

R9A06G062GNP

RTK0EE0013D10002BJ User's Manual

Sub-GHz Wireless Communication Evaluation Kit
For Europe

Rev.1.02

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General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity.

Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems.

The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

How to Use This Manual

1. Purpose and Target Readers

This manual is intended to give users an understanding of the basic specifications and correct usage of this product. This manual is intended for users who want to use this product to evaluate the MCU and debug programs. The readers of this manual are expected to have knowledge of the MCU functions and debuggers.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to RTK0EE0013D10002BJ. Be sure to refer to the latest versions of these documents. The newest versions of the listed documents are available on the Renesas Electronics Web site.

| Document Type | Description | Document Title | Document No. |
|--|---|---|------------------------------|
| User's manual | RTK0EE0013D10002BJ hardware specifications | RTK0EE0013D10002BJ User's Manual | R02UZ0005EJ (this manual) |
| Design data | RTK0EE0013D10002BJ Circuit schematics Parts list | RTK0EE0013D10002BJ Circuit schematics Parts list | R02AN0048EJ |
| User's manual for R9A06G062GNP | Hardware specifications (pin assignments, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation | R9A06G062GNP Sub-GHz Transceiver User's Manual: Hardware | R02UH0006EJ |
| RX65N User's manual for the hardware | Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation | RX65N Group User's Manual: Hardware | R01UH0590EJ |
| ISL80510 Datasheet | Hardware specifications (pin assignments, electrical characteristics) and descriptions of operation | ISL80510 Datasheet | FN8767 |
| ISL9005A Datasheet | Hardware specifications (pin assignments, electrical characteristics) and descriptions of operation | ISL9005A Datasheet | FN6452 |

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1. Overview

1.1 Package Components

Thank you for purchasing the Sub-GHz Wireless Communication Evaluation Kit from Renesas (hereinafter referred to as "this product"). This product consists of the Target Board for Sub-GHz Wireless Communication Evaluation Kit (RTK0EE0013D10002BJ)

1.2 Purpose

This product is an evaluation tool for a Sub-GHz Wireless Communication Solutions. This manual describes hardware specifications.

1.3 Features

This product includes the following features:

- Sub-GHz Wireless Communication evaluation
This product offers sub-GHz wireless communication solutions with CE(REDA) of Europe to help you easily start developing your application.

1.4 Sub-GHz Wireless Communication Evaluation Kit: Table of Specifications

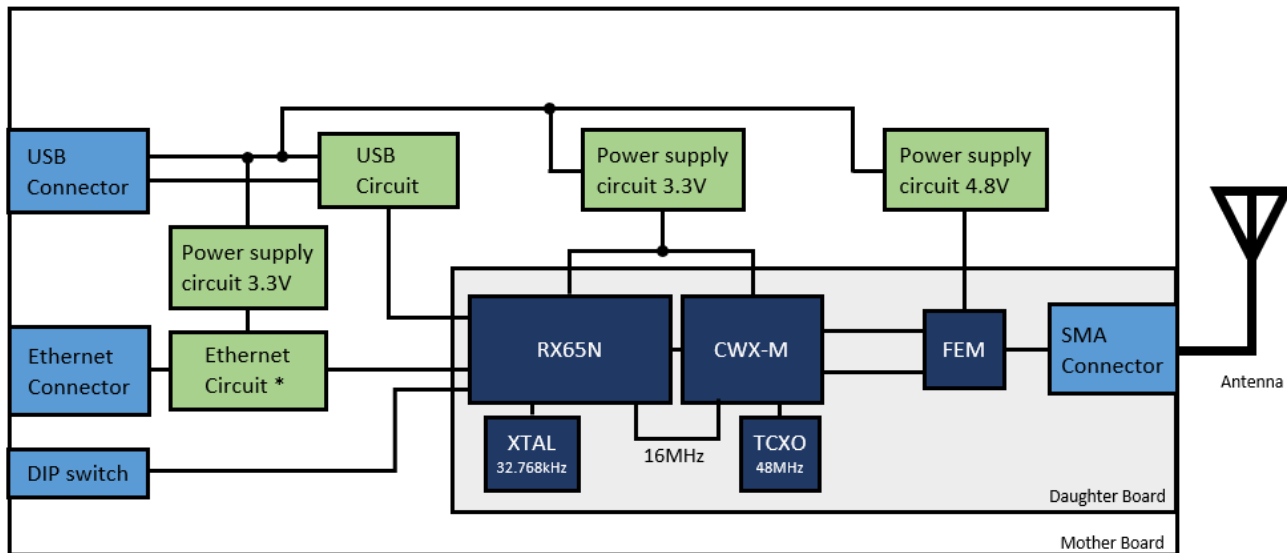
Table 1-1 shows the specifications of this product.

