NEC

Preliminary User's Manual

IECUBE2 for FX4 uPD70F3555-uPD70F3560, uPD70F4007-uPD70F4012 In-Circuit Emulator

QB-V850E2-EE + QB-V850E2FX4-PD-EE

Target Devices

µPD70F3555-uPD70F3560,
µPD70F4000-uPD70F4012

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1. Circumstances not covered by product warranty

- 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 AC adapter, interface cable, or connection to the target system was in an unsatisfactory state.
- If the cable of the AC adapter, the interface cable, the target cable, 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 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 connected or disconnected while power was being supplied to the product.
- If an excessive load was applied to a connector or cable.
- 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 to 60℃). Be careful of high 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 warranty.
- The AC adapter supplied with the product is exclusively for this product, so do not use it with other products.

INTRODUCTION

Readers

This manual is intended for users who wish to perform debugging using the QB-V850E2-EE + QB-V850E2FX4-PD-EE (FX4).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-V850E2-EE + QB-V850E2FX4-PD-EE (FX4).

Organization

This manual is divided into the following sections.

- General
- Setup procedure
- Settings at product shipment
- Notes
- Optional functions

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-V850E2-EE + QB-V850E2FX4-PD-EE (FX4)

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

To know the manipulations, command functions, and other software-related settings of the QB-V850E2FX4
→ See the user's manual of the debugger (supplied with the QB-V850E2FX4) 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 (system provided by the user). This includes the target program and the hardware provided by the user.
IECUBE2™	Generic name for NEC Electronics' high-performance, compact in-circuit emulator.
UC	Umbrella Emulation Chip
CPLD	Complex Programmable Logic Device

Related Documents

Please use the following documents in combination 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
FX4 uPD70F3555-uPD70F3560, uPD70F4007-uPD70F4012 Emulation Environment		This Manual

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

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1. General

The IECUBE2 is an in-circuit emulator for emulating the target device shown below.
Hardware and software can be debugged efficiently in the development of systems in which the target device is used. This manual descries basic setup procedures, hardware specifications, system specifications, and how to set switches.

Series	Device	Package	Frequency	Instruction flash memory	Data flash memory	Internal RAM	Back-up RAM
FK4	uPD70F3555 uPD70F4007	176GM	80MHz	768 KB	32k	64k	8k
	uPD70F3556 uPD70F4008	176GM	80MHz	1 MB	32k	80k	8k
	uPD70F3557 uPD70F4009	176GM	80MHz	1.5 MB	64k	112k	16k
	uPD70F3558 uPD70F4010	176GJ	80MHz	2 MB	64k	144k	16k
FL4	uPD70F3559 uPD70F4011	208GD	80MHz	1.5 MB	64k	112k	16k
	uPD70F3560 uPD70F4012	208GD	80MHz	2 MB	64k	144k	16k

1.1 Hardware Specifications

Parameter		Specifications
Target system Interface Voltage	CxVDD	1.2V
	ExVDD	3.3 or 5.0V
	AVDD	3.3 or 5.0V
Maximum operating frequency		80 MHz
Capability of main clock oscillator		4 to 20MHz
Low-speed internal oscillator		240kHz (typ.)
High-speed internal oscillator		8MHz (typ.)
Operating temperature range		-0 to 40℃ (No Condensation)
Storage temperature range		-15 to 60℃ (No Condensati on)
External dimensions		See Figure 1
Power Consumption	AC adapter	15V, 4A
	Target system power supply	Tbd.
Weight		Approx. 500g
Host Interface		USB Interface (1.1, 2.0)

The composition of the FX4 Emulation Environment and its different components is shown in the figure below.

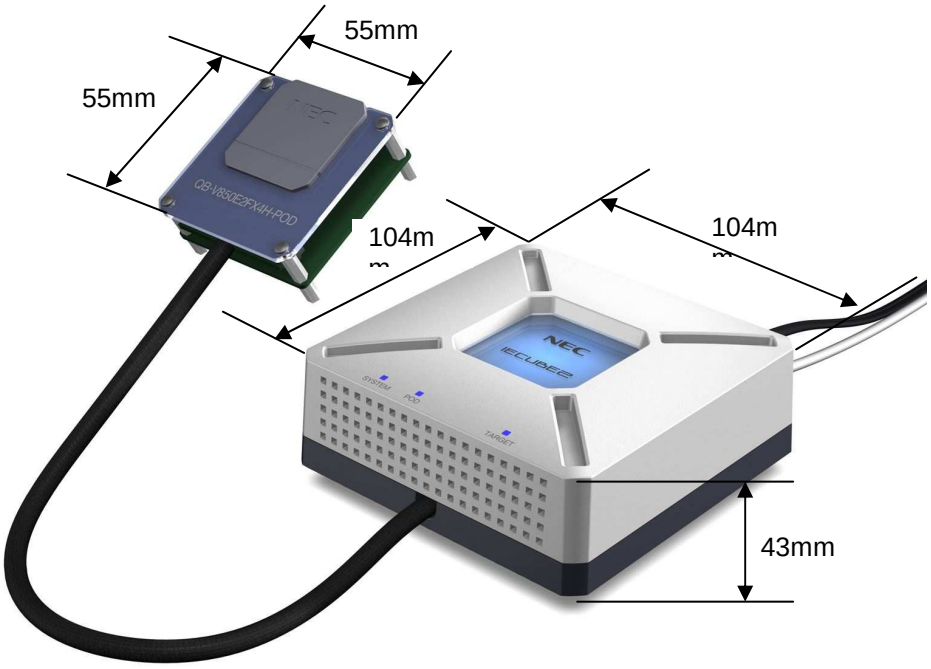


Figure 1-1 Description of external Dimensions

Notes 1 Does not include projection of power switch, host connection and power supply connection

1.2 System Specification

This section shows the IECUBE2 system specifications. For the usage of the debugging function, refer to the documentation of the debugger.

