

QB-MINI2-RF

MINICUBE2 Wireless Option

1 Preface

Thank you for purchasing MINICUBE2 Wireless Option (QB-MINI2-RF). This product can be used with the programmable on-chip debug emulator MINICUBE2 to make the connection between your development system and MINICUBE2 wireless.

This document describes how to prepare to use and start this product and also describes wireless communication.

<1> Checking the package contents

Check the package contents in accordance with the packing list supplied with QB-MINI2-RF.

If there are any missing or damaged items, contact an Renesas Electronics sales representative or distributor.

<2> Product information and documents

For information on QB-MINI2-RF, access the following Renesas Electronics website. (hereinafter referred to as Wireless Option information site).

<http://www.renesas.com/minicube2>

Click "Wireless Option" on the above website.

Documents for this product are also provided on the wireless option information website.

<3> Software download

Renesas Electronics software for QB-MINI2-RF is available on the following website (hereinafter referred to as ODS).

<http://www2.renesas.com/micro/en/ods/>

Click "Version-up Service" on the above website, and then, on the next website, click "MINICUBE2_Software".

We recommend using the latest software. If you want to be notified about software updates, subscribe to the Version-up Service according to the Version-up Service guide.

To use software made by a partner company, see the documents issued by that company.

2 Software Installation

First, install the software necessary to use this product.

<1> Software for MINICUBE2

Install the software tool (CubeSuite+ etc) for using MINICUBE2 in a standard configuration. And the MINICUBE2 USB driver must be installed.

<2> Runtime libraries provided by Microsoft

For Windows Xp, install the runtime libraries provided by Microsoft.

- Microsoft .NET Framework 2.0 Service Pack 1
- Microsoft Visual C++ 2005 Redistributable

The above libraries can be downloaded from a website that is linked to the wireless option information website.

<3> MINICUBE2 RF utility

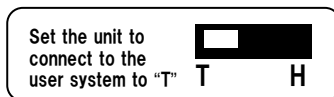
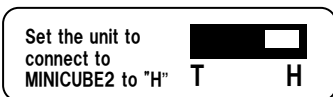
The MINICUBE2 RF utility (the RF utility) is used for monitoring the used radio frequency, the unit ID specified for the connection destination, and the wireless connection status.

Download the RF utility from among the MINICUBE2 software products available with the Version-up Service, and then decompress it. "mqb2rfutil.exe" is the RF utility.

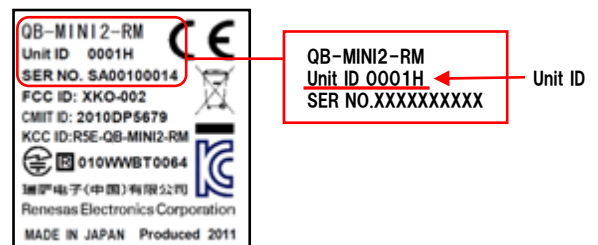
Target OS : Same as MINICUBE2.

3 Setting up Wireless Unit and Checking Unit ID

This product includes two wireless units (QB-MINI2-RM). One unit is connected to MINICUBE2 and the other is connected to the user system. Switch the former unit to "H" and the latter unit to "T". The wireless units will not be damaged by connecting them with a different setting, but note that they might malfunction.



The wireless units have four-digit unit IDs that are unique to each product. Memorize the unit IDs of the two wireless units because they will be used for identification when connecting them wirelessly.



4 Connecting and Starting Hardware

Connect the hardware, and then turn on the system.

Caution Before connecting the hardware, confirm the following:

- MINICUBE2 is not connected via USB.
- The user system is turned off.

<1> Flipping the MINICUBE2 switches

Flip the MINICUBE2 switches to the following positions:

Flip the MINICUBE2 switches to positions "M2" and "3"



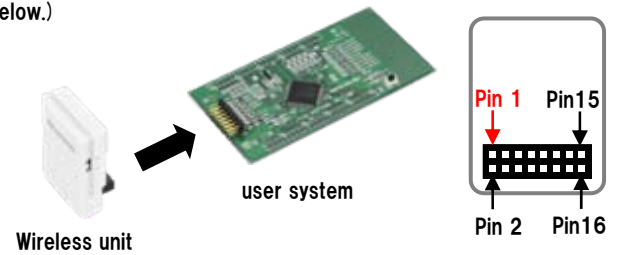
<2> Connecting a wireless unit to MINICUBE2

Connect the wireless unit that was set to "H" to MINICUBE2. Note the direction when connecting the unit.



