User's Manual

32

RX Family

Cloud Option Board User's Manual

RENESAS 32-Bit MCU

RX Family

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Precautions

The following precautions should be observed when operating Cloud Option Board product:

The Target Board is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this product and any sensitive equipment. Its use outside the laboratory, classroom, and study area or in area not conform to the protection requirements of the Electromagnetic Compatibility Directive could lead to prosecution.

This product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If any harmful interference to radio or television reception occurs by turning the equipment off or on, you are encouraged 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
- Contact the dealer or an experienced radio/TV technician for help

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

This product is potentially susceptible to certain EMC phenomena. It is recommended to take following measures in order to migrate them;

- Do not use mobile phones within 10m of the product when in use.
- Take ESD precautions when handling the equipment.

The Cloud Option Board neither represents an ideal reference design for an end product nor fulfils the regulatory standards for an end product.

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the Target Board hardware functionality, and electrical characteristics, and not intend to be a guide to embedded programming or hardware design.

Particular attention should be paid to the precautionary notes when using the manual. These notes are attached at the end of each section and in the Usage Notes section, not within the body of the text.

The revision history only shows the summary of revised or added parts and does not include all revisions. Refer to the text in this manual for details.

The following documents apply to the Cloud Option Board. Make sure to use the latest versions for reference, available on the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
QuickStart Guide	Provides instruction on how to get started with the Renesas RX65N Cloud Kit.	Quick Start Guide Renesas RX65N Cloud Kit	R12QS0036EJ
User's Manual	Provides technical details of the Cloud Option Board Hardware.	Cloud Option Board User's Manual	R12UM0039EG
User's Manual	Provides the technical details of the Target Board for RX65N hardware	Target Board for RX65N User's Manual	R20UT4167EJ
User's Manual	Provides the technical details of the RX65N group of microcontrollers.	RX65N Group, RX651 Group User's Manual: Hardware	R01UH0590EJ
Schematics	Describes circuit schematics of the Cloud Option Board in full detail.	Cloud Option Board Schematics	R12UT0009EG
Schematics	Describes circuit schematics of the Target Board for RX65N in full detail.	Target Board for RX65N Schematics	R20UT4164EJ
Schematics	Describes circuit schematics of the Silex Pmod Module in full detail.	Silex Pmod Module Schematics	R12UT0008EG

2. List of Abbreviations and Acronyms

Abbreviation	Full Form
CPU	Central Processing Unit
DNF	Do Not Fit
Grove	Modular standardised connector system. See http://wiki.seeedstudio.com/Grove_System/
I2C	Inter-InterConnect Communications Interface
IRQ	Interrupt Request
LED	Light Emitting Diode
MCU	Micro-controller Unit
n/a (NA)	Not Applicable
n/c (NC)	Not Connected
PC	Personal Computer
Pmod™	Digilent Pmod™ Compatible connector. Pmod™ is registered to Digilent Inc. Digilent-Pmod_Interface_Specification
RAM	Random Access Memory
ROM	Read Only Memory
SPI	Serial Peripheral Interface
USB	Universal Serial Bus

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1. Overview

1.1 Purpose

The Cloud Option Board connects to an RX Target Board to enable internet services via WiFi. It also provides a variety of environmental sensors for data measurement and logging purposes. The design is also easily extendable with a variety of measurement and communications options available.

This manual describes the technical details of the hardware that is included in the Cloud Option Board. It also describes the connectivity of the Cloud Option Board to the RX Target Board and the Pmod™ WiFi module.

1.2 Features of Cloud Option Board

The Cloud Option Board extends an RX Target Board with the following additional features:

- Pmod™ Connection for WiFi module (or other Pmod™ peripherals).
- Additional storage via QSPI Serial Flash memory.
- Data acquisition from ambient light, Environmental (Pressure, humidity, temperature, gas) and Inertial Sensors.
- USB Serial Connection.
- USB Function connection.
- Grove™ connectors to allow off-board connectivity of Serial, I2C and analogue.
- Re-sited Reset and User Switches.
- Power Indicating LED and two User-controllable LEDs.

