RX65N Group

Cloud Kit for RX65N Microcontroller Group
CK-RX65N v1
User's Manual

Renesas RX Family
RX600 Series

Renesas Electronics
www.renesas.com

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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.

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   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.

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The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:

• Ensure attached cables do not lie across the equipment.

• Reorient the receiving antenna.

• Increase the distance between the equipment and the receiver.

• Connect the equipment into an outlet on a circuit different from that which the receiver is connected.

• Power down the equipment when not in use.

• Consult the dealer or an experienced radio/TV technician for help.

Note: It is recommended that wherever possible shielded interface cables are used.

The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken:

• The user is advised that mobile phones should not be used within 10 m of the product when in use.

• The user is advised to take ESD precautions when handling the equipment.

The Evaluation Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

Renesas RX Family

CK-RX65N v1

Contents

Figures

Tables

Glossary

Table 1. List of Abbreviations and Acronyms

BoM	Bill of Materials
CK	Cloud Kit
E2OB	E2 On Board
ETM	Embedded Trace Module
FINE	Debugging Interface
FS	Full Speed
GPIO	General Purpose Input Output
I²C (or IIC)	Inter-Integrated Circuit
IDE	Integrated Development Environment
IMU	Inertial Measurement Unit
I/O	Input/Output
IRQ	Interrupt Request
LDO	Low Dropout
LED	Light Emitting Diode
LQFP	Low-profile Quad Flat Pack
MCU	Micro Controller Unit
MEMS	Micro-Electromechanical Systems
MISO	Master In Slave Out
MOSI	Master Out Slave In
NC	Not Connected
PHY	Physical Layer Transceiver
PMOD™	Peripheral Module
PWM	Pulse Width Modulation
RDP	RX Driver Package
RGB	Red Green Blue
RMII	Reduced Media-Independent Interface
RXD	Receive Data
SCI	Serial Communications Interface
SCL	Serial Clock Line
SDA	Serial Data Line
SMD	Surface Mount Device
SMT	Surface Mount Technology
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
TXD	Transmit Data
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

1. Kit Overview

The CK-RX65N, Cloud Kit for RX65N MCU Group, enables users to experience the cloud connectivity options available from Renesas and Renesas Partners. A broad array of sensors on the CK-RX65N provide multiple options for observing user interaction with the Cloud Kit. By selecting from a choice of add-on devices, multiple cloud connectivity options are available.

MCU Features

- R5F565NEHDFB MCU (referred to as RX MCU)
- 120 MHz, RX CPU (RXv2)
- 2 MB Code Flash, 32 kB data flash, 640 kB SRAM
- 144 pins, LQFP package
- MCU current measurement points for precision current consumption measurement
- Multiple clock sources - RX MCU oscillator and sub-clock oscillator crystals, providing precision 24.000 MHz and 32,768 Hz reference clock. Additional low-precision clocks are available internal to the RX MCU

Ecosystem Access and Connectivity

- USB Full Speed Host and Device (micro AB connector)
- Two 5 V input sources
  - USB (Debug, Full Speed)
  - External power supply (using traditional pin header)
- Debug modes
  - Debug on-board (FINE)
- User LEDs and buttons
  - Four User LEDs (red, blue, green, RGB)
  - Power LED (white) indicating availability of regulated power
  - Debug LED (yellow) indicating the debug connection
  - One User button
  - One Reset button
- Two of the most popular ecosystems expansions
  - 2 Digilent Pmod™ (SPI and UART) connectors
  - Arduino™ (Uno R3) connector
- MCU boot configuration jumpers
- Ethernet (RJ45 RMII interface)

Sensors

- Renesas HS3001 Humidity and Temperature sensor
- Renesas ZMOD4410 Indoor Air Quality Index sensor
- Renesas ZMOD4510 Outdoor Air Quality Index sensor
- Renesas OB1203 Biometric sensor
- TDK ICP-10101 Barometric Pressure sensor
- TDK ICM-20948 IMU (Gyroscope, Magnetometer, Accelerometer)
- Knowles SPU0410LR5H-QB MEMS Microphones in stereo configuration

Arduino Uno Connectors (Analog and Power)   Sensors   Arduino Uno Connectors (Digital)

Pmod 1 Power
Test Point

Pmod 1
Connector

Reset Switch

User Switch

User LEDs

USB Serial
Connector

USB Full Speed

Biometric Sensor

MCU Current
Test Point

Pmod 2
Connector

Pmod 2 Power
Test Point

Run/Debug
Link

External Power
Connector

E2OB
Debugger

Ethernet

Option Links   RX65N MCU
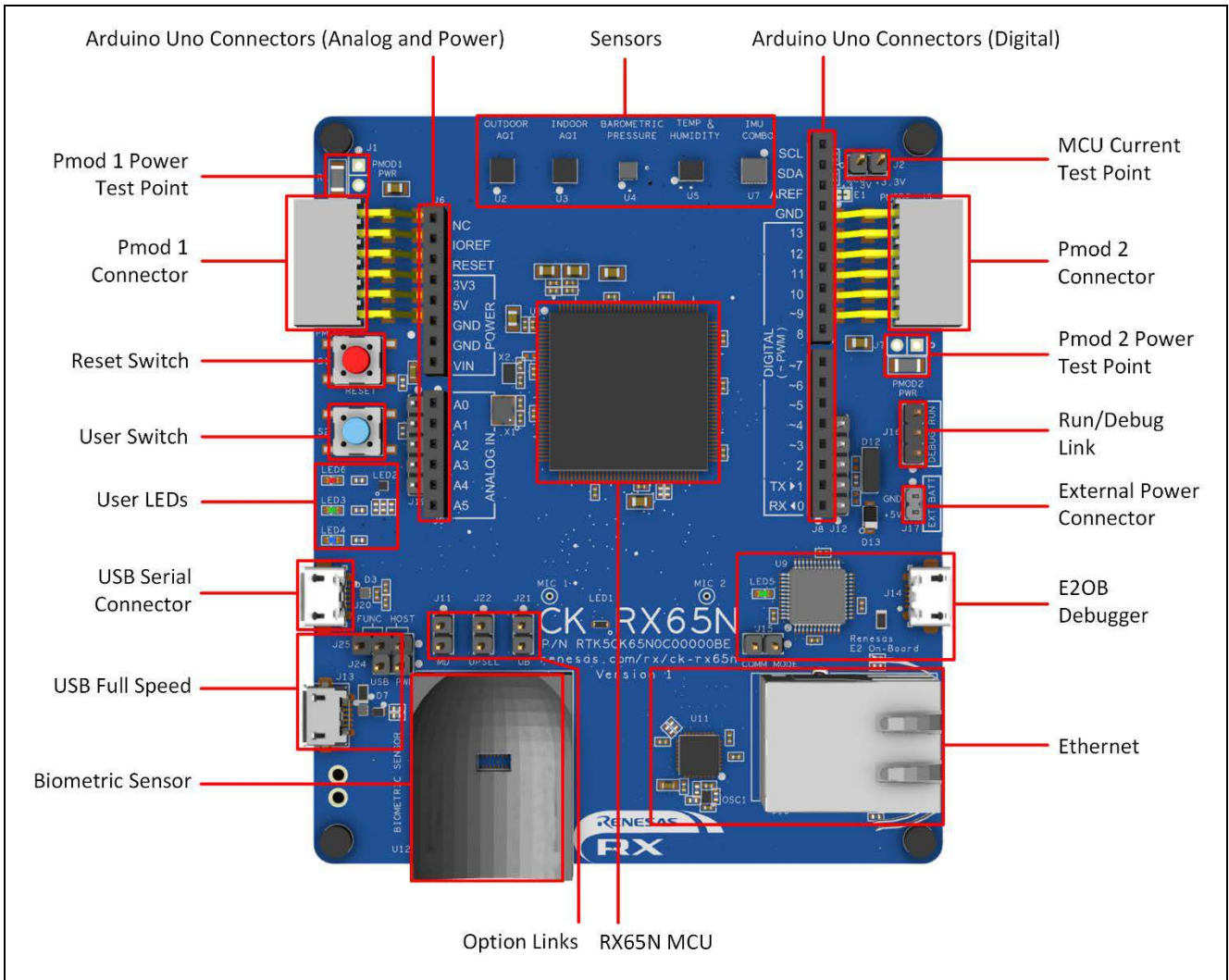
Figure 1.   CK-RX65N Board Top Side
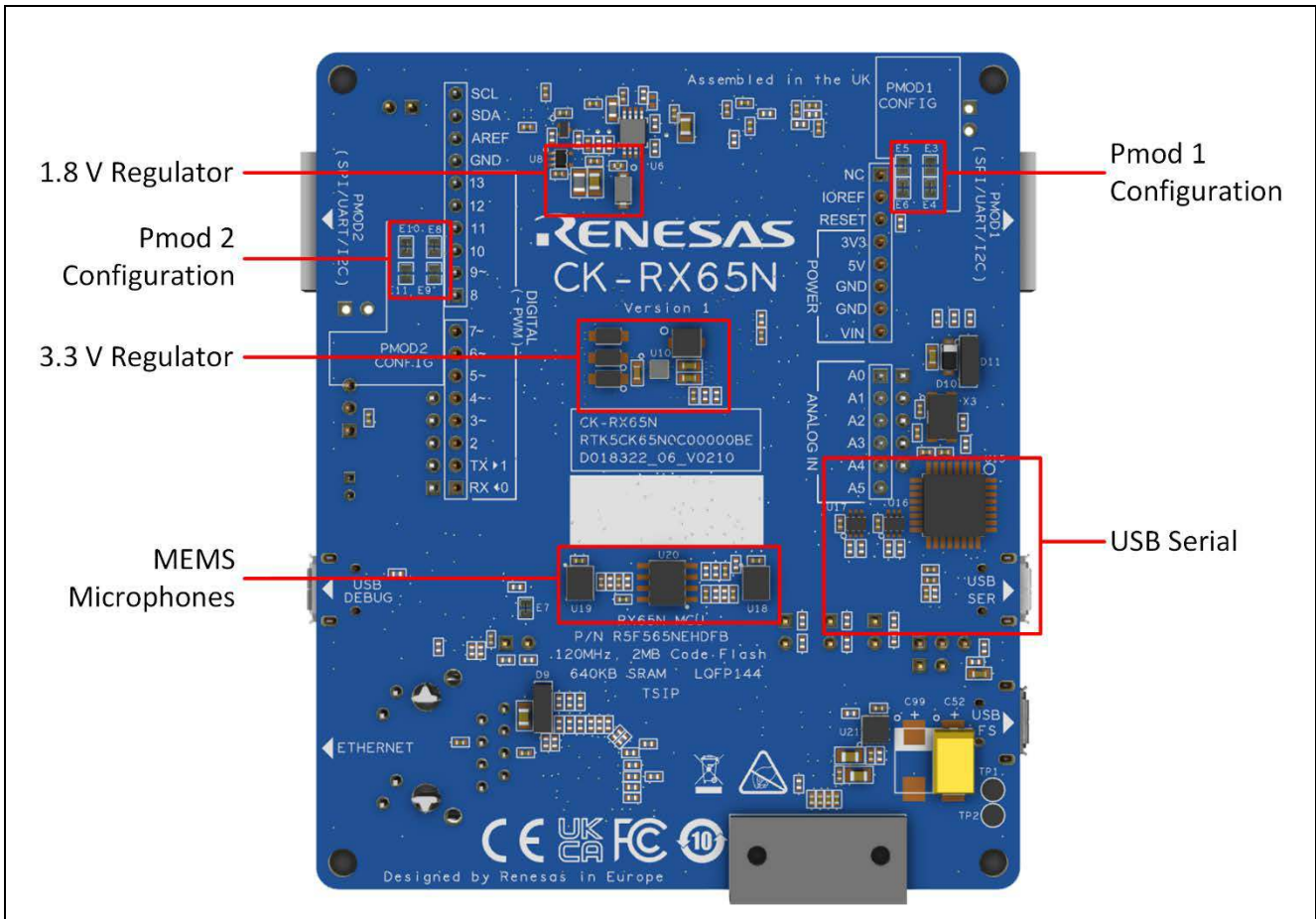
Figure 2.   CK-RX65N Board Bottom Side