<3> Connecting a wireless unit to the user system

Connect the wireless unit that was set to "T" to the user system. Note the position of pin 1, because the wireless unit is not protected against false connection. (The pin layout is shown in the figure to the right below.)



<4> Starting the system

- (1) Connect MINICUBE2 to the host by using a USB cable. The LED on the wireless unit turns on and off.
- (2) Turn on the user system. The LED on the wireless unit turns on and off as in (1) above.

5 Establishing Wireless Communication and Checking Firmware

Next, perform wireless communication, use the wireless units, and then check the firmware version and the radio wave status.

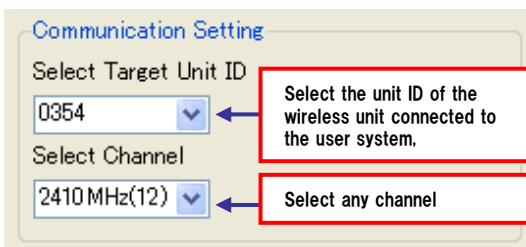
<1> Starting the RF utility

Run the mqb2rfutil.exe file that was downloaded and decompressed in step 2. The following window is displayed.



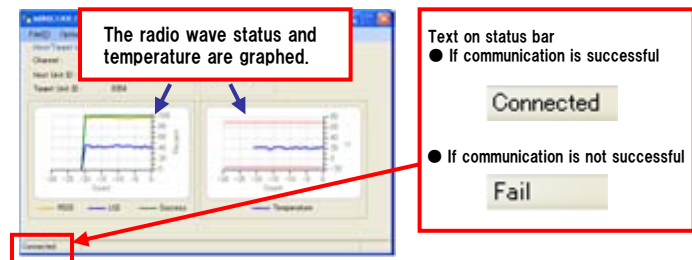
<2> Specifying the basic settings for wireless communication (the frequency channel and target unit ID)

Click [Option] on the menu bar and then [Configuration] to display the configuration dialog box. Specify the frequency channel and target unit ID, and then click the [OK] or [Apply] button.



<3> Starting and checking wireless communication

Wireless communication starts when the basic settings have been specified. After the settings are specified, they are held in the host registry and automatically specified every time the host starts. If wireless communication is successful, the radio wave status and measured temperature are graphed in the main window.



If wireless communication was not successful, "Fail" is displayed on the status bar. In this case, change the frequency channel and check the target unit ID in the configuration dialog box.

<4> Checking the firmware version

Click [Help] on the menu bar and then [Version]. The firmware versions of the RF utility and wireless units are displayed. On the Version-up Service website, check whether these are the latest versions.



6 Starting Debugging and Programming

After wireless communication ends, create a program in the same way as for a standard configuration in which the target cable is used. For example, when starting debugging, start the debugger, download the program, and then perform debugging.

The radio wave status during wireless communication changes depending on external factors such as other used wireless devices. Such changes can be determined using the RF utility. Be sure to use this product in an environment where radio waves are relatively stable.

We recommend reading the additional information on the following pages.

7 End Procedure

To end debugging or programming, turn off the system according to the following procedure. Next, disconnect the wireless units as required.

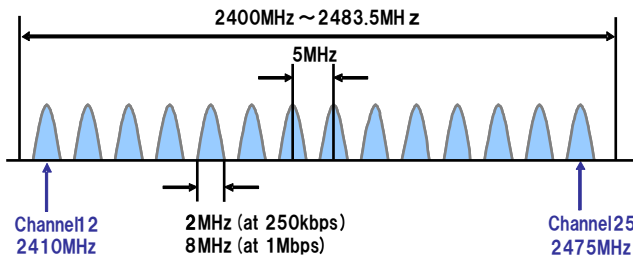
- (1) Close the debugger or programming GUI.
- (2) Close the RF utility.
- (3) Turn off the user system.
- (4) Disconnect MINICUBE2 from the host.



