET_IN}}$) to cancellation of a target device reset ($\overline{\text{RESET_OUT}}$) (the period from when the target reset ($\overline{\text{RESET_IN}}$) becomes low to when the target device reset ($\overline{\text{RESET_OUT}}$) becomes high) is required for mode setting. See Figure 5-1 below.
- A delay fo about $25\ \mu\text{s}$ is required from input of a target reset ($\overline{\text{RESET_IN}}$) to when the target device is reset ($\overline{\text{RESET_OUT}}$). See Figure 5-1 below.

Figure 5-1. Timing of Target Reset



- When setting to on-chip debugging mode via the normal port, without using pins X1 and X2, two of the user ports will be unavailable for use.
- When the user program is downloaded, flash memory programming is performed by self-writing. At that time, be sure to use a clock that supports the self programming routine's operating frequency range.
- A high-level signal is always output from to the FLMD0 pin during emulation. Be sure to connect a pull-down resistor to the FLMD0 pin, and manipulate this pin based on high/high/impedance levels, rather than on high/low levels, when using ports for manipulation.

- Restriction on using the self-check board (1.0)^{Note} for operation check.
 - There is a communication problem due to a bug in the microcontroller mounted on the self-check board when the QB-78K0MINI operates on the Ring-OSC. The debugger takes a measure to avoid this problem by forcibly switching to the main clock when a break occurs, and re-switches to the Ring-OSC when the program is executed. Consequently, the QB-78K0MINI always operates on the main clock during a break.
 - A fail-safe break (Uninitialize Stack Pointer; a break that occurs due to a failure to perform stack pointer initialization) occurs when an internal reset is generated due to a bug in the microcontroller mounted on the self-check board.

[Workaround]

Stop the watchdog timer operation or repeat starting the count operation to suppress generation of the internal reset by the watchdog timer.

Note The part number is shown as “QB-78K01H-TB X.X” on the label attached to the device mounted on the self-check board. “X.X” indicates the version.

CHAPTER 6 CAUTIONS

6.1 Cautions When On-chip Debug

(1) Reserved area used by QB-78K0MINI

The following reserved areas are used by QB-78K0MINI.

(a) Flash memory area

- Addresses 0x02 and 0x03
- Addresses 0x7E and 0x7F (when using a software break)
- Address 0x84
- Addresses 0x85 to 0x8E
- Addresses 0x8F to 0x18F: Standard value of program
(+256 bytes when using pseudo real-time RAM monitor function)
(when using a device with 10 or more SFRs the can be accessed in 16-bit units: +n (the number of exceeding registers x 6 bytes))

(b) Internal extended RAM area

- Addresses 0xF7F0 to 0xF7FF
(when using pseudo real-time RAM monitor function)

(c) Internal high-speed RAM area

- 7 bytes as stack area: Standard value of stack
(+2 bytes when using software breaks)
(+7 bytes when using pseudo real-time RAM monitor function)

(2) Values at addresses 0x02, 0x03 and 0x8F or higher

Values other than 0xFF cannot be downloaded to address 0x02, 0x03 or the program area starting from address 0x8F. 0xFF is always displayed in the Memory window in order to prevent errors that occur by changing the value. Uploaded data is also displayed as 0xFF. In addition, on-chip debugging cannot be performed on these areas after they are overwritten by self programming.

(3) Values specified by linker option -go

Among the reserved areas used by QB-78K0MINI, the following areas can be secured using the linker option -go.

- Addresses 0x02 and 0x03
- (Size of program specified from address 0x8F) +1

Specify the -go option default value, 256, for the program size for on-chip debugging.

	Value Specified by Option	Program Size	Program Area
Standard	256	257	0x8F to 0x18F

When using the pseudo real-time RAM monitor function, expand the program area by 256 bytes. When using a device with 10 or more SFRs that can be accessed in 16-bit units, expand the program area for on-chip debugging (default: 257 bytes of 0x8F to 0x18F) by the amount exceeding the 10-SFR area. As a rough guide, add the number of exceeding registers x 6 bytes.

Specify the size of the program area as “default size (257 bytes) + (the number of exceeding registers x 6 bytes) with the linker option.