1.1   Assumptions and Advisory Notes

1.   It is assumed that the user has a basic understanding of microcontrollers and embedded systems hardware.
2.   It is recommended that the user refers to the *CK-RX65N Quick Start Guide* to get acquainted with the kit and the Quick Start example project that the CK-RX65N board comes pre-programmed with.
3.   The RX Driver Package (RDP) and an Integrated Development Environment (IDE) such as e^2 studio are required to develop embedded applications on the CK-RX65N kit.
4.   Instructions to download and install software, import example projects, build them and program the CK-RX65N board are provided in the quick start guide.
5.   The MCU fitted to the CK board may not contain the latest version of the on-chip boot firmware.

2.   Kit Contents

The following components are included in the kit:

1.   CK-RX65N v1 board
2.   RYZ014A Pmod (RX CAT-M1 Cellular Kit)
3.   SIM card (RX CAT-M1 Cellular Kit)
4.   Micro USB A/B to A adapter cable
5.   Micro USB to A cable
6.   Antenna (RX CAT-M1 Cellular Kit)
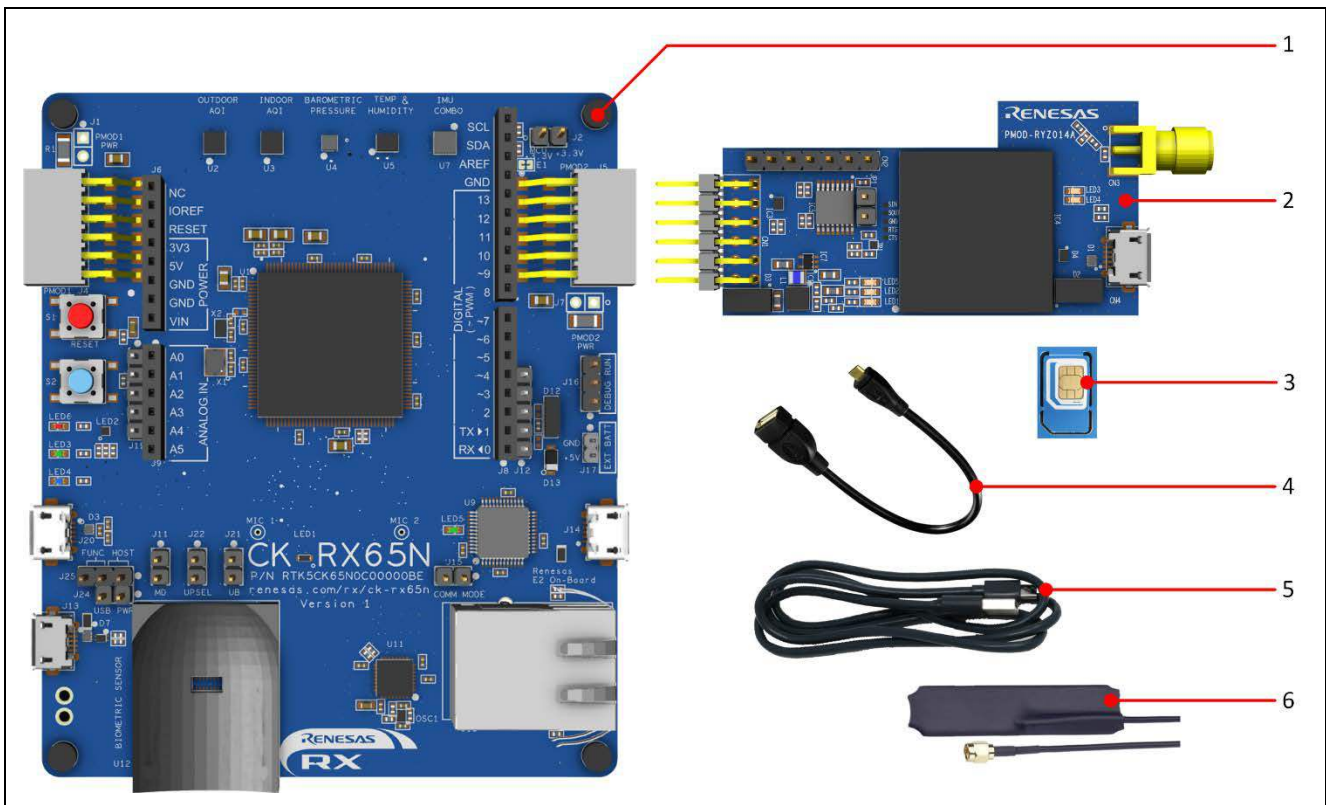
Figure 3.   CK-RX65N v1 Kit Contents

3.   Ordering Information

- CK-RX65N v1 kit orderable part number:
  RTK5CK65N0S04000BE   CAT-M1 Cloud – (base kit plus RYZ014A Pmod)

- CK-RX65N board dimensions: 80 mm (width) x 95 mm (length)

4. Hardware Architecture and Default Configuration

4.1 Kit Architecture

The CK-RX65N board is designed to demonstrate many options available to connect the RX65N MCU to various cloud services. The board includes the RX65N MCU, multiple environmental sensors and connectivity options such as USB, Ethernet, and Pmod connections for use with add-on wireless connectivity devices, as well as support for Arduino Uno R3 shields. The board also includes an on-board debugger and all required hardware needed to power, program, and debug software running on the MCU. The board also has LED indicators and a push-button available for user interaction with the board.