Table 1-1: Sub-GHz Wireless Communication Evaluation Kit Specification Table

| Item | Specification |
|---|---|
| Enclosure size | Size: 92.0mm x 66.5mm x 28.0mm |
| Operating ambient temperature | -10 to +60°C |
| Power-supply circuit | USB connector: 5-V input |
| Transceiver IC (CWX-M) | Part Number: R9A06G062GNP (Renesas) Package: 40-Pin HVQFN |
| Control MCU (RX65N) | Part Number: R5F565NEDDFP (Renesas) Package: 100pin LQFP |
| Power-supply IC | Part Number: ISL80510 (Renesas) Part Number: ISL9005A (Renesas) |
| FEM | Part Number: SKY66122-11(Skyworks) |
| Control MCU/ Main clock | Connected to CKOUT pin of CWX-M (16MHz) |
| Control MCU/ Sub-clock | Crystal oscillator for the sub-clock (32.768KHz) |
| Wireless function | Sub-GHz Wireless circuit Europe band: 863 to 870MHz (CE) Modulation Method: FSK / OFDM |
| USB : Type-C USB bus power (DC5.0V/3.0A) USB2.0 | Connector for an on-board emulator: USB Connector for a USB serial-conversion interface |
| Setting of USB Mode | DIP switch x1 |
| Ethernet | Part Number: LAN8720A (Microchip) Note: The Ethernet function is disabled on this product. |
| Antenna | Part Number: W1063M (Pulse Electronics) |

1.5 Block Diagram

Figure 1-1 shows the block diagram of this product.



*Ethernet function is disabled.

Figure 1-1: Block Diagram

2. External view

Figure 2-1 shows the external view of this product.



Figure 2-1: External view

Note:

Never disassemble or remodel this product.

3. Parts Layout

Figure 3-1 shows the parts layout of this product.



Figure 3-1: Parts Layout

Connect the antenna provided with the product to SMA connector on this product



Figure 3-2: Antenna connection diagram

This product includes Sub-GHz wireless function.

Note:

Never use an antenna other than the antenna provided with the product, as it violates the radio-related laws.

4. Operating Environment

Figure 4-1 shows the operating environment of this product. Install “Virtual COM Port USB Driver” on the host PC. In addition, install the serial terminal software as it will be used for wireless evaluation.