Parameter		Specification
Emulation memory capacity	Internal ROM	Same as target devices.
	Internal RAM	Same as target devices.
	External memory	None
Program execution functions	Real-time execution function	Available
	Non-real-time execution function	Available (Step execution in source level depends on debugger)
Event functions	Detection of execution	Pre-execution: 4 points (only for break function) Post-execution: 8 points
	Detection of access	6 points
	Pass counter	12 bits
	Sequential	4 steps
	Modification when running	Available
Break functions	Hardware break	Available
	Software break	Depends on Debugger
	Other	Trace full break, forced break, timer overflow break
Trace functions	Trace data types	Branch-source PC, branch-destination PC, access data, access address, R/W status, time stamp, DMA access data, DMA access address, DMA R/W status, DMA transfer count, DMA channel number
	Trace events	Delay trigger, section, qualify
	Memory capacity	512K frames
	Other	Trace full stop
Time measurement functions	Measurement clock	200 MHz
	Measurement objects	Beginning through end of program execution Start event through end event (6 sections)
	Maximum measurement time	Approximately 195 hours (When using measurement-dedicated clock divided by 32)
	Minimum resolution	5 ns
	Measurement results	Execution time (Start through end of execution) Maximum, minimum, average, pass count (between events)
	Other	Timer overflow break function (1 point)
Other functions		Open break function, peripheral break function, mask function(_RESET, internal reset)

1.3 Functional Overview

IECUBE2 is provided with a wealth of debug functions to enable efficient program debugging, in addition to being used to emulate the operation of a target device. An overview of the functions is provided in this section. Some functions are not supported, depending on the debugger to be used. See also the manual of the debugger to be used to confirm.

1.3.1 Program execution function (real-time execution function)

The program execution function enables program execution equivalent to that of the target device. The executed program can be stopped under various conditions by using the break functions. The operation of only a function can be checked by executing a program, because a program can be executed from any address.

1.3.2 Step execution function (non-real-time execution function)

The step execution function can be used to execute instructions one by one, in assemble instruction units. Only instructions to be executed purely in steps can be executed, because interrupts are not acknowledged during step execution.

Caution **Step execution to be performed at the C language level is performed by a debugger using the break function. In this case, interrupts are acknowledged in step execution. Consequently, if processing at the interrupt destination cannot be completed, step execution may not be completed. For handling such a case, see the manual of the debugger.**

1.3.3 Break functions (program execution stop)

The break functions are used to stop program execution. With IECUBE, program execution can be stopped under the following various conditions. See (1) to (5) for an overview of each break function.

- An address has been executed → Hardware break function, software break function
- A variable has been accessed → Hardware break function
- A specific time has elapsed → Timer overflow break function

Variable values can be checked during a break and a program can be executed again by changing register values, because the CPU operates even during a break (while the program is stopped). Interrupts generated during the break are suspended, because basically peripheral functions also operate during the break. Use the peripheral break function to stop peripheral functions during the break.

(1) Hardware break function

The hardware break function is used to observe the CPU bus cycles and set a break for a specific fetch or access operation. For example, a break can be set by detecting a state where an address has been executed or a variable has been accessed. For states that can be set, see **"Event function"**.

Caution **The address for which a break has been set is at a position ahead of the address where an actual access has occurred, because the break set for the access (write, read) is detected at an MEM stage or a WB stage on the CPU pipeline.**

(2) Software break function

The software break function is used to set a break when a specific address has been executed (fetched).

(3) Timer overflow break function

This function is used to set a break when a time set by using the time measurement function has elapsed. For example, if the execution time of a function must be 2 ms, a break can be set when at least 2 ms have elapsed between starting and ending the function. This function and the trace function can be used together to find the source that has taken time.

(4) Forced break function

This function is used to forcibly stop a program when it is desired to be stopped.

(5) Trace full break function

This function is used to stop a program when the trace memory is full.

1.3.4 Trace function (program execution history)

The trace function can be used to check the CPU execution history (trace). Items (1) to (7) can be recorded in the execution history.

.

(1) Program counter (PC) of branch source and branch destination
The PCs of a branch source and a branch destination can be recorded in the history.
Consequently, practically all executed programs can be checked, because programs executed between branch points also will be clarified. The amount of trace memory used can be saved and more history items can be traced by that amount, by recording only branch information. (The amount of traces that can be traced back depends on the number of branches.)

(2) Access data/access address
Access addresses for memories and peripheral I/O registers, and access data can be recorded in the history.
Read and write operations can also be recorded in the history.

Caution **Accesses to CPU program registers (such as r1 and r2) and system registers (such as PSW and EIPC) cannot be recorded in the history.**

(3) Time stamp
The time elapsed from the trace start point can be added to each trace information. The timer performance for time stamps is the same as that of the time measurement function.

(4) DMA access address, data, status, channel number, transfer count
When the DMA function of the target microcontroller is being used, the DMA access can be recorded in the history.
- Access address
- Access data
- Access status (R/W)
- DMA channel number
- Transfer count

(5) History of specific sections (section trace)
Only specific sections can be recorded in the history by using the event function in combination. For example, the execution history of from the start to the end of a function can be recorded.

(6) History of specific phenomenon occurred (qualify trace)
Only the occurrence of specific phenomena can be recorded in the history by using the event function in combination.
For example, a history of having accessed to only a variable can be recorded.

(7) Recording histories before and after specific phenomenon has occurred (delay trigger trace)
The history after a specific phenomenon has occurred can be recorded by using the event function in combination. This is similar to being able to observe a signal waveform by assuming an edge as a trigger, when using an oscilloscope to observe a signal.
For example, the program execution histories before and after a write access has been performed for a variable can be viewed.

1.3.5 Time measurement function

This function is used to measure the execution time of a specific section. The measurement start and end points can be set by using the event function.
In addition, the maximum, minimum, and average execution time and the number by which the measurement section has been passed can be measured.