Most of the on-board sensors are connected to the MCU using I^{2}C. The on-board microphones use the Analog to Digital Converter (ADC) peripheral within the MCU.

Board Functionality	Area Features	Function present on all similar kits	Functionality is:
MCU Native Access	RX MCU, power / current measurement	Yes	MCU dependent
System Control and Ecosystem Access	Power, Debug MCU, User LED and buttons, reset, ecosystem connectors, USB Full Speed, Boot configuration, Ethernet	Yes	Same or similar across similar kits

4.2 System Block Diagram

Figure 4.   CK-RX65N Board Block Diagram

4.3   Jumper Settings

Two types of jumpers are provided on the CK-RX65N board.

1. Copper jumpers (trace-cut type and solder bridge type)
2. Traditional pin header jumpers

The following sections describe each type and their default configuration.

4.3.1   Copper Jumpers

Copper jumpers are of two types, designated **trace-cut** and **solder-bridge**.
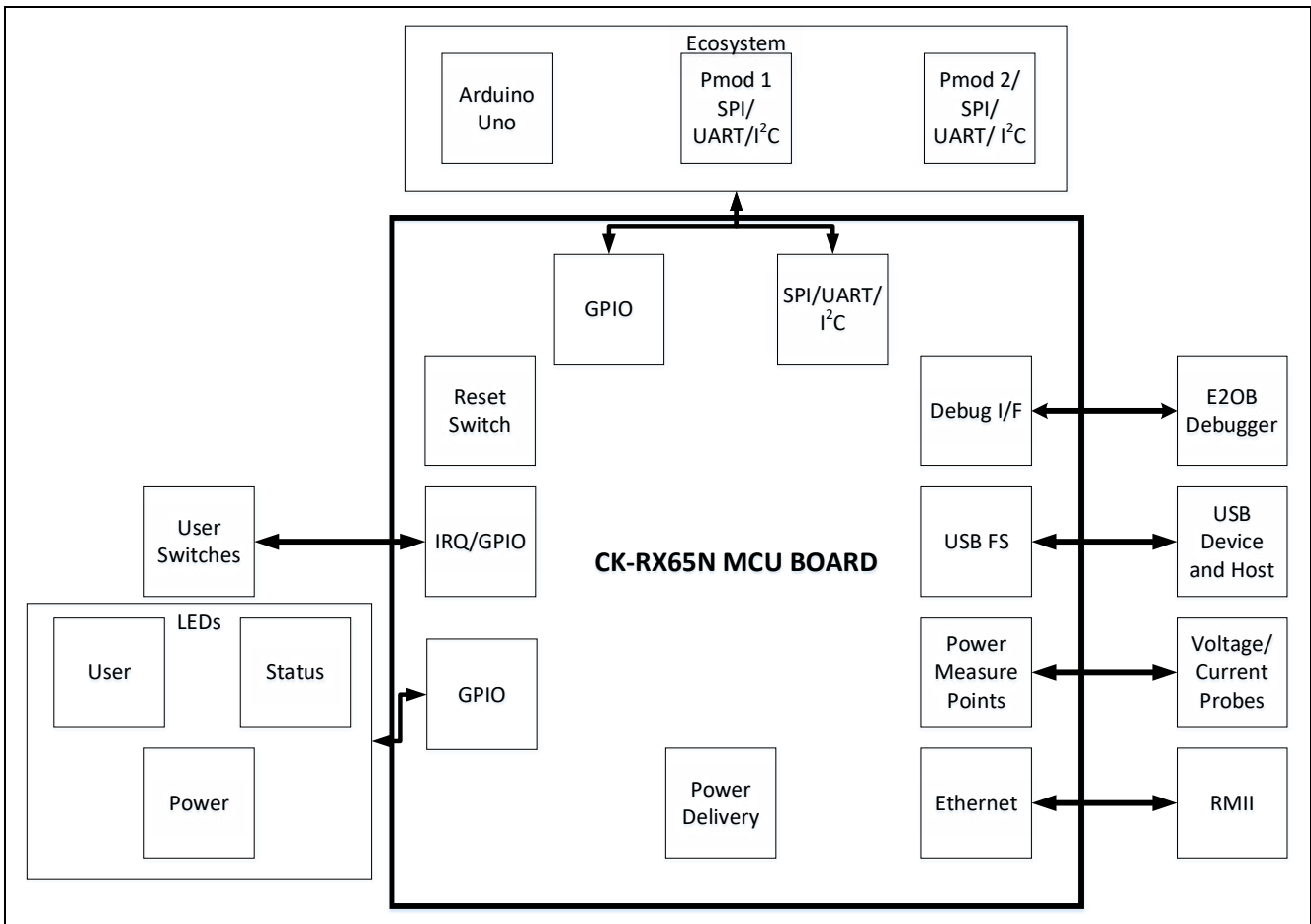
A **trace-cut jumper** is provided with a narrow copper trace connecting its pads. The silk screen overlay printing around a trace-cut jumper is a solid box. To isolate the pads, cut the trace between pads adjacent to each pad, then remove the connecting copper foil either mechanically or with the assistance of heat. Once the etched copper trace is removed, the trace-cut jumper is turned into a solder-bridge jumper for any later changes.

A **solder-bridge** jumper is provided with two isolated pads that may be joined together. The silkscreen overlay printed around a solder-bridge jumper has gaps in the surround. Three methods can be used for joining:

- Solder may be applied to both pads to develop a bulge on each and the bulges joined by touching a soldering iron across the two pads.
- A small wire may be placed across the two pads and soldered in place.
- A SMT resistor, size 0805, 0603, or 0402, may be placed across the two pads and soldered in place. A zero-ohm resistor shorts the pads together.

For any copper jumper, the connection is considered **closed** if there is an electrical connection between the pads (default for trace-cut jumpers.) The connection is considered **open** if there is no electrical connection between the pads (default for the solder-bridge jumpers.)
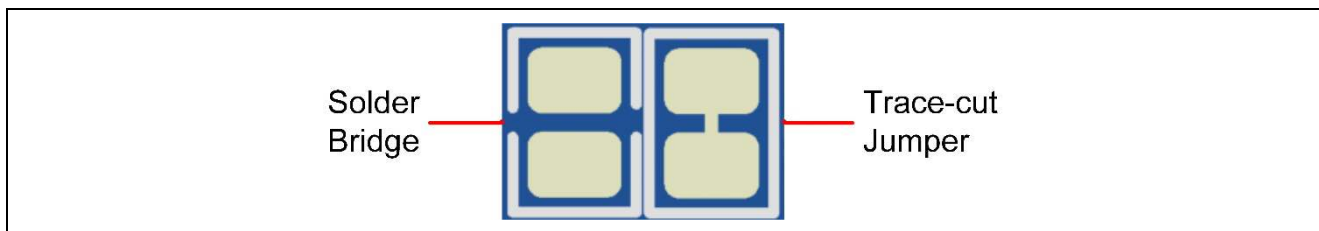
Figure 5.   Copper Jumpers

4.3.2   Traditional Pin Header Jumpers

These jumpers are traditional small pitch jumpers that require an external shunt to open/close them. The traditional pin jumpers on the CK-RX65N board are 2.54 mm (0.1") pitch headers and require compatible 2.54 mm shunt jumpers.

4.3.3   Default Jumper Configuration

The following table describes the default settings for each jumper on the CK-RX65N board. This includes copper jumpers (Ex designation) and traditional pin jumpers (Jx designation).

The Circuit Group for each jumper is the designation found in the board schematic (available in the Design Package). Functional details for many of the listed jumpers may be found in sections associated with each functional area of the kit.

Table 2.   Default Jumper Settings

Location	Circuit Group	Default Open/Closed	Function
J1	Pmod 1	Open	Current Measurement point for Pmod 1
J2	MCU Power	Closed	Current Measurement point for MCU
J7	Pmod 2	Open	Current Measurement point for Pmod 2
J11	MCU Boot Mode	Open	Configures the MCU for normal boot mode
J15	E2OB Debugger	Open	Select debugger comms mode

Location	Circuit Group	Default Open/Closed	Function
J16	E2OB debugger	Link 1-2 (debug)	Select debug or free run
J17	Power	Open	Connect external power source
J21	MCU Boot Mode	Closed	Enable USB boot mode
J22	MCU Boot Mode	Open	Select USB boot mode power supply method
E1	AREF	Closed	Links AREF to +3.3 V
E3	Pmod 1	Open	Connects P21 (SCL1) to Pmod 1
E4	Pmod 1	Closed	Connects P01 (MISO6/RXD6) to Pmod 1
E5	Pmod 1	Open	Connects P20 (SDA1) to Pmod 1
E6	Pmod 1	Closed	Connects P02 (SCK6) to Pmod 1
E7	Power	Closed	Connects E2OB to +3.3 V
E8	Pmod 2	Closed	Connects P34 (SCK0) to Pmod 2
E9	Pmod 2	Open	Connects PE1 (SDA12) to Pmod 2
E10	Pmod 2	Closed	Connects P33 (MISO0/RXD0) to Pmod 2
E11	Pmod 2	Open	Connects PE2 (SCL12) to Pmod 2

5. System Control and Ecosystem Access

The CK-RX65N provides a power supply regulator, an on-board debugger, simple I/O (switches and LEDs), and popular I/O ecosystem connectors. These are all described in detail below.