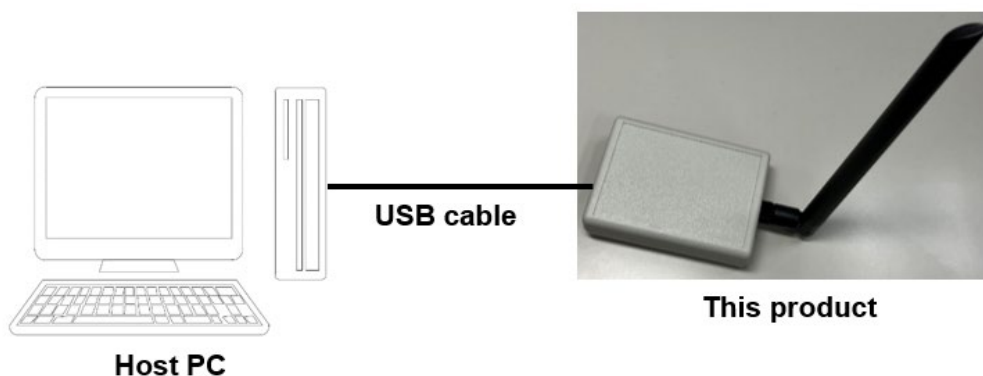


Figure 4-1: Operating Environment

4.1 Virtual COM Port USB Driver

If your PC is connected to the Internet, Windows Update will automatically install the latest driver. Please wait until you see the following pop-up message: Your device is ready to use. If you have not yet installed the driver on your PC, Download and install the driver. Virtual COM port drivers can be downloaded from the FTDI website. FTDI manufactures USB chips embedded in this product.

FTDI website : <http://www.ftdichip.com/Drivers/VCP.htm>

4.2 Serial Terminal Software

The serial terminal software enables data to be input to and output from a serial console. The serial terminal settings are as shown in **Table 4-1**.

Table 4-1: Serial Terminal Settings

| Setting item | Setting value |
|--------------|--|
| Baud rate | 500000 bps |
| Data | 8 bits |
| Parity | None |
| Stop bit | 1 bit |
| Flow control | Not used |
| Newline code | Reception: LF or AUTO Transmission: CR+LF or LF |
| Local echo | Enabled |

Note:


Windows does not come with serial terminal software. Please use the free terminal software of your choice.

5. User Circuits

5.1 DIP switch

Set the following when evaluating (normal mode).

Table 5-1: DIP switch Settings

| Mode | DIP switch Settings |
|--------------------------|--|
| Evaluation (normal mode) | ON:1,2 OFF:3,4,5,6,7,8  |

5.2 Connection of control MCU(RX65N) and wireless transceiver IC (CWX-M)

Table 5-2: Connection of control MCU(RX65N) and wireless transceiver IC (CWX-M)

| Control MCU(RX65N) | Transceiver IC (CWX-M) | Note |
|--------------------|------------------------|----------------------------------|
| RSTB | P46 | CWX-M reset control |
| MODE | P47 | CWX-M operation mode control |
| INTOUT0 | PD5 | CWX-M GPIO0 |
| INTOUT1 | PD6 | CWX-M GPIO1 *1 |
| INTOUT2 | PD7 | CWX-M GPIO2 *1 |
| CLK | PD3 | SPI Serial clock *2 |
| SEN | PD4 | SPI Slave select *2 |
| SIN | PD1 | SPI MOSI(Master Out Slave In) *2 |
| SOUT | PD2 | SPI MISO(Master In Slave Out) *2 |

*1 Reserved for option use.

*2 RX65N is master device.

6. Wireless evaluation

6.1 Serial terminal software connection settings

1. Connect the host PC and this product with a USB cable.
2. Check which COM port the USB of this product is assigned to using the device manager.
3. Start up the serial terminal software and set serial port.

6.2 Command specification

1. When the sample program is started, it enters "command menu mode" and is ready to accept commands. **Table 6-1** shows the command list of sample program.
2. To execute the function of a command, enter the command and then press the return key. When the command has an argument, enter the command, a space and the argument, and then press the return key.