1.3.6 Event function (specific CPU operation detection)

The event function is used to detect specific fetch and access operations by observing the CPU bus cycle. CPU operations, such as of an address being executed and a variable being accessed can be detected. Such specific CPU operations are called events. Use the event function together with the following functions.
- Hardware break function
- Trace function
- Time measurement function

(1) Pre-execution event
Pre-execution event
A pre-execution event is detected when execution of an address is attempted. It can be used only with the hardware break function. Four pre-execution event points can be specified.
[Detection conditions that can be specified]
- Execution address

(2) Post-execution event

A post-execution event is detected when an address has been executed. The address of a post-execution event can be specified as a range. Up to eight post-execution event points can be specified, but if the execution address has been specified as a range, two points will be consumed. When the execution address has been specified as a range for all events, four event points can be specified.

[Detection conditions that can be specified]

- Execution address (can be specified as a range)

(3) Access event

An access event is detected when an address has been accessed (read or written). The following detection conditions can be specified for an access event.

Up to six access event points can be specified, but if the access address has been specified as a range, two points will be consumed. When the access address has been specified as a range for all events, three event points can be specified.

[Detection conditions that can be specified]

- Access address (can be specified as a range)
- Access data
- Access size
- Access status (read, write, both read and write)

1.3.7 Event link function (event combinations)

The event link function is used to combine into one event, events that have been registered by using the event function. It is used to detect a specific sequence, such as when an address has been executed after a variable was accessed.

1.3.8 Peripheral break function

When the break function has been used to stop program execution, peripheral functions other than the watchdog timer continue to operate in general, but some peripheral functions can be stopped by using the peripheral break function.

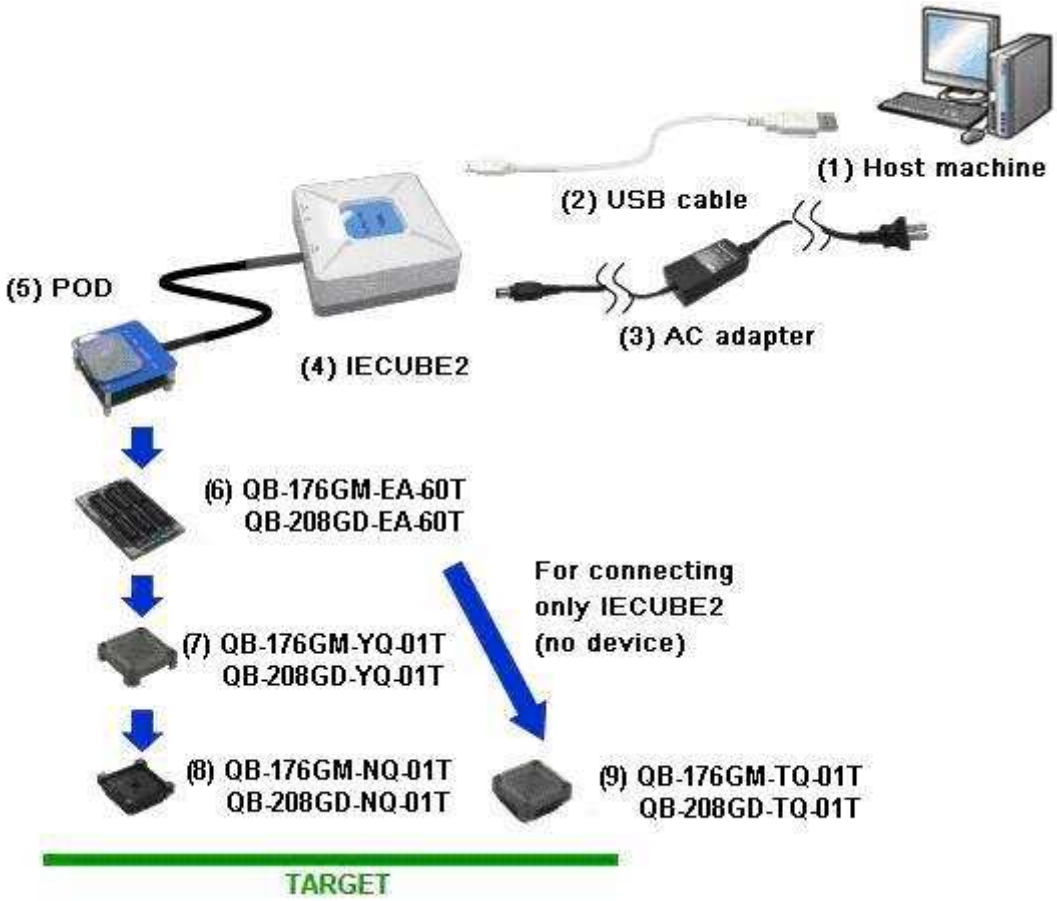
1.3.9 Mask function

The mask function can be used to mask the following sources.

- _RESET terminal
- internal reset (For example, watch dog timer)