The value specified by the option may change when the function is extended in future.

(4) Values at address 0x7E and 0x7F

Use the areas at addresses 0x7E and 0x7F for setting a software break. Refer to the program example shown below and secure those areas so that they are not used by the user program.

Example: When securing address 0x7E to 0x7F

```
SSS   CSEG  AT    07EH; "SSS" is any name (up to 8 characters)
DB    0FFH, 0FFH
```

(5) Value at address 0x84

The following settings can be made for the security ID code by setting address 0x84 to a value shown below.

0x00: Connection of QB-78K0MINI is prohibited.

0x02: The flash memory in the device is not erased how many times security ID code authentication fails.

0x03: All the flash memory areas in the device are erased when security ID code authentication fails

Values other than 0x02 and 0x03 cannot be written to address 0x84. The processing is performed so that 0x00 (the value set to disable QB-78K0MINI connection) or any other illegal value is not written. When setting 0x00, use a flash memory programmer (such as PG-FP4).

If address 0x84 is overwritten by 0x00 by self programming, communication is disabled after reset and debugging can no longer be performed. The target microcontroller and QB-78K0MINI can no longer be connected even after the debugger is restarted.

Example: When setting address 0x84 to 0x02

```
SSS   CSEG  AT    084H; "SSS" is any name (up to 8 characters)
DB    2H
```

(6) Values at addresses 0x85 to 0x8E

The security ID of addresses 0x85 to 0x8E can be changed in the Memory window, etc. If addresses 0x85 to 0x8E are overwritten by self programming, communication is disabled after reset and debugging can no longer be performed.

When the debugger is restarted, set the new security ID in the Configuration dialog box. If the security ID is unknown, on-chip debugging can not be performed. The areas assigned at addresses 0x85 to 0x8E, which are reserved for the security ID, can be secured and set using the linker option (-gi).

(7) Values at address 0xF7F0 to 0xF7FF

When using the pseudo real-time RAM monitor function, use the areas at address 0xF7F0 to 0xF7FF for setting a software break. Refer to the program example shown below and secure those areas so that they are not used by the user program. If the device does not have these areas, there is no need to do any securing.

Example: When securing address 0xF7F0 to 0xF7FF

```
SSS   CSEG  AT    0F7F0H; "SSS" is any name (up to 8 characters)
DS    16
```

(8) Stack pointer set value

Use address 0xFEDE or lower for the stack area.

The internal RAM area varies depending on the value set to the IMS register. If the RAM address starts from 0xFB00, the stack pointer set value is 0xFB07 to 0xFEDF (0xFB09 to 0xFEDF when using software breaks, and 0xFB10 to 0xFEDF when using the pseudo real-time RAM monitor function). The stack size to be used may change when the function is extended in future. Using address 0xFEDF for the stack area is disabled, but it can be used as the variable area. QB-78K0MINI temporarily uses address 0xFEDF as a flag for processing the program during a break, but the original value is held.

(9) Overwriting flash memory during on-chip debugging

If the following operations are performed during on-chip debugging, the flash memory in the device is overwritten.

- <1> Manipulation in Download dialog box
- <2> Manipulation in Memory Fill dialog box
- <3> Manipulation in Memory Copy dialog box
- <4> Manipulation to change memory in Memory window
- <5> Online assembly in Assemble window
- <6> Program execution when using software breaks
- <7> Program execution that uses hardware breaks or software reset operation, while “Permit” has been selected for the Target Power Off setting in the Configuration dialog box
- <8> Operation that uses pseudo real-time RAM monitor function

(10) 8-bit timer (TM50)

With a device such as the 78K0/Kx1+^{Note}, the 8-bit timer (TM50) is used by firmware during self programming. It is used in the operations shown in **(9) Overwriting flash memory during on-chip debugging**. Therefore, use the 8-bit timer (TM50) under the following conditions.

[Conditions for execution]

- Select “Not Permit” for the Target Power Off setting in the Configuration dialog box.
- Use hardware

[Conditions at a break]

- Do not perform operations <1> to <8> shown in **(9)**

Note Devices in which “OCD Control Code V1.xx” is displayed by selecting [About...] from the [Help] menu in the ID78K0-QB.