5.1 Power

The CK-RX65N kit is designed for +5 V operation. An on-board switching voltage regulator (ISL8002IRZ) is used to convert the 5 V supply to a 3.3 V supply. Also fitted is a low dropout regulator (ISL9008AIECZ-T) to convert the 3.3 V supply to a 1.8 V supply. The 3.3 V supply is used to power the RX MCU and other peripheral features as well as the microphones and some of the sensors. The 1.8 V supply is used to power some of the motion and pressure sensors.

5.1.1   Power Supply Options

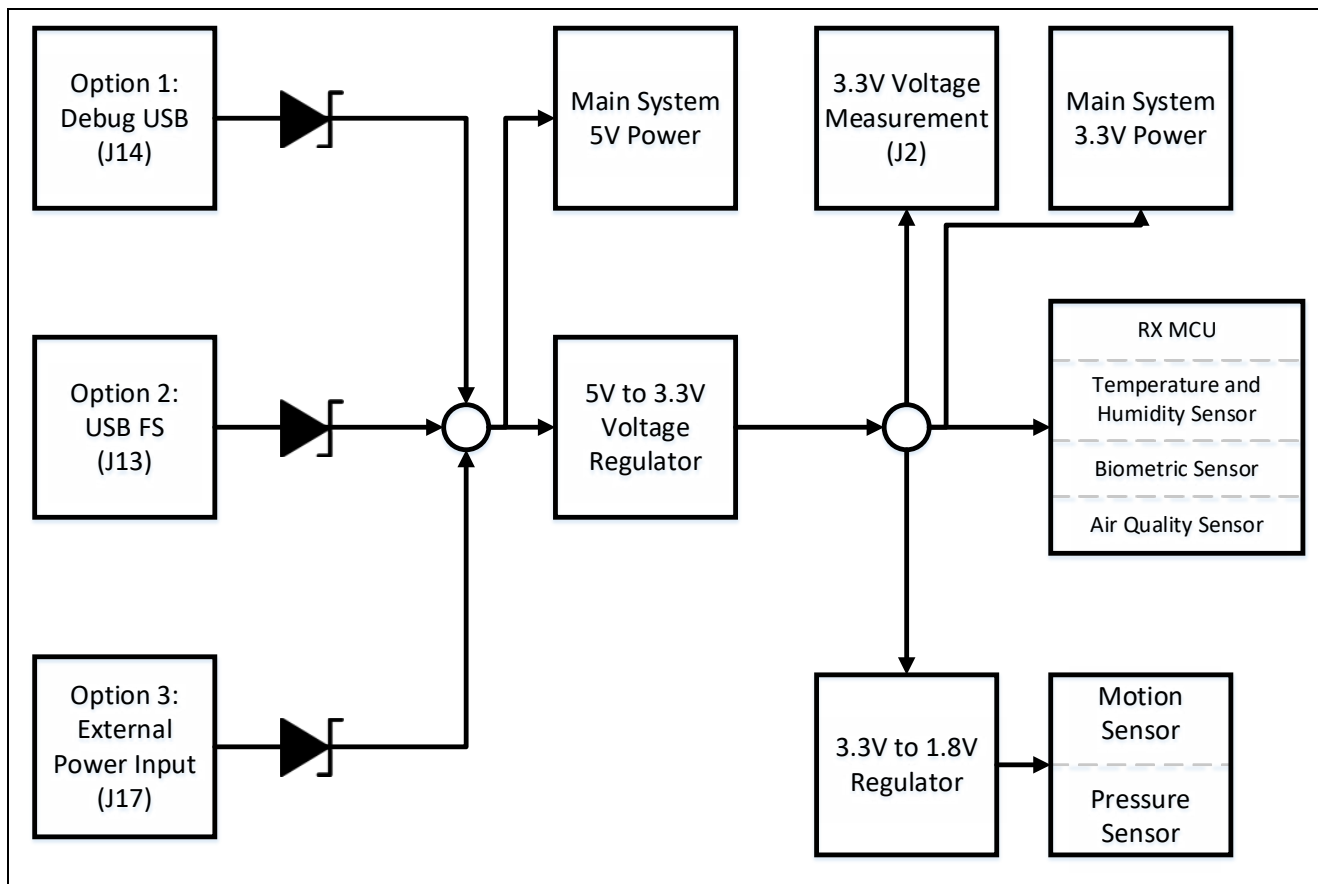This section describes the different ways in which CK-RX65N kit can be powered.

Figure 6.   Power Supply Options

5.1.1.1   Option 1: Debug USB

5 V may be supplied from an external USB host to the USB Debug connector (J14) labelled USB DEBUG on the board. Power from this source is connected to the Main System 5 V Power. Reverse current protection is provided between this connector and the Main System 5 V Power.

5.1.1.2   Option 2: USB Full Speed

5 V may be supplied from an external USB host to the USB Full Speed connector (J13) labelled USB FS on the board. Power from this source is connected to the Main System 5 V Power. Reverse current protection is provided between this connector and the Main System 5 V Power.

5.1.1.3   Option 3: External Power Input

5 V may be supplied from an external power supply or battery to 2-pin header J17 labelled EXT BATT on the board. Polarity is J17-2 (+5 V) and J17-1 (GND). Power from this source is connected to the Main System 5 V Power. Reverse current protection is provided between the 5 V test points and the Main System 5 V Power.

5.1.2   Power Supply Considerations

The on-board regulator which supplies +3.3 V has a built-in current limit of 2.0 A and the regulator which supplies +1.8 V has a built-in current limit of 150 mA. Make sure that the total current required by the RX MCU, any active on-board features, and any connected peripheral device does not exceed these limits.

Note: The total current available from a typical USB host is 500 mA maximum. Depending on the configuration of the kit, multiple power sources may be required.

5.1.3   Power-up Behavior

When powered, the white LED near the center of the board (the "dash" in the CK-RX65N name) will light up. For more details on initial power up behavior, see the *CK-RX65N Quick Start Guide*.

5.2   Debug and Trace

The CK-RX65N board supports one debug mode.

Table 3.   Debug Modes

Debug Mode	Debug MCU (the one that connects to the IDE on PC)	Target MCU (the one that is being debugged)	Debugging Interface/Protocol	Connector Used
Debug on-board	E2OB (on-board)	RX65N (on-board)	FINE	Micro USB (J14)

Notes: See Table 4 for the Debug USB connector pin definition.

5.2.1   Debug On-Board

The on-board debug functionality is provided using a Renesas E2 On Board debugger. Debug USB Micro-B connector (J14) connects the E2OB debug MCU to an external USB Full Speed host, allowing debugging and re-programming of the target RX MCU firmware.

The E2OB debug MCU connects to the target RX MCU using the FINE interface.

Table 4.   Debug USB Connector

Debug USB Connector		CK-RX65N
Pin	Description	Signal/Bus
J14-1	+5 VDC	+5V_USB_DBG
J14-2	Data-	USB_DM (U9-18)
J14-3	Data+	USB_DP (U9-19)
J14-4	USB ID, jack internal switch, cable inserted	NC
J14-5	Ground	GND

A green indicator, LED5, shows the visual status of the debug interface. When the CK-RX65N board is powered on, and LED5 is blinking, it indicates that the E2 Emulator On-Board debugger is not connected to a programming host. When LED5 is on solid, it indicates that it is connected to a programming interface. When LED5 is flickering, it indicates that data is being transferred between the E2 Emulator On-Board debugger and the programming host.