1.4 System Configuration

Figure 1-2 Description of System Configuration



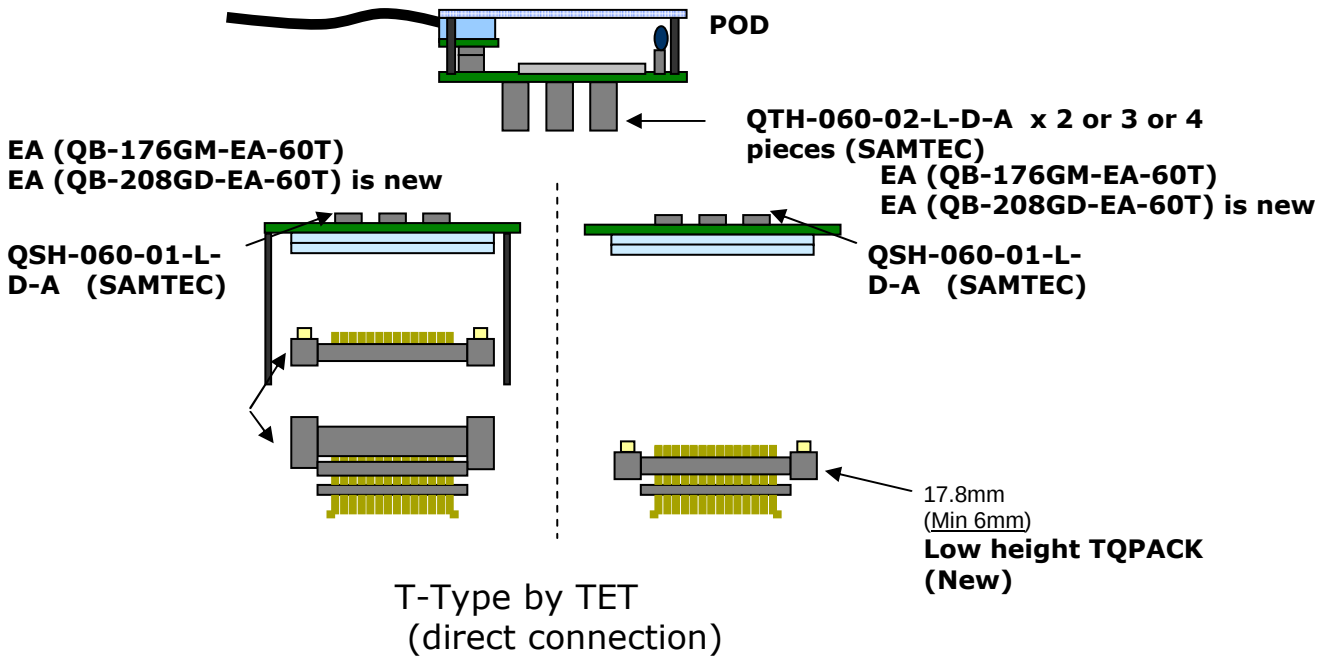
Parameter	Description
(1) Host machine	Computer equipped with a USB port Software tools including the USB driver and debugger must be installed.
(2) USB cable	Cable used to connect IECUBE2 to the host
(3) AC adapter	AC adapters classified by region
(4) IECUBE2	IECUBE2 main unit that controls debugging
(5) POD	IECUBE2 peripheral to interface with the target system
(6) QB-176GM-EA-60T QB-208GD-EA-60T	Adapter that converts the signals output from the emulation Pod so that they correspond to the pins laid out in the target device.
(7) QB-176GM-YQ-01T QB-208GD-YQ-01T	Connector for the exchange adapter and NQPACK
(8) QB-176GM-NQ-01T QB-208GD-NQ-01T	Connector mounted on the target board This connector can be connected to IECUBE2 via the YQPACK.
(9) QB-176GM-TQ-01T QB-208GD-TQ-01T	Connector mounted on the target board This connector can be connected to IECUBE2 with only QB-144GJ-EA-60T.

1.5 Adapters, Connectors

The following adapters and connectors are necessary to use IECUBE2 connected to the target system. These are sold separately.

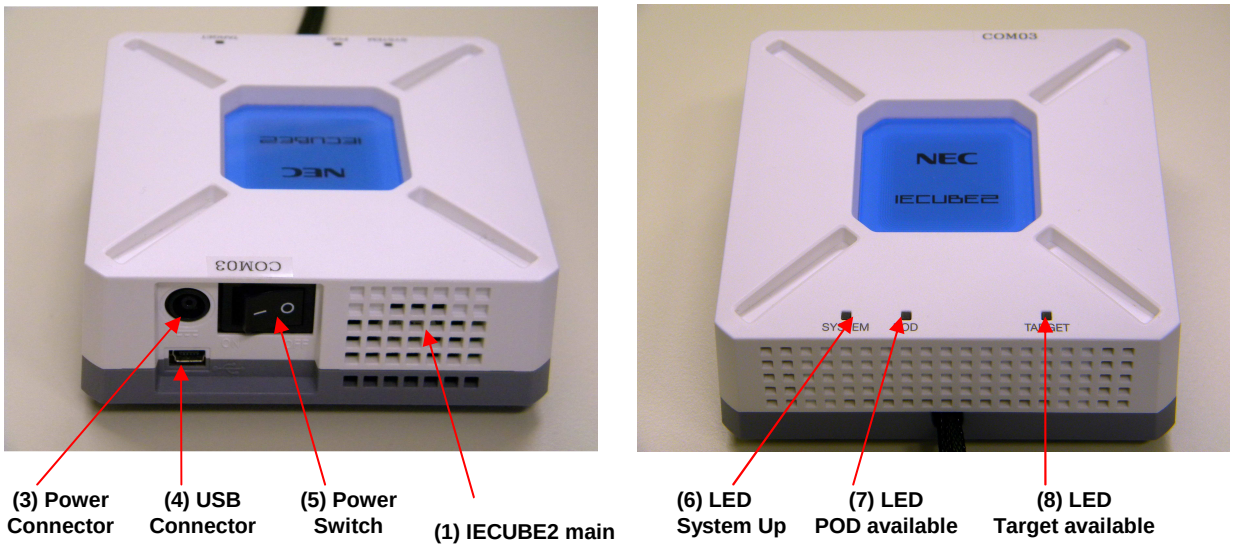
Type	Target devices FK4		Target devices FL4	
	176Pin GM		208Pin GD	
Exchange adapter	QB-176GM-EA-60T		QB-208GD-EA-60T	
Emulator connector	QB-176GM-YQ-01T	QB-176GM-TQ-01T	QB-208GD-YQ-01T	QB-208GD-TQ-01T
Target connector	QB-176GM-NQ-01T		QB-208GD-YQ-01T	