(11) GUI operability

The flash memory is overwritten when an operation described in **(9) Overwriting flash memory during on-chip debugging** is performed, but it takes time for returning the control to GUI form completion of flash memory writing.

(12) Boot swap during self programming

When using the boot swap function during self programming, it is performed in cluster units. The cluster varies depending on the device used; cluster 0 (0000H to 0FFFH) and cluster 1(1000H to 1FFFH) are used in the μ PD78F0148HD. In this case, cluster 0 (0000H to 0FFFH) includes the area described in **(1) Reserved area used by QB-78K0MINI (a) Flash memory area**, so data in these areas must be copied to cluster 1 (1000H to 1FFFH), that is, the area in which 1000H is added to the address.

(13) Software break during self programming

When a software break is set, the debugger temporarily substitutes the debug instruction for the instruction to which the break is set, and restores the original instruction. Therefore, do not set a software break to the program area that is targeted to be overwritten by self programming; otherwise the debugger writes back the original instruction to the instruction overwritten by self programming.

(14) Emulation in self programming mode A1

When using the functions of each firmware by self programming, the mode is switched from normal mode to self programming mode A1.


```

MOV PFCMD,#0A5H
MOV FLPMC,#1H ← <1>
MOV FLPMC,#0FEH
MOV FLPMC,#1H
----- From this position
CALL !08100H ← <2>      ↑
MOV PFCMD,#0A5H
MOV FLPMC,#0H           Mode A1
MOV FLPMC,#0FFH
MOV FLPMC,#0H ← <3>      ↓
----- To this position

```

The section between <2> and <3> is in self programming mode A1 (including A2). Step execution or a break by STOP or a breakpoint cannot be performed by the debugger in this section.

In addition, do not set a software break in the section between <1> and <3>; otherwise the execution continues without a break but emulation is not performed normally.

(15) Break function for stack pointer initialization failure

This function executes a break when an interrupt occurs or a PUSH instruction is executed while the initial setting has not been made for the stack pointer.

If the manipulation or instruction shown below is executed immediately after a reset operation, the break function for stack pointer initialization failure becomes invalid.

- Setting a software break
- Write to the stack pointer from the Register window
- Write to the flash memory from the Memory window, etc

If a software break occurs while the initial setting has not been made for the stack pointer, the message “Uninitialized Stack Pointer” is displayed on the status bar.

The subsequent operations are not performed normally, so make sure to set the SP value in the user program.

(16) Caution on downloading HEX file

When downloading a HEX file while a value other than 0xFF is specified as the filling value using an object converter option (-U), the operation contradicts that described in **(2) Values at addresses 0x02, 0x03, and 0x8F or higher**. In such a case, keep consistency using the following program, instead of using the linker option (-go).

Example:

```

ORG 0002h
DB 0ffh,0ffh

ORG 008fh
DB 0ffh
DB 0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh
DB 0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh
:
: 16 lines 1 byte + 16 bytes × 16 = 257 bytes
:
DB 0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh,0ffh

```

(17) Software break

If the debugger does not terminate normally due to a factor such as a freeze while a software break is set, the instruction for which the software break is set and that has been substituted by a debug instruction remains as is. To avoid this, select "Object" in the Download dialog box and download the load module. In particular, take care regarding this point when activating the debugger using a project file, as well as when using PM plus.

(18) Setting of "Monitor Clock"

With a device such as the 78K0/Kx1+^{Note}, when "System" is selected for "Monitor Clock" in the Configuration dialog box, the clock source of the device is changed to the clock from QB-78K0MINI during a break. If the peripheral emulation function does not stop (by selecting "Non Break" for "Peripheral Break"), due to clock changes, timing may differ from the timing in the actual operation. In order to adjust the clock timing even during a break, mount an oscillator with the same frequency as the actual clock, in QB-78K0MINI.

Note Devices in which "OCD Control Code V1.xx" is displayed by selecting [About...] from the [Help] menu in the ID78K0-QB.

(19) Caution on performing step execution

Some peripheral registers remains stopped during step execution. In such a case, execute the instruction with "Run-Break" specified.