1.3 Board Specification Table

Table 1-1 shows the Cloud Option Board Specification

Item	Specification
Board Size	90.0mm x 53.34mm x 1.6mm
Power Supply	3.3V logic supply from connected target board (from its USB/debugger connection, 200mA max). 3.3V, 1A max supply for PMOD and Grove Connections from either USB connection, CN18, CN6 or optional header CN4[*1]. This supply is sequenced from the 3.3V logic supply to prevent supply back-feed issues and controllable from the Target Board.
Push Switches	1 x Reset (to replace inaccessible reset switch on Target Board). 1 x User switch.
LEDs	2 x User-controlled LEDs 1 x Power indication LED
USB Connector	1 x Micro B (Connecting to USB on target board). 1 x Mini B (for USB/Serial connection).
Pmod™ Connector	Dual row, right-angle type, 12-pin
MCU Headers	Header: 50-pin, 2.54mm pitch, dual row x 2.
Sensors	Light Sensor (ISL29035) Environmental Sensor (BME680) Inertial Sensor(BMI160) These sensors connect to the RX Target Board via I2C communications.
Memory	QSPI Flash 32Mb (MX25L3233FM2I-08G)
Grove Connectors	1 x UART 1 x I2C 1 x ADC

*1 Parts are not mounted (DNF).