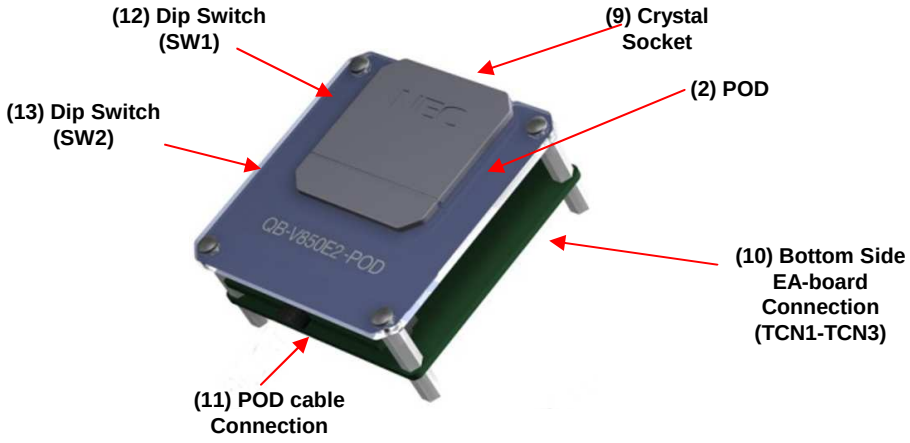
Figure 1-3 Description of Target Connection Details



2. Names and Function of Hardware

Figure 2-1 Names of parts of IECUBE2





(1) IECUBE2 main

IECUBE2 main is unit that controls debugging

(2) Pod

Pod is IECUBE2 peripheral to interface with the target system. This unit is equipped with the major features for emulating the real device. A 4 MHz resonator will be mounted upon shipment.

(3) Power connector

This connector is for the power supply cable.

(4) USB connector

This connector is for a USB cable.

(6) Power switch

This switch turns the power on and off. Press the “|” side to turn on the power or the “O” side to turn off the power.

(6,7,8) Status LEDs

The status LEDs turn on or blink according to specific causes as described in the table below. If any LED does not turn on, IECUBE2 might be broken. In this case, contact an NEC Electronics sales representative or distributor.

LED name	Description
SYSTEM	This LED turns on when the power switch is turned on. This LED blinks if the FPGA in IECUBE2 is not running correctly. In this case, IECUBE2 might be broken.
POD	This LED turns on when communication with the emulation Pod is established.
TARGET	This LED turns on when the target system is turned on.

(9) Crystal Socket

This switch turns the power on and off. Press the "|" side to turn on the power or the "O" side to turn off the power.

(10) Target Connection

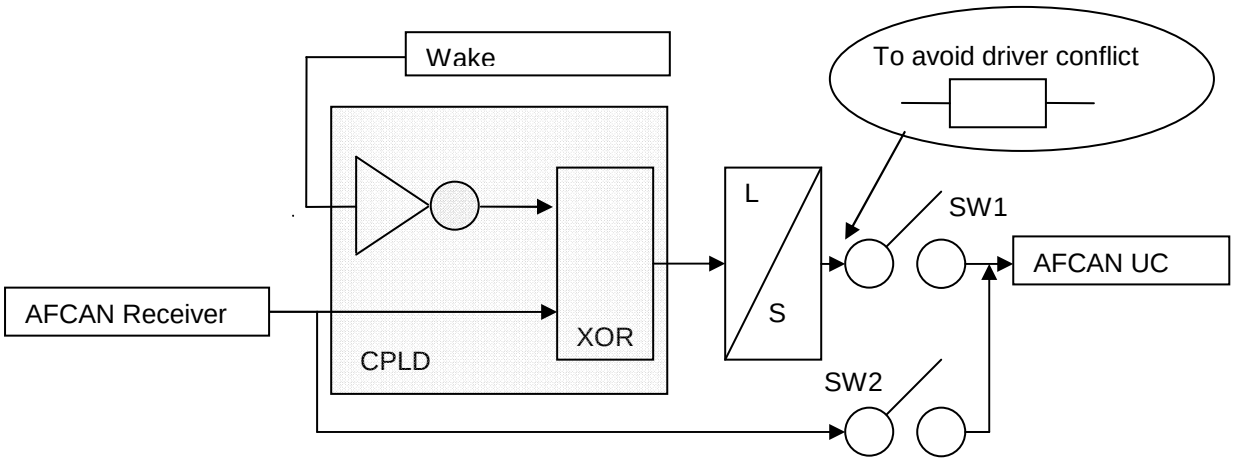
For the target connection an EA-adapter is used. This adapter is connected between the POD (TCN1-3) and the customer target. The EA-adapter is the device specific connection board for the POD

(11) POD cable connection

A coaxial cable is used to connect the IECUBE2 main unit and emulation Pod. The cable length is 37cm. Be careful not to excessively bend this cable because doing so might break the cable.

(12,13) DIP switch SW1,SW2

SW1 and SW2 are used to select the direct connection between CAN receive pins and the additional wake up logic of CAN receive pins. For each bit only one switch should be closed. If the CAN wake up feature is selected the normal pin function is not working anymore!