(20) Software break in RAM area

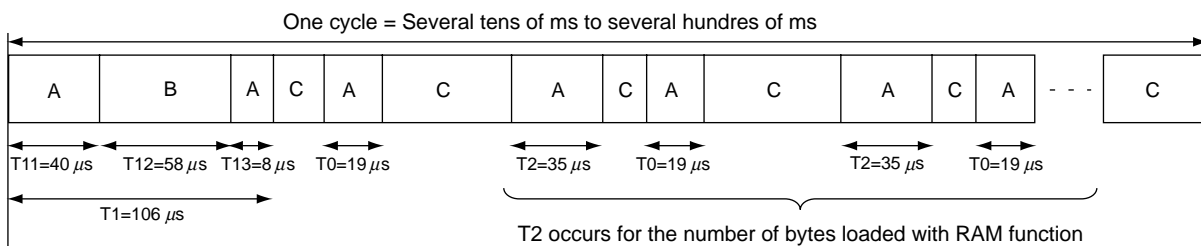
Do not overwrite the program in which a software break has been set to the internal low-speed RAM area or external RAM area; otherwise the break may not occur normally. Even if the break occurs, the program before being overwritten is automatically restored.

Therefore, be sure set a software break after the program is overwritten.

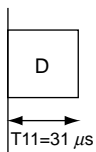
(21) Execution time when using pseudo real-time RAM monitor function

The following shows the execution time when using the pseudo real-time RAM monitor function, whereas the operating frequency = 5 MHz and PCC = 0.

<When Interrupts are enabled (EI) (with an RRM generated while a user program main routine is running)>



<When Interrupts are disabled (DI) (with an RRM generated while a user program interrupt service routine is running)>



RRM Point	Break Processing Time	Total interrupt Pending Time	MAX. Interrupt Pending Time
2 bytes	$106 + 19 + (35 + 19) \times 2 = 233 \mu\text{s}$	$40 + 8 + 19 + (35 + 19) \times 2 = 175 \mu\text{s}$	40 μs
4 bytes	$106 + 19 + (35 + 19) \times 4 = 341 \mu\text{s}$	$40 + 8 + 19 + (35 + 19) \times 4 = 283 \mu\text{s}$	40 μs
16bytes	$106 + 19 + (35 + 19) \times 16 = 989 \mu\text{s}$	$40 + 8 + 19 + (35 + 19) \times 16 = 931 \mu\text{s}$	40 μs

A	User program interrupt servicing disabled (held pending); processing at a break (RRM data collection and RRM data transmission).
B	User program interrupt servicing enabled; period for reading 16-byte RRM data.
C	User program is running.
D	RRM is not performed in his period.

(22) Cautions when using pseudo real-time RAM monitor function

- <1> If an interrupt occurs during period **B** shown in (21) while RRM data are being collected, data of the HL and AX registers immediately before RRM is started and values of the PC and PSW (7 bytes in total) remain in the stack. If a break occurs during the interrupt servicing, execution returns to the RRM routine by the RET instruction, but processing immediately before RRM is started can be restored automatically by continuing the processing (RUN) as is.
- <2> The priority (ISP value) of interrupts which occur during period **B** shown in (21) while RRM data are being collected is the same as that immediately before RRM is started.
- <3> When RRM is used, the IXS value is forcibly set as shown below, so that the internal low-speed RAM area size becomes the maximum.

When using a device such as the 78K0/Kx1+^{Note 1}: 0Ah

When using a device such as the 78K0/Kx2^{Note 2}: 00h

- <4> If the interrupt disabled state (DI setting) is set or the operating clock is switched to Ring-OSC^{Note 3} or subclock by the user program during RRM processing, the RRM processing is suspended.
- <5> If RRM is executed during a standby state, the standby state is released.
- <6> The RRM function is supported in QB-78K0MINI with control code B or later.

- Notes 1.** Devices in which “OCD Control Code V1.xx” is displayed by selecting [About...] from the [Help] menu in the ID78K0-QB
- 2.** Devices in which “OCD Control Code V2.00” (or later) is displayed by selecting [About...] from the [Help] menu in the ID78K0-QB
- 3.** Only when using a device of **Note 1**

(23) Handling of device that was used for debugging

Do not mount a device that was used for debugging on a mass-produced product (this is because the flash memory was rewritten during debugging and the number of rewrites of the flash memory cannot be guaranteed).