Table 6-1: Command list of sample program

| Command | Function | Argument |
|----------|--|--|
| tboot | Renesas Sub-GHz transceiver bootstrapping | Boot mode |
| tinit | Test function initialization and reset Renesas Sub-GHz transceiver | (None) |
| tope | PHY operation mode setting | FSK/OFDM operation mode Prohibit the use in modes other than the following. tope FSK EU FSKwoFEC 1a 32 tope FSK EU FSKwoFEC 2a 33 tope OFDM EU OFDMOP4 MCS6 33 |
| tch | Channel number setting | Channel number |
| txpow | FSK and OFDM transmission output power setting | Transmission output power value (Index number) |
| txpowd | FSK and OFDM transmission output power setting (dBm) | Transmission output power value (dBm) |
| ttxpowd | FSK transmission output power setting (dBm) | FSK transmission output power value (dBm) |
| totxpowd | OFDM transmission output power setting (dBm) | OFDM transmission output power value (dBm) |
| trxgain | External gain setting for reception signal | External gain value for RF input signal |
| trxgaind | External gain setting for reception signal | External gain value for RF input signal(dBm) |
| tfrlen | Transmission packet length setting | Transmission packet length |
| ti | Continuous transmission interval time setting | Continuous transmission interval time setting |
| txopt | Transmission option setting | Transmission option |
| tsfd | FSK SFD mode setting | FSK SFD mode |
| tfpl | FSK Preamble length setting | FSK Preamble length |
| tdw | FSK Data whitening option setting | FSK Data whitening option |
| tffcs | FSK FCS length setting | FSK FCS length |
| tfscheme | FSK FEC scheme setting | FSK FEC Scheme |
| tffecrx | FSK Reception packet FEC setting | FSK FEC setting |
| tofcs | OFDM FCS length setting | FSK FCS length (CRC bit width) |
| tointl | OFDM Interleaving mode setting | Interleaving mode |
| toscr | OFDM Scrambler value setting | OFDM Scrambler value |
| tostf | OFDM STF length setting | OFDM STF length |

| | | |
|----------|---|--|
| tccam | CCA mode setting | CCA mode |
| tfcdr | CCA duration setting for FSK | CCA duration for FSK |
| tfccavt | CCA level threshold for FSK | CCA level threshold value for FSK |
| tfccavtd | CCA level threshold for FSK in dBm | CCA level threshold value (dBm) for FSK |
| tocdr | CCA duration setting for OFDM | CCA duration for OFDM |
| tocavt | CCA level threshold for OFDM | CCA level threshold value for OFDM |
| tocavtd | CCA level threshold for OFDM in dBm | CCA level threshold value (dBm) for OFDM |
| tgpios | GPIO terminal setting | GPIO terminal function |
| tgpio | Get the current settings of the GPIO terminal | (None) |
| tgpioo | GPIO output port voltage level setting | GPIO output port voltage level |
| tgpioi | Get the GPIO input port voltage level | GPIO port number |
| tberlen | Frame length for RX BER setting | Frame length for RX BER |
| tberpn9 | PN9 mode for BER setting | PN9 mode for BER |
| tffh | Frequency hopping transmission (FSK) | Setting for frequency hopping transmission |
| tofh | Frequency hopping transmission (OFDM) | Setting for frequency hopping transmission |
| ram | RAM read and write mode | read and write mode setting |
| reg | Register read and write mode | read and write mode setting |
| tftx | FSK Packet transmission | Number of transmissions |
| totx | OFDM Packet transmission | Number of transmissions |
| tfpn9 | FSK PN9 continuous modulated transmission | (None) |
| topn9 | OFDM PN9 continuous modulated transmission | (None) |
| tnmtx | Continuous unmodulated transmission | (None) |
| tfrx | FSK Packet reception | Reception option |
| torx | OFDM Packet reception | Reception option |
| te | ED measurement | (None) |
| tcca | CCA execution | (None) |
| tmstxs | Tx setting for ModeSwitch & New Mode Frame | Setting option |
| tmstx | ModeSwitch & New Mode Frame transmission | Number of transmissions |
| tmsrxs | Rx setting for ModeSwitch & New Mode Frame | Setting option |
| tmsrx | ModeSwitch & New Mode Frame reception | Reception options |
| tttl | Regulation mode setting (Tx Total Time Limit, Max Tx Duration and Min Pause Duration Setting) | Regulation mode and parameters Fixed to the following settings. Function OFF and settings cannot be changed. mode: UD tcum_period: 60 tcum_limit: 100000 tcn_max: 1000 toff_min: 100 threshold_time: 1000 |
| tantdv | Antenna diversity setting | Enable / Disable |
| tantnum | Setting the number of antennas to use | Number of antennas |
| tantsel | Setting the antenna number used for Tx / Rx | Antenna number |
| rst | Reset all (Test function, RF driver and | (None) |

| | | |
|--------|--------------------------------|-------------------------------|
| | Renesas Sub-GHz transceiver) | |
| opt | Test function option setting | Display mode of Test function |
| val | Test function settings display | (None) |
| help | Command list display | (None) |
| tsleep | Sleep Mode Setting | (None) |