Table 1-1: Board Specification Table

2. Board Connectivity

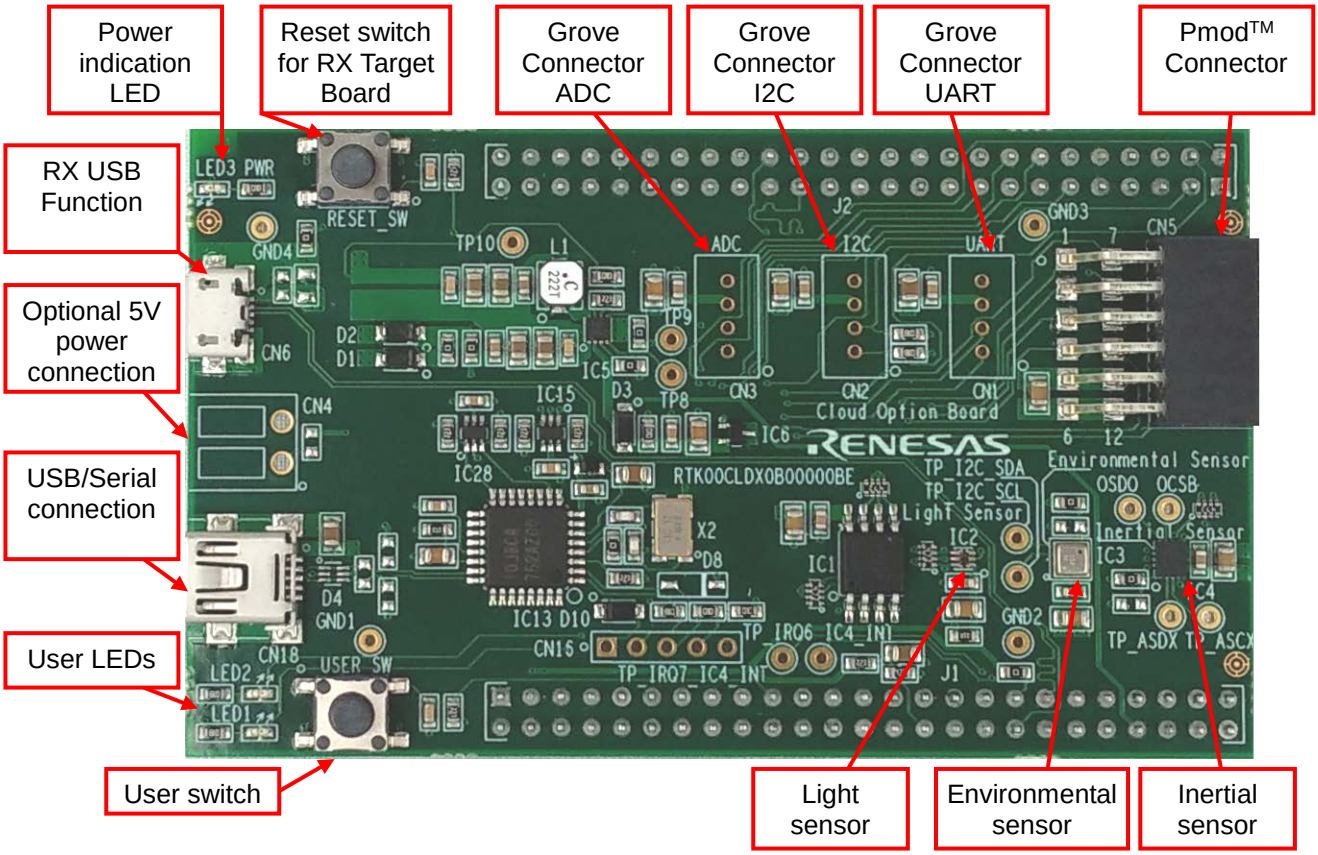

Figure 2-1 : Cloud Option Board Top View

Figure 2-2 : Cloud Option Board Bottom View

3. Component Locations

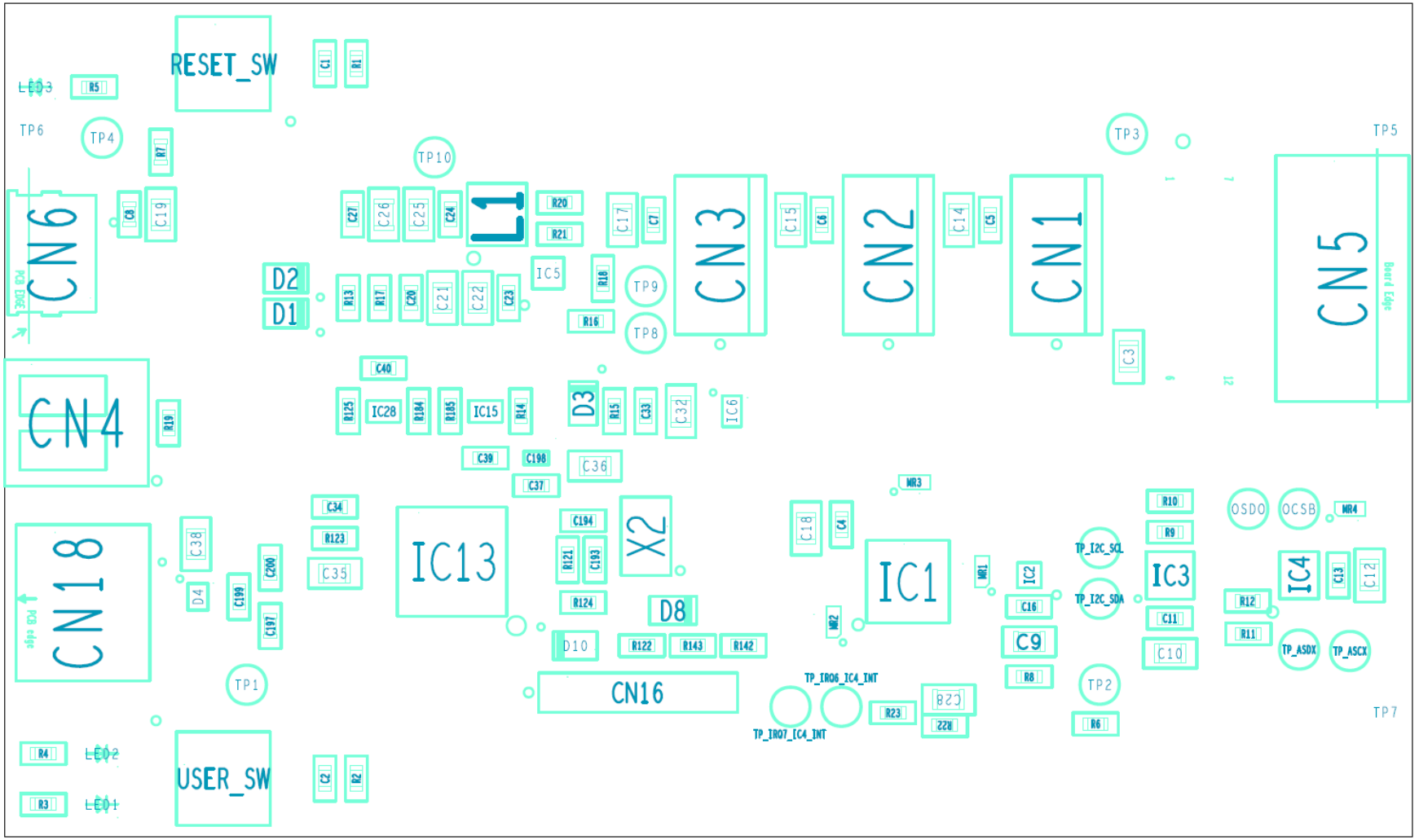

Figure 3-1 : Component Positions on Top Side of Board

4. Cloud Option Board Circuit Description

4.1 LEDs

Table 4-1 below documents the LEDs mounted on the Cloud Option Board.

LED Reference	Colour	Function / Useful information	Target Board Connection / Signal Name	Target Board MCU port/pin
LED1	Red	Firmware controlled (pin low to turn on LED)	J2 Pin 11 PB0_LED1	Port B0 / pin61
LED2	Red	Firmware controlled (pin low to turn on LED)	J2 Pin 9 PB1_LED2	Port B1 / pin59*1
LED3	Green	Power Indication	---	---

*1 Note that Port B1 is also connected to the user switch on the Target Board. When the Cloud Option Board is connected, this switch is obscured on the Target Board. It is however recommended to configure port B1 to drive LED2 in open-collector mode to avoid potential short circuits if the target board user switch is used by mistake.

Table 4-1 : Cloud Option Board LEDs

4.2 Switches

Table 4-2 below documents the switches mounted on the Cloud Option Board.

Switch Reference	Function / Useful information	Target Board Connection / Signal Name	Target Board MCU port/pin
RESET_SW	MCU Reset switch. 22k pullup to TARGET_3V3 supply.	J1 Pin 10 RESn_TGT	RES# / pin10
USER_SW	User Switch, mapping to IRQ1 on Target MCU. 22k pullup to TARGET_3V3 supply.	J1 Pin 19 P31_IRQ1_SW	Port 31 / pin19

Table 4-2 : Cloud Option Board Switches

4.3 USB/Serial Communications

The Cloud Option Board implements USB/Serial communications with a host PC. The Host PC connects to mini-B USB connector CN18. The USB/Serial conversion is handled by an on-board Renesas RL78/G1C MCU IC13 and passed to the 3.3V Target MCU via level-shifter ICs IC15 and IC28. Full Hardware RTS/CTS handshaking is provided for. **Table 4-3** below describes the connectivity of the USB/Serial to the RX Target Board.