Wireless Communication

Type of wireless communication used

- An ISM frequency band from 2,400 MHz to 2,483.5 MHz is used.
- Physical layers (PHY) and media access layers (MAC) formulated according to IEEE802.15.4 are used.
- The 14 channels of communication frequencies shown below can be selected. If the interference by peripheral wireless devices is strong, communication can sometimes be improved by changing the channel.



- This product uses a spread spectrum method called direct sequence spread spectrum (DSSS) that is highly resistant to disturbing and interfering waves. This method transmits 4-bit data by multiplying the data by pseudonoise codes and then restores the 4-bit data on the receiving side as actual data. Due to the used code string, the signal frequency is spread and less affected by interfering waves in specific frequency bands.

Bit	Code
0000	11011001110000110101001000101110
1000	11101101100111000011010100100010
0100	00101110110110011100001101010010
:	:
1111	11001001011000000111011110111000

Radio wave status and temperature Indicated using RF utility

●RSSI (Receive Signal Strength Indicator)

This indicator indicates the signal intensity. If the indicator is greater than 0, radio waves can be transmitted in the relevant environment. This indicator does not take the effects of interfering waves into consideration, but can be used as a reference to determine the intensity of the signal received by the wireless unit connected to the user system. For example, if the user system is running, this indicator decreases the longer the communication distance becomes. By using this indicator, you can estimate how far a signal can be transmitted in the current environment.

●LQI (Link Quality Indication)

This indicator is calculated based on the intensity of the signal and noise interference. If this indicator is greater than 0, communication can be performed in the relevant environment. Unlike RSSI, the effects of interfering waves are taken into consideration. Therefore, this indicator is affected by the used frequency band and communication speed.

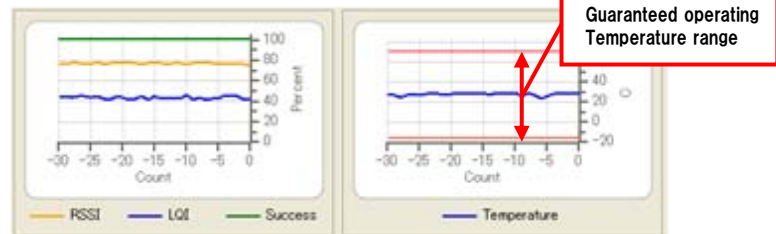
For example, if the signal is affected by other wireless devices even though RSSI is large, LQI decreases. This can sometimes be improved by changing the used channel.

●Success

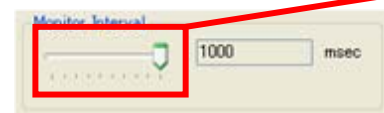
This indicator indicates whether the wireless unit connected to the user system is correctly receiving the data transmitted from the wireless unit connected to MINICUBE2. Because data that is not correctly received is ignored, no malfunction occurs, but the operating speed of the debugger and programming tool is affected.

●Temperature

The wireless units have a temperature sensor that determines the internal temperature of the wireless unit connected to the user system. This indicator indicates the internal temperature of the unit, not the ambient temperature. The guaranteed operating temperature for the wireless units is -15°C to $+70^{\circ}\text{C}$. The red line shown on the graph in the RF utility shows this temperature range. Use this product in the guaranteed operating temperature range.



To change the interval at which to update the graphs, change the below setting in the configuration dialog box .



Can be specified in the range from 100 ms to 1,000 ms.



Using RF Utility More Flexibly

Performing faster wireless communication

The data transfer speed according to the default RF utility settings is 250kbps. The data transfer speed can be changed to 1 Mbps by changing the setting below in the RF utility configuration dialog box. However, because LQI tends to decrease if the speed increases, make sure the radio wave status is relatively stable before changing the speed to 1 Mbps.

Even if 1 Mbps is specified, the operating speed of the debugger does not simply quadruple. The data transfer speed for wireless communication quadruples, but the speed of processing the firmware in the wireless units and USB communication for MINICUBE2 does not change.



Customizing LED color for wireless units

When using the wireless units for the first time, the LEDs on the wireless units turn on in blue. The color of the LEDs can be changed or the LEDs can be turned off to reduce current consumption.

The LED color for the wireless unit connected to MINICUBE2 can be changed by specifying a setting in the RF utility configuration dialog box. By selecting [Synchronize], the same color is specified for the LED on the wireless unit connected to the user system.