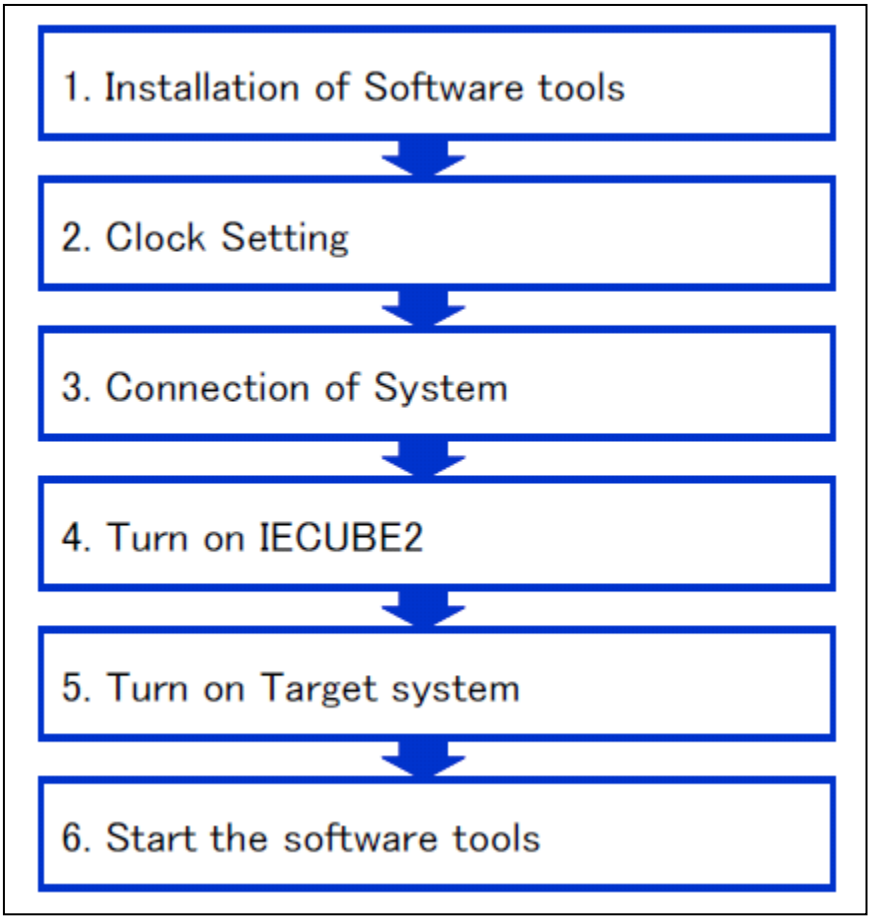


Switch SW1	Setting	Function
1	On	FCN0RX (P0_5): CAN receive wake up feature usable
	Off	Connection between wakeup logic and FCN0RX is **open**
2	On	FCN1RX (P0_6): CAN receive wake up feature usable
	Off	Connection between wakeup logic and FCN0RX is **open**
3	On	FCN2RX (P0_8): CAN receive wake up feature usable
	Off	Connection between wakeup logic and FCN0RX is **open**
4	On	FCN3RX (P0_10): CAN receive wake up feature usable
	Off	Connection between wakeup logic and FCN0RX is **open**
5	On	FCN4RX (P0_15): CAN receive wake up feature usable
	Off	Connection between wakeup logic and FCN0RX is **open**
6	On	FCN5RX (P0_14): CAN receive wake up feature usable
	Off	Connection between wakeup logic and FCN0RX is **open**

Switch SW2	Setting	Function
1	**On**	FCN0RX (P0_5): Direct connection between EA-Adapter and emulation device
	Off	Direct connection between EA-Adapter and emulation device is **open**
2	**On**	FCN1RX (P0_6): Direct connection between EA-Adapter and emulation device
	Off	Direct connection between EA-Adapter and emulation device is **open**
3	**On**	FCN2RX (P0_8): Direct connection between EA-Adapter and emulation device
	Off	Direct connection between EA-Adapter and emulation device is **open**
4	**On**	FCN3RX (P0_10): Direct connection between EA-Adapter and emulation device
	Off	Direct connection between EA-Adapter and emulation device is **open**
5	**On**	FCN4RX (P0_15): Direct connection between EA-Adapter and emulation device
	Off	Direct connection between EA-Adapter and emulation device is **open**
6	**On**	FCN5RX (P0_14): Direct connection between EA-Adapter and emulation device
	Off	Direct connection between EA-Adapter and emulation device is **open**

3. Setup Procedure

This chapter explains the IECUBE2 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.
To shut down the system, refer to 3.7 Shut Down Procedure



3.1 Installation of Software tools

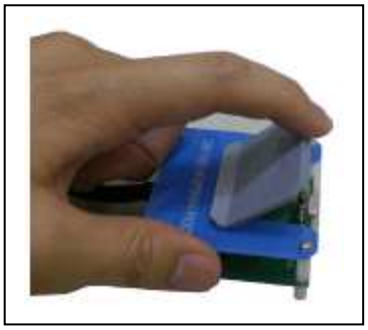
Before setting up hardware, install the necessary software tools.
For details about how to do so, see the documents supplied with the software tools.

3.2 Clock Settings

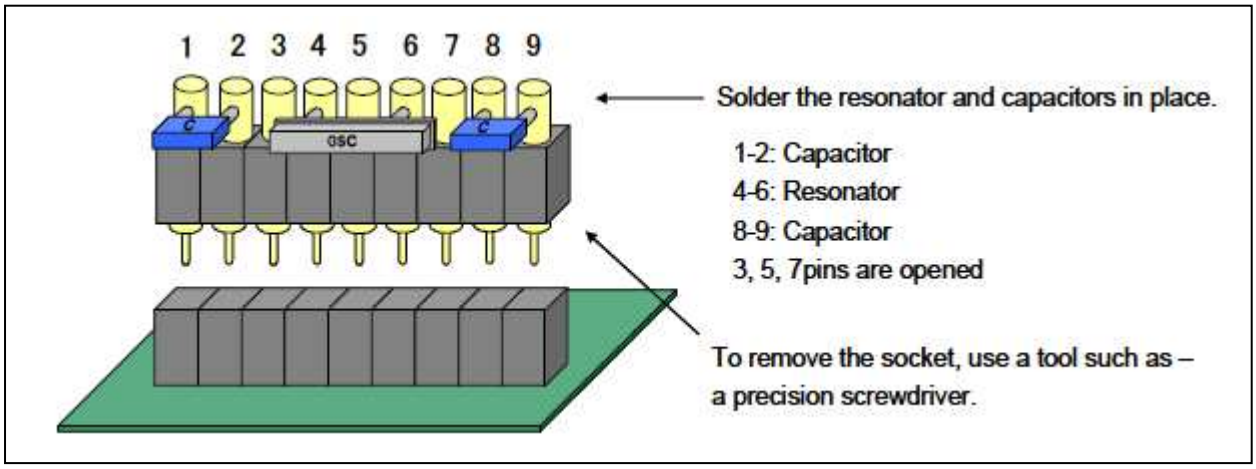
The main clock is generated by the oscillator in the emulation Pod. If 16 MHz is acceptable for the frequency of the resonator, the setting is not required to be changed. If modification is necessary, see following procedures.