Function	Signal Name	Target Board Connection	MCU	
			Port	Pin
Transmit	PA4_TXD5_USBSERIAL	J1 Pin25	PA4	66
RTS Handshaking	PC0_RTS5_USBSERIAL	J1 Pin28	PC0	52
Receive	PA3_RXD5_USBSERIAL	J1 Pin27	PA3	67
CTS handshaking	PA5_CTS5_USBSERIAL	J1 Pin 26	PA5	65

Table 4-3: USB/Serial Target Board Connections

4.4 Power Supply

4.4.1 Power Supply Scheme

The Cloud Option Board is primarily supplied with 3.3V from the RX Target board that is connected to it. This supply is referenced as TARGET_3V3 in the schematics and is taken from Connectors J1 pin 14 and J2 pin 10. TARGET_3V3 powers the reset and user switches, LEDs, on-board sensor devices and QSPI Flash.

Since the RX Target Board 3.3V supply is derived from the USB debugger connection, it is assumed that this will have a maximum of 200mA current capability. For other connections such as the Pmod™ and Grove connections, it is expected that overall current demand could exceed this, so a separate 3.3V supply, VCC3V3 has been created. This VCC3V3 supply powers the PMOD™ and the three Grove connectors.
VCC3V3 is powered by a switched-mode buck converter capable of supplying up to 1A, based around an Intersil ISL80019AIRZ IC, IC5. The 5V input to this converter is provided by default from a diode-or'd connection to the USB/Serial and application USB 5V supply connections. Optionally Header CN4 could be used to power the VCC3V3 supply.
Figure 4-1 below shows a block scheme of the power supply implementation. Table 4-4 below describes the VCC3V3 Configuration options available.

4.4.2 Power Supply Sequencing

To prevent back-feed issues where VCC3V3 is powered when the Target Board Supply TARGET_3V3 is not, an Intersil power monitoring IC ISL88002IE31Z-T (IC6) has been fitted to prevent the VCC3V3 being powered when TARGET_3V3 is out of tolerance. The monitoring threshold for TARGET_3V3 is 3.07V. When TARGET_3V3 exceeds this level, the open-collector output releases the enable pin EN of the ISL80019 converter IC (IC5). The EN pin of the ISL80019 then charges up at a rate dictated by R15, C32 and C33 and 94ms later reaches the 1.4V threshold of the EN line, enabling VCC3V3.
There is provision for the Target MCU to control VCC3V3 by means of J1 pin 44. This is connected via diode D3 to the enable line and can hold off VCC3V3 if pulled low.
The delay of 94ms before enabling VCC3V3 allows software applications to be able to initialise and prevent VCC3V3 started immediately after the application of power to the Target Board, by changing the GPIO line connected to J1 pin44 to pull low.