5.2.1.1   Debugger Jumper Settings

Table 5.   COMM MODE Jumper J15

Jumper Position	Function
Closed	E2OB Debugger acts as a serial to USB communications port
Open	E2OB Debugger normal debugging mode

Table 6.   Debug Jumper J16

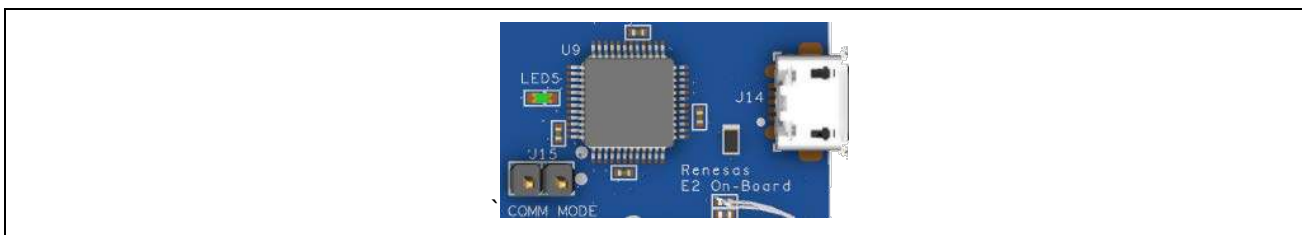| Jumper Position	Function
Pins 1-2	Debugger enabled
Pins 2-3	Debugger held in reset (RX65N MCU free-running operation)

Figure 7.   CK-RX65N Debug Interface

5.3   Ecosystem

The Ecosystem connectors provide users the option to simultaneously connect several third-party add-on modules compatible with two popular ecosystems using the following connectors:

1. Two Digilent Pmod™ (SPI and UART) connectors
2. Arduino™ (Uno R3) connectors

5.3.1   Digilent Pmod™ Connectors

Two 12-pin connectors are provided to support Pmod modules where the RX MCU acts as the master, and the connected module acts as a slave device.

These interfaces may be configured in firmware to support several Pmod types such as Type-2A (expanded SPI) and Type-3A (expanded UART).

The CK-RX65N board also provides jumpers so the 12-pin connector may alternatively be used for 2 independent 6-pin Pmod devices where the top row supports Pmod Type-2 (SPI) and Type-3 (UART) while the bottom row supports Pmod Type-6 (I^2C).

This 12-pin Pmod interface supports +3.3 V devices. Please ensure that any Pmod device installed is compatible with a +3.3 V supply.

5.3.1.1   Pmod 1 Connector

A 12-pin Pmod connector is provided at J4, Pmod 1.

Table 7.   Pmod 1 Connector

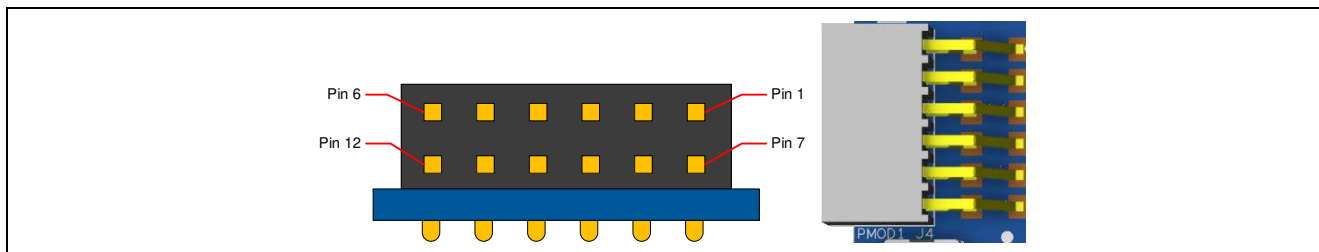| Pmod 1 Connector Default			CK-RX65N	Pmod 1 Configuration	
Pin	Description	Option Type 6A	Signal/Bus	Short	Open
J4-1	SSLA / CTS_RTS	NC	PJ3 (SS6/CTS_RTS6)		
J4-2	MOSI / TXD	NC	P00 (MOSI6/TxD6)		
J4-3	MISO / RXD		P01 (MISO6/RxD6)	E4	E3
		SCL	P21 (SCL1)	E3	E4
J4-4	SCK/RTS		P02 (SCK6)	E6	E5
		SDA	P20 (SDA1)	E5	E6
J4-5	GND		GND		
J4-6	VCC		+3.3 V		
J4-7	GPIO / INT (slave to master)		P15 (IRQ5)		
J4-8	GPIO / RESET (master to slave)		P55 (IRQ10)		
J4-9	GPIO / CS1		PB7 (TxD9)		
J4-10	GPIO / CS2		PB6 (RxD9)		
J4-11	GND		GND		
J4-12	VCC		+3.3 V		

Figure 8.   Pmod 1 Connector

5.3.1.2 Pmod 2 Connector

A 12-pin Pmod connector is provided at J5, Pmod 2.

Table 8.   Pmod 2 Connector

Pmod 2 Connector Default			CK-RX65N	Pmod 2 Configuration	
Pin	Description	Option Type 6A	Signal/Bus	Short	Open
J5-1	SS / CTS	NC	P23 (SS0)		
J5-2	MOSI / TXD	NC	P32 (MOSI0/TXD0)		
J5-3	MISO / RXD		P33 (MISO0/RXD0)	E10	E11
		SCL	PE2 (SCL12)	E11	E10
J5-4	SCK/RTS		P34 (SCK0)	E8	E9
		SDA	PE1 (SDA12)	E9	E8
J5-5	GND		GND		
J5-6	VCC		+3.3 V		
J5-7	GPIO / INT (slave to master)		PD0 (IRQ0)		
J5-8	GPIO / RESET (master to slave)		PA1 (IRQ11)		
J5-9	GPIO / CS1		P50 (TxD2)		
J5-10	GPIO / CS3		P52 (RxD2)		
J5-11	GND		GND		
J5-12	VCC		+3.3 V		
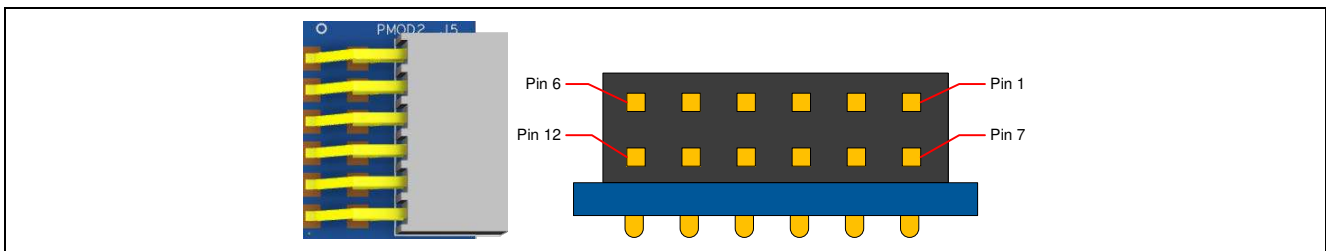
Figure 9.   Pmod 2 Connector

5.3.2 Arduino™ Connector

Near the center of the System Control and Ecosystem Access area is an Arduino Uno R3 compatible connector interface.

Table 9.   Arduino Uno Connections

	Arduino Compatible Connector	CK-RX65N
Pin	Description	Signal/Bus
J6-1	NC	NC
J6-2	IOREF	+3.3V
J6-3	RESET	P64
J6-4	3.3 V	+3.3V
J6-5	5 V	+5V
J6-6	GND	GND
J6-7	GND	GND
J6-8	VIN	NC
J9-1	A0	P40 (AN000)
J9-2	A1	P41 (AN001)
J9-3	A2	P42 (AN002)
J9-4	A3	P43 (AN003)
J9-5	A4	P44 (AN004)