- The gray areas are commands not supported by this product.
- The transmission output power setting of R9A06G062GNP is fixed to the following settings. It cannot be changed by command.
FSK : -11.0dBm OFDM : -9.5dBm
- Details on the command specification is explained in the application note " RF Characteristic Evaluation Program for Renesas Sub-GHz Transceiver Operation Manual (R30AN0376)". Obtain the latest version of this document from the Renesas website.

7. Hardware specifications

Table 7-1 shows the communication specifications of this product.

Table 7-1: Communication specifications

| | | Channel Spacing | Modulation | | |
|-----------------------------|------|-----------------|--------------------|------|------------------------------|
| | | | Option | MCS | Data Rate / Modulation Index |
| Europe Band 863 - 870MHz | OFDM | 200KHz | Option4 | MCS6 | 300kbps |
| | FSK | 100KHz | Operating mode #1a | | 50kbps / m=0.5 |
| | | 200KHz | Operating mode #2a | | 100kbps / m=0.5 |

7.1 Europe Band

7.1.1 OFDM、Channel Spacing = 200KHz、Modulation = Option4 / MCS6 / 300kbps

- Transmission output power at SMA connector = +14dBm
- Channel Number Setting: ChanPlanID 33

| Channel number | Frequency [MHz] | Channel number | Frequency [MHz] | Channel number | Frequency [MHz] | Channel number | Frequency [MHz] |
|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|
| 0 | 863.1 | 1 | 863.3 | 2 | 863.5 | 3 | 863.7 |
| 4 | 863.9 | 5 | 864.1 | 6 | 864.3 | 7 | 864.5 |
| 8 | 864.7 | 9 | 864.9 | 10 | 865.1 | 11 | 865.3 |
| 12 | 865.5 | 13 | 865.7 | 14 | 865.9 | 15 | 866.1 |
| 16 | 866.3 | 17 | 866.5 | 18 | 866.7 | 19 | 866.9 |
| 20 | 867.1 | 21 | 867.3 | 22 | 867.5 | 23 | 867.7 |
| 24 | 867.9 | 25 | 868.1 | 26 | 868.3 | 27 | 868.5 |
| 28 | 868.7 | 29 | 868.9 | 30 | 869.1 | 31 | 869.3 |
| 32 | 869.5 | 33 | 869.7 | 34 | 869.9 | | |

The gray areas are channels that this product does not support and should not be used for wireless evaluation.

7.1.2 FSK, Channel Spacing = 100KHz, 50kbps / m = 0.5

- Transmission output power at SMA connector = +14dBm
- Channel Number Setting: ChanPlanID 32

| Channel number | Frequency [MHz] | Channel number | Frequency [MHz] | Channel number | Frequency [MHz] | Channel number | Frequency [MHz] |
|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|
| 0 | 863.1 | 1 | 863.2 | 2 | 863.3 | 3 | 863.4 |
| 4 | 863.5 | 5 | 863.6 | 6 | 863.7 | 7 | 863.8 |
| 8 | 863.9 | 9 | 864.0 | 10 | 864.1 | 11 | 864.2 |
| 12 | 864.3 | 13 | 864.4 | 14 | 864.5 | 15 | 864.6 |
| 16 | 864.7 | 17 | 864.8 | 18 | 864.9 | 19 | 865.0 |
| 20 | 865.1 | 21 | 865.2 | 22 | 865.3 | 23 | 865.4 |
| 24 | 865.5 | 25 | 865.6 | 26 | 865.7 | 27 | 865.8 |
| 28 | 865.9 | 29 | 866.0 | 30 | 866.1 | 31 | 866.2 |
| 32 | 866.3 | 33 | 866.4 | 34 | 866.5 | 35 | 866.6 |
| 36 | 866.7 | 37 | 866.8 | 38 | 866.9 | 39 | 867.0 |
| 40 | 867.1 | 41 | 867.2 | 42 | 867.3 | 43 | 867.4 |
| 44 | 867.5 | 45 | 867.6 | 46 | 867.7 | 47 | 867.8 |
| 48 | 867.9 | 49 | 868.0 | 50 | 868.1 | 51 | 868.2 |
| 52 | 868.3 | 53 | 868.4 | 54 | 868.5 | 55 | 868.6 |
| 56 | 868.7 | 57 | 868.8 | 58 | 868.9 | 59 | 869.0 |
| 60 | 869.1 | 61 | 869.2 | 62 | 869.3 | 63 | 869.4 |
| 64 | 869.5 | 65 | 869.6 | 66 | 869.7 | 67 | 869.8 |
| 68 | 869.9 | | | | | | |