6.2 Caution on Option Byte

Emulation of the option byte which is assigned to addresses 0x80 to 0x83 (refer to the user's manual of the device used for the address and function) is performed as follows.

When QB-78K0MINI is connected:

The option byte setting reflected in emulation.

The following shows a software description example for setting the option byte.

Example: When setting address 0x80 to 0x00

```
SSS  CSEG  AT    080H; "SSS" is any name (up to 8 characters)
      DB    0H
```

APPENDIX A ON-CHIP FLASH MEMORY SECURITY FUNCTIONS

Microcontrollers that include flash memory include an authentication function that reads an embedded 10-byte ID code as a security measure against unauthorized access to flash memory.

This ID code's specifications are described below. Be sure to write the ID code to on-chip flash memory according to these specifications. Also, when using the integrated debugger with the QB-78K0MINI to start debugging (i.e., when reading the target device's on-chip flash memory code), enter the ID code in the integrated debugger's configuration screen and perform ID code authentication.

[ID code specifications]

- The values of addresses 0x85 to 0x8E comprise the 10-byte ID code.
- Bits 0 and 1 at address 0x84 are the use enable flag bits for the QB-78K0MINI ("00b" = use prohibited, any other value = use enabled).
- If the ID code input to the integrated debugger matches the ID code embedded in the on-chip flash memory, debugging can be performed.
- Even if these two ID codes match, debugging cannot be performed when the QB-78K0MINI use enable flag value is "00b".
- When flash memory contents are erased, its ID code becomes 0xFFFFFFFFFFFFFFFF.

Caution Of "00" is written to address 0x84, write operations from the QB-78K0MINI become disabled, and only write operations from a flash programmer are enabled.

The following is an ID code setting example.

(Example) When the following values are set to addresses 0x85 to 0x8E

Address	Value [7:0]
0x85	0x12
0x86	0x34
0x87	0x56
0x88	0x78
0x89	0x9A
0x8A	0xBC
0x8B	0xDE
0x8C	0xF1
0x8D	0x23
0x8E	0xD4



```

Assembler code
cseg secur_id
db 12h
db 34h
db 56h
db 78h
db 9ah
db 0bch
db 0deh
db 0f1h
db 23h
db 0d4h
    
```

The ID code to be input via the integrated debugger ID78K0-QB's configuration dialog box is either 123456789ABCDEF123D4 or 123456789abcdef123d4.

APPENDIX B REVISION HISTORY

The revision history is shown below. Applicable Chapter refers to the chapter in each version.

Version	Revised Points	Applicable Chapter
Second	Change of Figure 1-1 External Dimensions of QB-78K0MINI	CHAPTER 1 GENERAL
	Table 1-1 Product Specifications Addition and change of description	
	1.3 System Configuration Addition and change of description	
	Addition of Figure 1-5 Package Contents <7> and <8>	
	Addition of Main Unit (Top View) logo mark	CHAPTER 2 NAMES OF PARTS
	Addition of 3.1.5 Display devices LED1 Before starting debugger	CHAPTER 3 HARDWARE SETTINGS AND FUNCTIONS
	3.6 Connections and Startup Procedure Addition and change of description	
	Addition of CAPTER 4 CAUTIONS ON USE OF SELF-CHECK BOARD	CHAPTER 4 CAUTIONS ON USE OF SELF- CHECK BOARD
Third	Addition of 1.1 Features	CHAPTER 1 GENERAL
	Change of Table 1-3 List of Debug Functions	
	Change of 1.3 System Configuration	
	Change of Figure 1-5 Package Contents	
	3.1.2 Clock socket for target device Caution Addition of description	CHAPTER 3 HARDWARE SETTINGS AND FUNCTIONS
	3.3 Target Reset Processing Note 2 of (2) Change of description	
	3.5 Connection Circuit Examples Note of Figure 3-6 to 3-8 Change of description	
	Change of CHAPTER 5 RESTRICTIONS	
	Change of CHAPTER 6 CAUTIONS	CHAPTER 6 CAUTIONS