|	Arduino Compatible Connector	CK-RX65N
Pin	Description	Signal/Bus
J9-6	A5	P47 (AN007)
J8-1	D0 / RXD	P92 (RxD7)
J8-2	D1 / TXD	P90 (TxD7)
J8-3	D2 / INT0	PD3 (IRQ3)
J8-4	D3 / INT1 / PWM	PC1 (IRQ12/MTIOC3A)
J8-5	D4 / PWM	PD4 (IRQ4/MTIOC8B)
J8-6	D5 / PWM	PB5 (MTIOC1B)
J8-7	D6 / PWM	PC4 (MTIOC3D)
J8-8	D7 / PWM	PC5 (MTIOC3B)
J3-1	D8 / CLKOUT	P53 (BCLK)
J3-2	D9 / PWM	PC6 (MTIOC3C)
J3-3	D10 / SPI_SS / PWM	PB2 (SS4)
J3-4	D11 / SPI_MOSI / PWM	PB1 (SMOSI4)
J3-5	D12 / SPI_MISO	PB0 (SMISO4)
J3-6	D13 / SPI_SCK	PB3 (SCK4)
J3-7	GND	GND
J3-8	AREF	+3.3V / VREFH / VREFH0
J3-9	I2C_SDA	P20 (SDA1)
J3-10	I2C_SCL	P21 (SCL1)
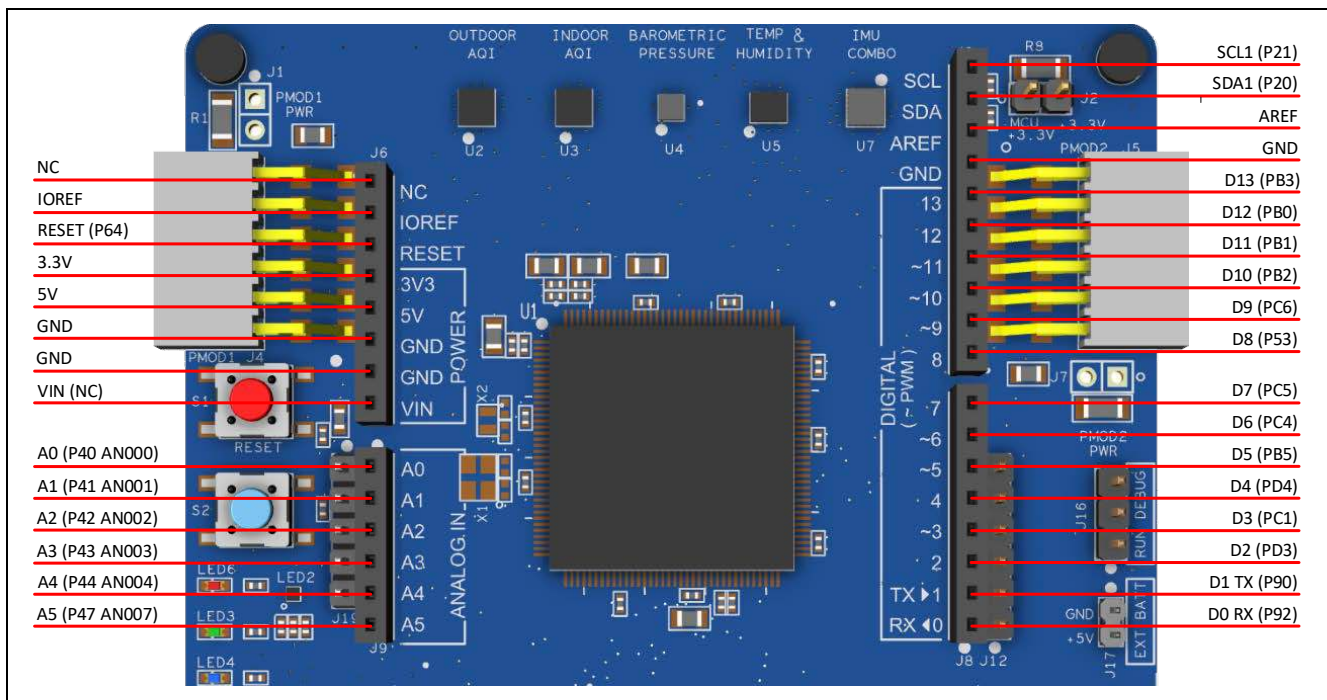
Figure 10.   Arduino Uno Connectors

5.4   Connectivity

5.4.1   USB Full Speed

The USB Micro-AB connection jack (J13) connects the RX MCU USB Full Speed interface to an external USB interface, allowing communications for testing and use of the RX MCU firmware. The USB port can be configured for either USB function or USB host.

Table 10. USB Full Speed Connector

USB Full Speed Connector		CK-RX65N
Pin	Description	Signal/Bus
J13-1	+5 VDC	+5V_USBFS, P16/USB0_VBUS
J13-2	Data-	USB0_DM
J13-3	Data+	USB0_DP
J13-4	USB ID, jack internal switch, cable inserted	NC
J13-5	Ground	GND

Table 11. USB Function / Host Jumper J25

Option	Selection
Host	Link 1-2
Function	Link 2-3

Table 12. USB Power Jumper J24

Option	Jumper
Bus-powered operation	Fitted
Self-powered operation	Not fitted
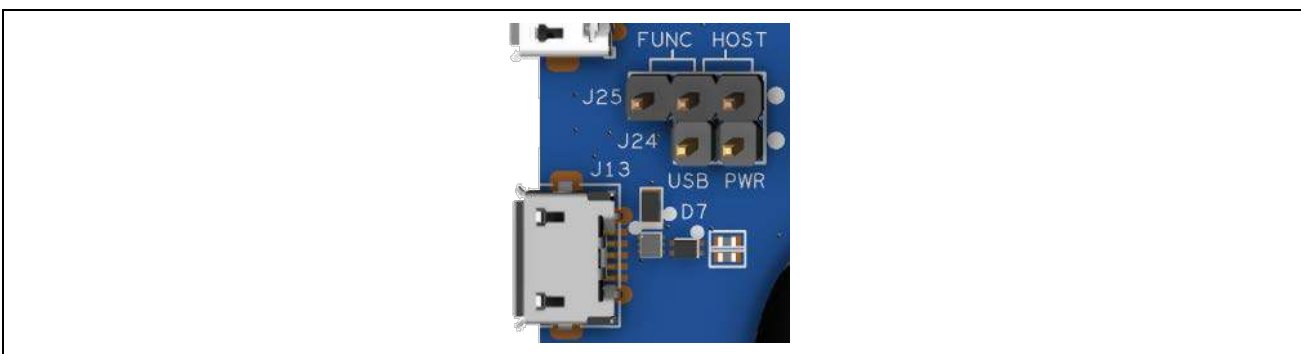
Figure 11.   USB Full Speed Connector

5.5   Miscellaneous

5.5.1   User and Power LEDs

Six LEDs are provided on the CK-RX65N board. In addition, the Ethernet connector has built-in link status and link speed LEDs.

Behavior of the LEDs on the CK-RX65N board is described in the following table.

Table 13. CK-RX65N Board LED Functions

Designator	Color	Function	MCU Control Port
LED1	White	Power on indicator	+3.3 V
LED2	RGB	User LED	R:P17, G:PA5, B:PA7
LED3	Green	User LED	P22
LED4	Blue	User LED	PA3
LED5	Green	Debug LED	E2OB debugger MCU
LED6	Red	User LED	P25

Figure 12.   User LEDs

Figure 13.   Power LED

5.5.2   User and Reset Switches

Two miniature, momentary, mechanical push-button type SMT switches are mounted on the CK-RX65N board.

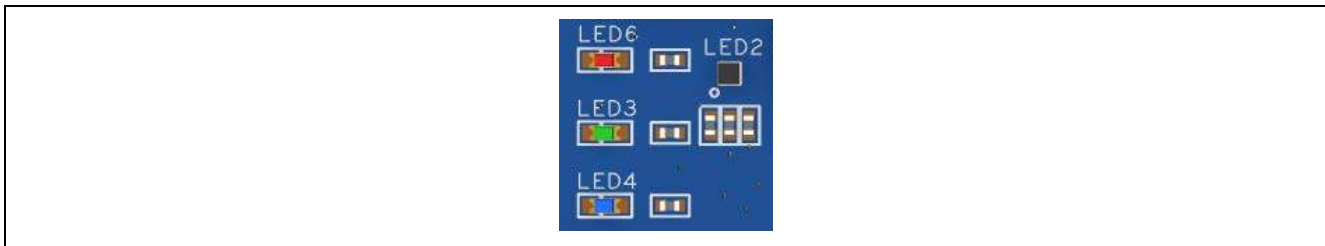Pressing the Reset switch (S1) generates a reset signal to restart the RX MCU.

Table 14. CK-RX65N Board Switches

Designator	Function	MCU Control Port	Button Color
S1	MCU Reset Switch	RESET#	Red
S2	User Switch	PD1 (IRQ01)	Blue
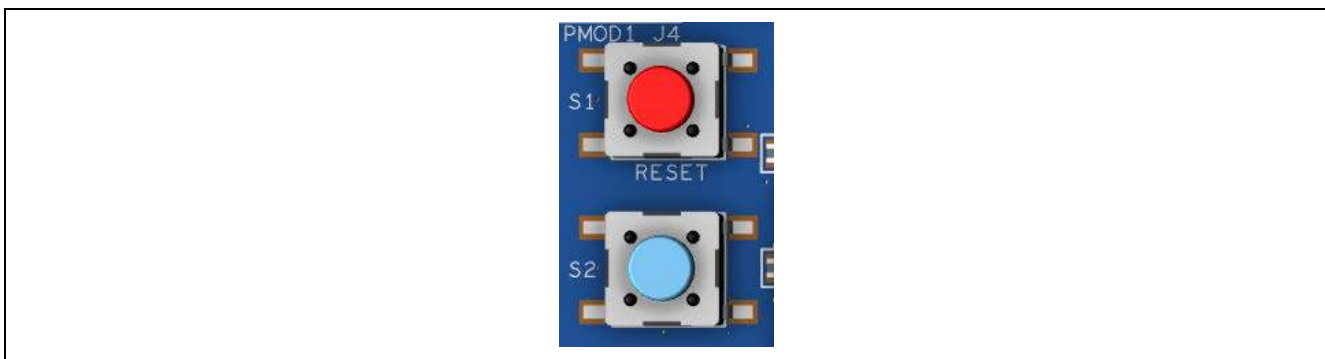
Figure 14.   Reset and User Switches

5.5.3   MCU Boot Options

When the MCU is released from reset, the levels on the MD, UB, and UPSEL pins determine the boot mode of the MCU.