Caution **This product does not support target clock input for the 32.768kHz oscillator in the emulation**

(1) Open the emulation Pod cover as shown below.



(2) Mount the resonator and capacitors onto the parts board in the emulation Pod.



(3) Close the emulation Pod cover.

3.3 Connection of System

This section describes how to mount and connect components including connectors. Mount the target connector on the target board. For details about how to do so, see the document supplied with the connector.
The following abbreviations are used in this section.

- Target connector : QB-176GM-NQ-01T, QB-208GD-NQ-01T
- Emulator connector : QB-176GM-YQ-01T, QB-208GD-YQ-01T
- Exchange adapter : QB-176GM-EA-60T, QB-208GD-EA-60T

3.3.1 Mounting Target Connector

Mount the target connector on the target board. For details about how to do so, see the document supplied with the connector.

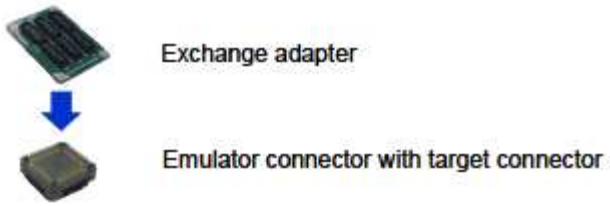
3.3.2 Connecting Emulator Connector

Connect the emulator connector to the target connector. For details about how to do so, see the document supplied with the connector.

3.3.3 Connecting Exchange Adapter

Note the position of pin 1 (positioned at the cut corner) and connect the exchange adapter to the emulator connector as shown below.

Figure 3-1 Description of connecting exchange adapter

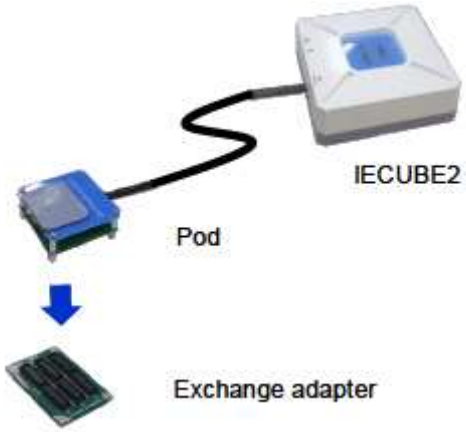


Remark: To remove the exchange adapter, use the stick included with IECUBE2 to gradually pull up the sides of the adapter.

3.3.4 Connecting POD and Target System

Connect the emulation Pod to the exchange adapter. Be careful not to excessively bend the emulation Pod cable.

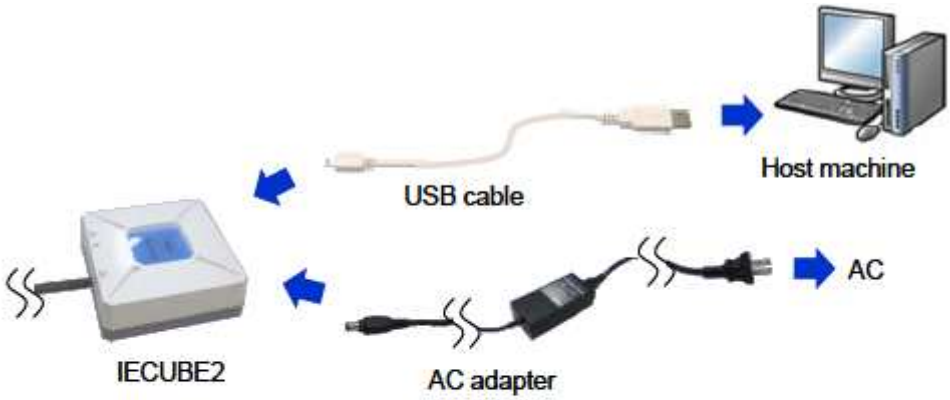
Figure 3-2 Description of connecting POD

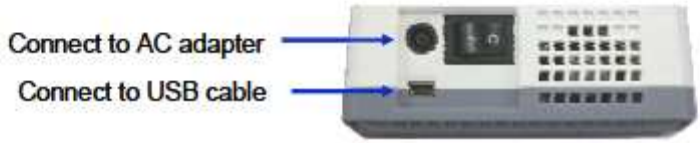


3.3.5 Connecting USB cable, AC adapter

Connect the USB cable and power supply adapter as shown below. At this time, make sure that IECUBE2 and the target system are not on.

Figure 3-3 Description of connecting USB cable, AC adapter



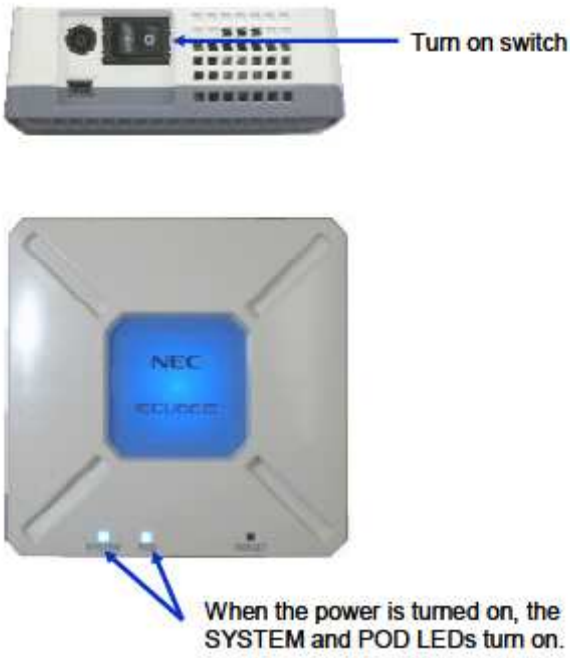


3.4 Turn on IECUBE2

Turn on IECUBE2. At this time, make sure that the target system is not on.
When the power is turned on, the SYSTEM and POD LEDs turn on. If these LEDs blink or remain off, IECUBE2 might be broken.