The gray areas are channels that this product does not support and should not be used for wireless evaluation.

7.1.3 FSK, Channel Spacing = 200KHz, 100kbps / m = 0.5

- Transmission output power at SMA connector = +14dBm
- Channel Number Setting: ChanPlanID 33

| Channel number | Frequency [MHz] | Channel number | Frequency [MHz] | Channel number | Frequency [MHz] | Channel number | Frequency [MHz] |
|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|
| 0 | 863.1 | 1 | 863.3 | 2 | 863.5 | 3 | 863.7 |
| 4 | 863.9 | 5 | 864.1 | 6 | 864.3 | 7 | 864.5 |
| 8 | 864.7 | 9 | 864.9 | 10 | 865.1 | 11 | 865.3 |
| 12 | 865.5 | 13 | 865.7 | 14 | 865.9 | 15 | 866.1 |
| 16 | 866.3 | 17 | 866.5 | 18 | 866.7 | 19 | 866.9 |
| 20 | 867.1 | 21 | 867.3 | 22 | 867.5 | 23 | 867.7 |
| 24 | 867.9 | 25 | 868.1 | 26 | 868.3 | 27 | 868.5 |
| 28 | 868.7 | 29 | 868.9 | 30 | 869.1 | 31 | 869.3 |
| 32 | 869.5 | 33 | 869.7 | 34 | 869.9 | | |

The gray areas are channels that this product does not support and should not be used for wireless evaluation.

8. Additional Information

Technical Support

For details on the Transceiver IC (CWX-M), refer to the R9A06G062GNP Sub-GHz Transceiver User's Manual: Hardware.

The latest information is available from the Web page.

Technical Contact Details

General information on Renesas microcontrollers can be found on the Renesas website at:

<https://www.renesas.com/>

Note

- This product has a CE and UKCA conformity declaration.
 - In order to use wireless equipment and devices, it is necessary to comply with the wireless regulations established in the country of use.
 - Modifications to the product will invalidate the CE and UKCA conformity, any modifications done to the evaluation board are done at the risk of the user and any CE and UKCA compliance is then the responsibility of the user. Example modifications are (but not limited to):
 - ✧ Using an antenna which is different to the one provided with the product.
 - ✧ Modifications to the firmware supplied on the kit.
- This product is designed as an evaluation platform only and therefore is not designed to be used as, or in combination with, an end product or for mass production purposes.

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9. Certification of Compliance

This product complies with the laws and regulations described below.

9.1 Radio-Related Laws

9.1.1 EU Compliance information



Simplified EU Declaration of conformity

Hereby, Renesas Electronics Corporation declares that the radio equipment type RTK0EE0013D10002BJ is in compliance with RED 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address:

<https://www.renesas.com/>

9.1.2 UK Compliance information



Simplified UK Declaration of conformity

Hereby, Renesas Electronics Corporation declares that the radio equipment type RTK0EE0013D10002BJ is in compliance with the Radio Equipment Regulations 2017.

The full text of the UK declaration of conformity is available at the following internet address:

<https://www.renesas.com/>

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|------------------|----------------------------------|
| Revision History | RTK0EE0013D10002BJ User's Manual |
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