Three two-pin jumpers (J11, J21 and J22) are provided to select the boot mode of the RX MCU. The tables below give the available options.

Table 15. Boot Mode Selection

Boot Mode	J11 (MD)	J21 (UB)
SCI Boot Mode	Closed	Closed
USB Boot Mode	Closed	Open
Normal Operation (Single Chip Mode)	Open	Closed

In USB boot mode, J22 (UPSEL) selects the bus mode.

Table 16. USB Bus Mode Selection

J22 (UPSEL) Setting	Setting
Open	USB Bus-Powered Mode Selected
Closed	USB Self-Powered Mode Selected

Please note that these jumpers should only be changed when the board is not powered.
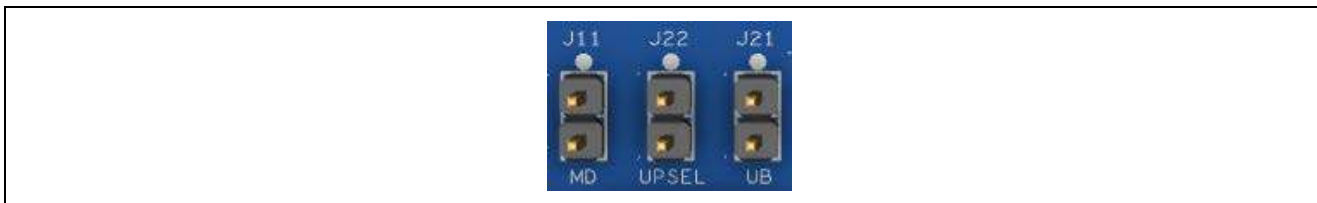
Figure 15.   Boot Option Jumpers

5.6   Ethernet

The Ethernet interface uses an RMII Ethernet Physical Layer Transceiver (PHY) (U11), connected to an RJ45 standard Ethernet connector (J18) with integrated magnetics and status indicators. The Ethernet clock is sourced from a precision 50 MHz crystal oscillator (OSC1) connected directly to the Ethernet PHY.

Table 17. Ethernet Port Assignments

Ethernet Signal Description	RX65N MCU Port
IRQ	PD2 (IRQ02)
MDC	P72
MDIO	P71
TXD1	P82
TXD0	P81
TXD_EN	PB4
RXD1	P74
RXD0	P75
CRS_DV	P83
RX_ER	P77
REF-50-CK	P76
RST#	P80

Table 18. Ethernet Components

Component	Manufacturer	Manufacturer Part Number
Ethernet PHY	Renesas	ICS1894-32
RJ-45 Connector	Pulse	J0011D21BNL
50 MHz Oscillator	ECS Inc International	ECS-1612MV-500

Figure 16.   Ethernet Connector

5.7   Onboard Sensors

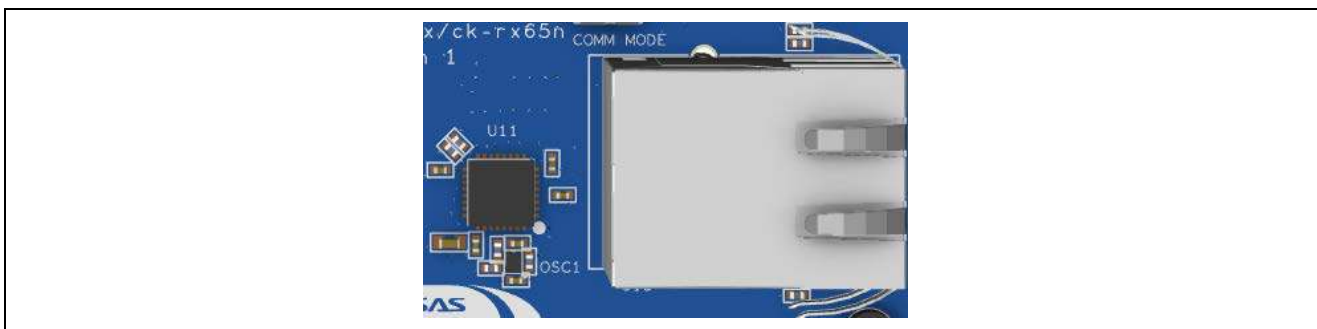The CK-RX65N is fitted with several onboard sensors, including a barometric pressure sensor, 9-axis MEMS motion tracking sensor, indoor air quality sensor, outdoor air quality sensor, biometric sensor, temperature and humidity sensor.
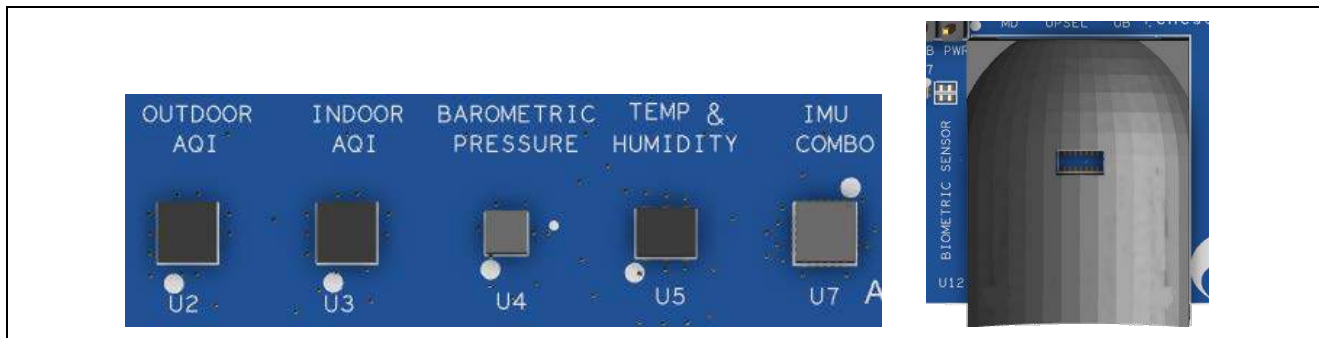

Figure 17.   On Board Sensors

5.7.1   HS3001 Temperature and Humidity Sensor

An integrated calibration and temperature compensation logic provides fully corrected relative humidity and temperature values via a standard I²C output. The measured data is internally corrected and compensated for accurate operation over a wide range of temperature and humidity levels.

Table 19. HS3001 Port Assignment

Pin Number	HS3001 Signal Description	RX65N MCU Port
1	SCL	P12 (SCL0)
2	SDA	P13 (SDA0)
3	VC	Connect a 0.1 µF decoupling capacitor from VC to ground
4	VDD	3.3 V
5	NC	NC
6	VSS	GND

5.7.2   OB1203 Biometric Sensor

The OB1203 is a fully integrated optical sensing module for Pulse Oximetry (PPG - photoplethysmography), multi-channel Color Sensing (CS), Ambient Light Sensing (LS) and Proximity Sensing (PS). It can determine human heart rate, blood oxygen saturation (SpO2), respiration rate and heart rate variability (a measure of stress). The OB1203 integrates all light sources, drivers, and the sensor elements, in a single optically optimized package.

Table 20. OB1203 Port Assignment

Pin Number	OB1203 Signal Description	RX65N MCU Port
1	NC	NC
2	SCL	P12 (SCL0)
3	SDA	P13 (SDA0)
4	LGND	GND
5	LED1	TP1
6	LED2	TP2
7	LVDD	3.3 V
8	LVDD	3.3 V
9	LVDD	3.3 V
10	LVDD	3.3 V
11	VDD	3.3 V
12	AGND	GND
13	INT	P67 (IRQ15)
14	NC	NC

5.7.3 ZMOD4510 Outdoor Air Quality Sensor

The ZMOD4510 gas sensor platform detects air quality in a variety of indoor and outdoor applications. The signal conditioner controls the sensor temperature and measures the MOx resistance, which is a function of the gas concentration. The device is ideal for monitoring and reporting Outdoor Air Quality (OAQ).

Table 21. ZOMD4510 Port Assignment

Pin Number	ZMOD4510 Signal Description	RX65N MCU Port
1	SCL	P12 (SCL0)
2	SDA	P13 (SDA0)
3	INT	P45 (IRQ13)
4	NC	NC
5	VDD	3.3 V
6	VSS	GND
7	VSS	GND
8	NC	NC
9	VSS	GND
10	VDDH	3.3 V
11	RES_N	P63
12	VDDIO	3.3 V

5.7.4 ZMOD4410 Indoor Air Quality Sensor

The ZMOD4410 Gas Sensor Module is designed for detecting total volatile organic compounds (TVOC) and monitoring indoor air quality (IAQ). The module's sense element consists of a heater element on a Si-based MEMS structure and a metal oxide (MOx) chemiresistor. The signal conditioner controls the sensor temperature and measures the MOx conductivity, which is a function of the gas concentration.