Safety Information

Encrypting wireless communication data

Because radio waves can be transmitted up to about 100 m and the used type of communication conforms to the IEEE 802.15.4 communication standard, programs under development might be stolen.

To prevent this, the data to transmit using wireless communication can be encrypted. AES-CTR can be used as the encryption format from the advanced encryption standards specified in the United States. If this format is used, communicating units that do not have the same encryption key cannot communicate.

An encryption key consists of 128 bits (16 bytes). If encryption is used, the communication speed drops. Therefore, encryption is not used in the default RF utility settings.

Data is encrypted as shown to the right.

Caution Even if sophisticated encoding is performed using AES-CTR, the data is never completely secure. To protect programs during development, use the target cable instead of this product.

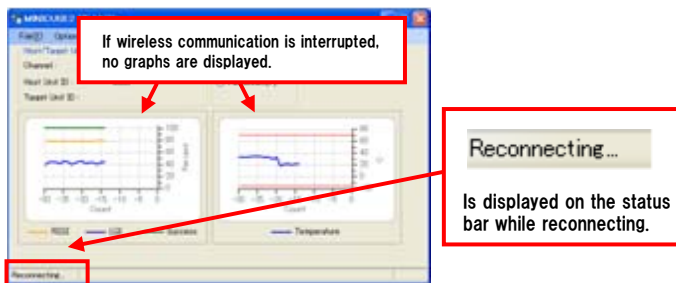
- (1) Set the two wireless units to "H".
- (2) Connect one wireless unit to MINICUBE2, and then start the RF utility.
- (3) Click [Option] on the menu bar and then [Security]. The security dialog box is displayed.
- (4) Select [Security Valid], and then enter an alphanumeric character string of 16 characters or less for [Security Key]. This string is case sensitive.



- (5) Click [OK]. The security setting is applied to the connected wireless unit.
- (6) Also, specify the security setting for the other wireless unit by repeating steps (2) to (5).

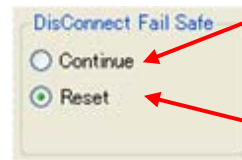
When wireless communication is interrupted

Wireless communication might be interrupted due to the effects of other wireless devices or when the distance between the wireless units changes. If this happens, the wireless units regularly issue a connection request and attempt to re-establish wireless communication. At this time, no graphs are displayed in the RF utility as shown below and [Reconnecting] is displayed on the status bar.



However, if wireless communication is interrupted during debugging or programming, the user system cannot be stopped until wireless communication is restored. Therefore, the system might be corrupted due to an infinite loop.

To prevent this, a setting that immediately resets the system when wireless communication is interrupted can be specified. Select [Reset] for the fail-safe setting in the RF utility configuration dialog box as shown below.



Select this to continue operation even if wireless communication is interrupted.

Select this to reset the system if wireless communication is interrupted.

Troubleshooting

If a problem occurs, first check for abnormalities by using the MINICUBE2 self-diagnosis tool. Also, check whether MINICUBE2 and the wireless units use the latest firmware according to the Version-up Service website. If the problem cannot be resolved, see the FAQs on the Renesas Electronics website or see the following website and contact us by E-mail.

WEB site: <http://www.renesas.com/contact/>

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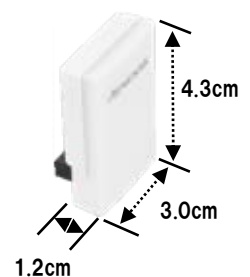
(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

Specification

Hardware

Item	Specification
Size	See the right figure.
Weight	About 10 g
Guaranteed operating temperature range	-15°C to +70°C
Storage temperature range	-15°C to +70°C
Connectors	16pins, general-purpose 2.54mm pitch
Special features	Temperature detection, changing the LED color, monitoring the radio wave intensity



Wireless communication

Item	Specification
Frequency band	2400MHz to 2483.5MHz
Connectable distance	Maximum 100m (depending on the used environment)
Usable number of frequency channels	14 (In 5MHz intervals)
Number of units identifiable in the same space	100
Current consumption (supplied from the user system)	About 50mA on average
Communication method	Direct Sequence Spread Spectrum (DSSS)
Data rate	250kbps, 1Mbps
Applicable laws	Radio Act (Japan), CE (Europe), FCC (USA), SRRC (China), KCC (Korea)