Remark: When the power is turned on for the first time, Plug and Play starts and sets up the USB driver. Continue setup according to the wizard.

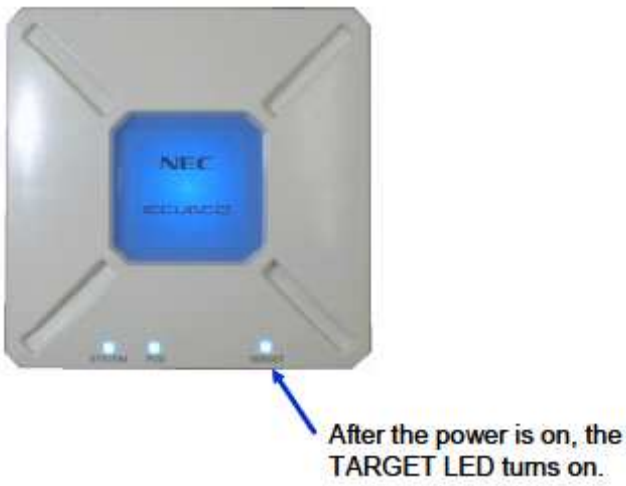
Figure 3-4 Description of turning on IECUBE2



3.5 Turn on Target System

Turn on the target system.
After the power is on, the TARGET LED turns on. If the LED remains off, connectors might be connected poorly, the emulation Pod cable might be broken, or voltage might not be correctly applied to the power supply pins of the microcontroller (such as VDD).

Figure 3-5 Description of turning on target system



3.6 Start the Software Tool

After the above procedure, the system starts up. For downloading and debugging a program by using the GHS MULTI generic debugger, please make sure that you have establish a USB connection between the host and the FX4 emulation environment. For doing so, please specify the following command string within the first line of your debugger script file (*.rc file).

Example:

Stand-alone mode (without connected target):

```
connect 850eserv2 -iecube -e2 -ip=C:\GHS\v850e -df=df3536.800 -id ffffffffffffffffffffffff
```

Target mode (with connected target):

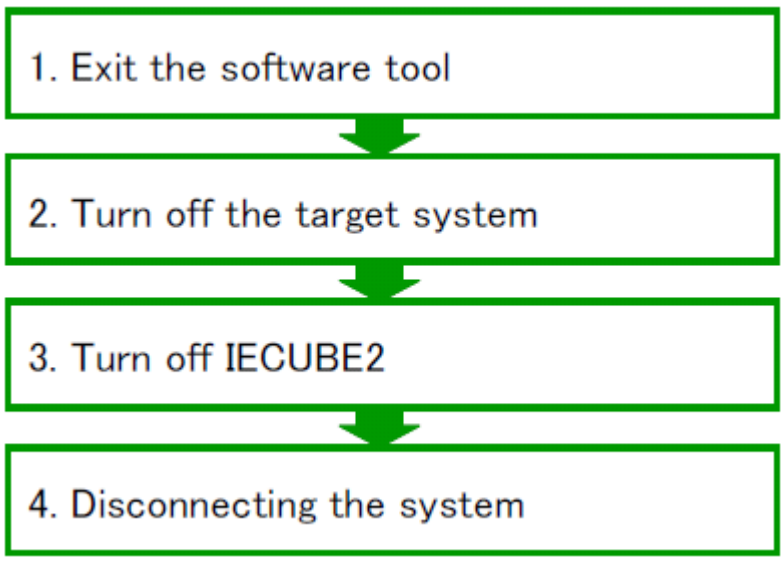
```
connect 850eserv2 -iecube -e2 -ip=C:\GHS\v850e -df=df3536.800 -tc -id ffffffffffffffffffffffff
```

Please note, when -df, -ip and environment variable DEVICE_FILE, IEPATH are specified simultaneously, the device file and the directory specified by -df and -ip are given to priority.

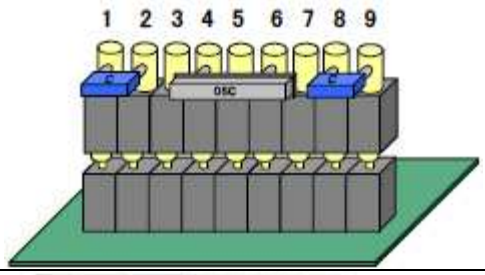
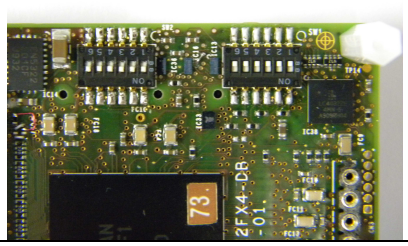
For details about debugging procedures, see the document supplied with the software tool.

3.7 Shut down Procedure

Shut down the system according to the procedure below. Note that shutting down the system incorrectly might damage IECUBE2.



4. Settings at Product Shipment

Item	Setting	Remarks
Clock setting on POD		A 16MHz crystal wil be mounted upon shipment
Power switch		Set to OFF at shipment
POD Dip Switches		SW1 all off, SW2 all on (no wake up feature enabled)

For further information, please contact:

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

[America]

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

[Europe]

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

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

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

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

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

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

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

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

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

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

[Asia & Oceania]

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

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

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

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

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

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

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

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