Table 22. ZMOD4410 Port Assignment

Pin Number	ZMOD4410 Signal Description	RX65N MCU Port
1	SCL	P12 (SCL0)
2	SDA	P13 (SDA0)
3	INT	P46 (IRQ14)
4	NC	NC
5	VDD	3.3 V
6	VSS	GND
7	VSS	GND
8	NC	NC
9	VSS	GND
10	VDDH	3.3 V
11	RES_N	P62
12	VDDIO	3.3 V

5.7.5 ICM-20948 9-AXIS MEMS MOTION TRACKING SENSOR

The ICM-20948 is a low power 9-axis motion tracking sensor with 3-axis gyroscope, 3-axis accelerometer, and 3-axis compass, as well as Digital Motion Processor; offloading computation from the RX65N MCU improving system performance.

Table 23. ICM-20948 Port Assignment

Pin number	ICM-20948 Signal Description	RX65N MCU Port
1	NC	NC
2	NC	NC
3	NC	NC
4	NC	NC
5	NC	NC
6	NC	NC
7	AUX_CL	NC
8	VDDIO	GND via 100 nF Capacitor
9	ADO/SD0	GND
10	REGOUT	GND via 100 nF Capacitor
11	FSYNC	GND
12	INT1	PE7 (IRQ7)
13	VDD	1.8 V
14	NC	NC
15	NC	NC
16	NC	NC
17	NC	NC
18	GND	GND
19	RESV_0	NC
20	RESV_1	GND
21	AUX_DA	NC
22	CS#	1.8 V
23	SCL	P12 (SCL0)
24	SDA	P13 (SDA0)

5.7.6 ICP-10101 Barometric Pressure Sensor

The ICP-10101 is based on MEMS capacitive technology which provides ultra-low noise at the lowest power, providing a high level of relative accuracy, sensor throughput, and temperature stability. The pressure sensor can measure pressure differences with an accuracy of ±1 Pa, enabling altitude measurement differentials as small as 8.5 cm.

Table 24. ICP-10101 Port Assignment

Pin Number	ICP-10101 Signal Description	RX65N MCU Port
1	RESV	1.8 V
2	SCL	P12 (SCL0)
3	RESV	GND
4	SDA	P13 (SDA0)
5	RESV	1.8 V
6	RESV	1.8 V
7	RESV	GND
8	GND	GND
9	GND	GND
10	VDD	1.8 V

5.7.7 SPU0410 MEMS Microphones

The SPU0410LR5H-QB is a miniature, low power, top port microphone with an analog output. It consists of a high-performance acoustic sensor, a low noise input buffer, and an output amplifier. For stereo, there are two microphones fitted to the board. The outputs from the microphones are further amplified by an ISL28214 dual operational amplifier, before being fed to the MCU.

Table 25. SPU0410 Port Assignment

Microphone	RX65N MCU Port
U18	P91 (AN115)
U19	P93 (AN117)

6. MCU Native Access Area

6.1 MCU and Pmod Current Measurement

Included in the Native Pin Access area are current measurement resistors and test points to measure the MCU USB controller current and the MCU core power current.

The CK-RX65N board has pin header test points for current measurement of the main 3.3 V MCU power and for Pmod power. To measure current remove 0 Ohm resistor and install pin header. Alternatively use a resistor of known value and measure the voltage drop across the resistor and use Ohm's Law to calculate the current. J2 can be used to measure the MCU power, J1 can be used to measure Pmod 1 power, and J7 can be used to measure Pmod 2 power.
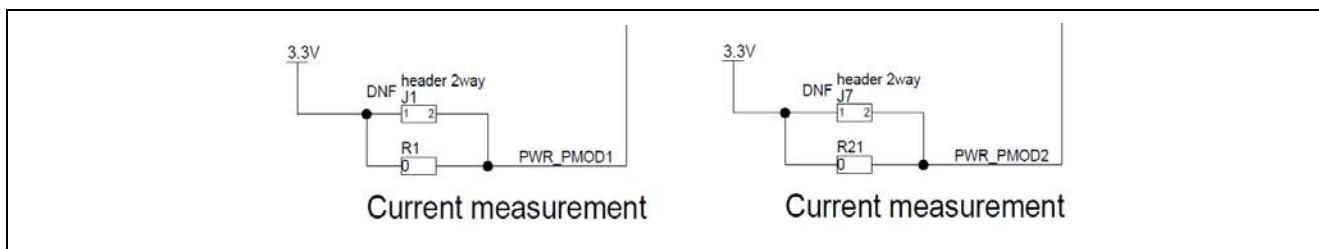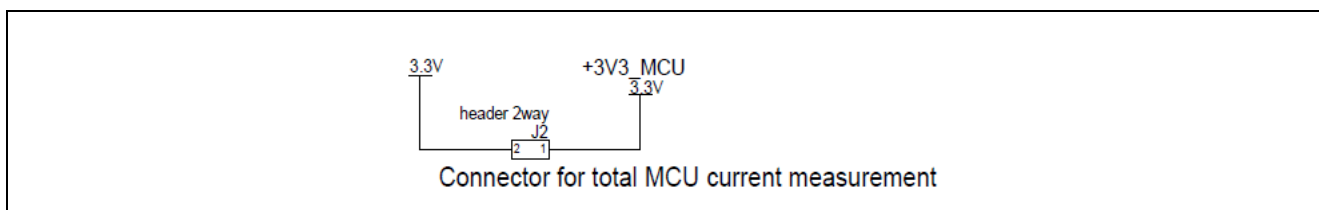

Figure 18. RX Pmod Current Measurement Circuit

Figure 19. RX +3.3 V Current Measurement Circuit

Figure 20. RX MCU Current Measurement

7. Recommended Parts

The below table lists recommended part numbers for optional components that can be fitted as required.

Table 26. Part Numbers

Designator(s)	Description	Manufacturer	Part Number
C18, C19	0402 15 pF Capacitor	YAGEO	CC0402JRNPO9BN150
C20, C21	0402 27 pF Capacitor	YAGEO	CC0402JRNPO9BN270
J1, J2, J7	1-Row 2-Way header	Wuerth Elektronik	613 002 111 21
X1	24 MHz Crystal	Diodes Incorporated	FL2400022
X2	32.768 kHz Crystal	ABRACON CORPORATION	ABS06-32.768KHZ-1-T

8.   Certifications

The CK-RX65N v1 kit meets the following certifications/standards. See page 3 of this user's manual for the disclaimer and precautions.

8.1   EMC/EMI Standards

- FCC Notice (Class A)

    This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

    NOTE- This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

    — Reorient or relocate the receiving antenna.
    — Increase the separation between the equipment and receiver.
    — Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
    — Consult the dealer or an experienced radio/television technician for help.

- Innovation, Science and Economic Development Canada ICES-003 Compliance:
  CAN ICES-3 (A)/NMB-3(A)

- CE Class A (EMC)

    This product is herewith confirmed to comply with the requirements set out in the Council Directives on the Approximation of the laws of the Member States relating to Electromagnetic Compatibility Directive 2014/30/EU.

    Warning – This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be requried to take adequate measures to correct this interference.

- UKCA Class A (EMC)

    This product is is in conformity with the following relevant UK Statutory Instrument(s) (and its amendments): 2016 No. 1091 Electromagnetic Compatibility Regulations 2016.

    Warning – This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be requried to take adequate measures to correct this interference.

- Taiwan: Chinese National Standard 13438, C6357 compliance, Class A limits
- Australia/New Zealand AS/NZS CISPR 32:2015, Class A

8.2   Material Selection, Waste, Recycling and Disposal Standards

- EU RoHS
- China SJ/T 113642014, 10-year environmental protection use period.

8.3   Safety Standards

- UL 94V-0

9.   Design and Manufacturing Information

The design and manufacturing information for the CK-RX65N v1 kit is available in the "CK-RX65Nv1 Design Package" available on renesas.com/rx/ck-rx65n.

- Design package file name: CK-RX65N-v1-designpackage.zip
- Design package contents

Table 27. CK-RX65N Board Design Package Contents

File Type	Content	File/Folder Name
File (PDF)	Schematics	CK-RX65N-v1-schematics
File (PDF)	Mechanical Drawing	CK-RX65N-v1-mechdwg
File (PDF)	3D Drawing	CK-RX65N-v1-3d
File (PDF)	BOM	CK-RX65N-v1-bom
Folder	Manufacturing Files	Manufacturing Files
Folder	Design Files	Design Files-Cadence Allegro

10. Website and Support

Visit the following URLs to learn about the kit and the RX family of microcontrollers, download tools and documentation, and get support.

CK-RX65N Resources	renesas.com/rx/ck-rx65n
RX Product Information	renesas.com/rx
RX Product Support Forum	renesas.com/rx/forum
Renesas Support	renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	May.17.22	—	Initial release
1.10	Apr.13.23	4, 5, 13	Corrected SWD debug references to FINE.

CK-RX65N v1 – User's Manual