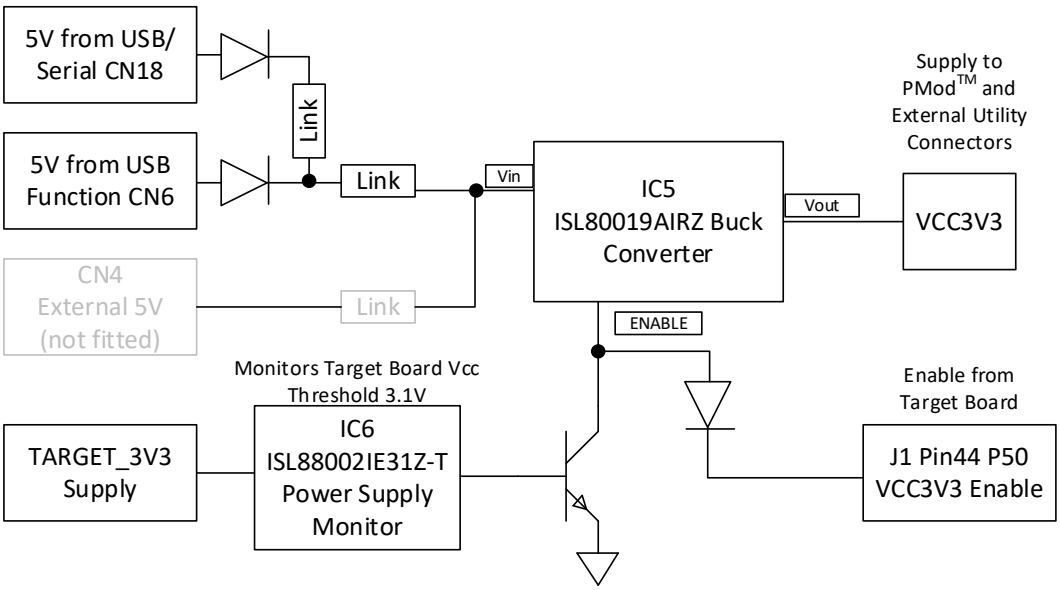

Figure 4-1 : Power Supply Scheme

VCC3V3 Source	Fit	Do Not Fit	"Don't Care"
CN18 or CN6 whichever is highest (default)	**D1, D2, R13, R17**	**R19**	**CN4 (Not Fitted)**
CN18 Only	D2, R17	R19, R13	CN4
CN6 only	D1, R13, R17	D2, R19	CN4
CN4 only	CN4, R19	R17	D1, D2, R13

Table 4-4 : VCC3V3 Supply Configurations (default highlighted in blue)

4.5 Pmod™ Connector

The Pmod™ connector CN5 allows the functionality of the Target board to be extended with various peripherals including WiFi or Bluetooth. CN5 is a dual-row 12 pin connection, with a different pin assignment compared to standard connectors. **Figure 4-2** shows the pin assignment of the Pmod™ connector and **Table 4-5** shows the signal assignment on the Cloud Option Board and its connection to the RX Target Board. The channel for RSP is assigned to 0, and the channel for interrupts is assigned to IRQ5 respectively. (Connector parts are not mounted)

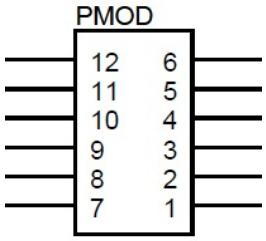

Figure 4-2: Pmod™ Connector Pin Assignment (Top View)

Pin	Circuit Net Name	Target Board Connection	Target Board MCU	
			Port	Pin
1	P23_PMOD_SCI0_CTS_SS	J1 Pin25	P23	25
2	P20_PMOD_SCI0_TX_MOSI	J1 Pin28	P20	28
3	P21_PMOD_SCI0_RX_MISO	J1 Pin27	P27	27
4	P22_PMOD_SCI0_CLK	J1 Pin 26	P22	26
5	GROUND		-	-
6	VCC3V3	-	-	-
7	P34_PMOD_IRQ4_GPIO	J1 Pin16	P15	31
8	PD0_PMOD_IRQ0_GPIO	J2 Pin36	PD0	86
9	P26_PMOD_SSDA1_PIN9	J1 Pin22	P26	22
10	P30_PMOD_SSCL1_PIN10	J1 Pin20	P30	20
11	GROUND		-	-
12	VCC3V3	-	-	-

Table 4-5: Pmod™ Connector Signal Assignment

4.6 On-Board Sensor Peripherals

The Cloud Option Board has 3 sensor peripherals fitted; an ambient light sensor, environmental sensor (temperature, pressure, humidity and gas) and an inertial sensor (accelerometer and gyroscope). These communicate with the RX Target Board as slave addresses on the RIIC peripheral channel 0.

4.6.1 Ambient Light Sensor

The light sensor is an Intersil ISL29035. The 7-bit address for the light sensor on the I2C communications line is 0x44. An open-collector interrupt line with a pullup to TARGET_3V3 connects to the IRQ5 on the Target Board MCU for alarm or monitoring applications. **Table 4-6** describes the connections of the Light Sensor peripheral. Please refer to the Renesas website for further details concerning the ISL29035IROZ device and its operation.

Function	Signal Name	Target Board Connection	MCU	
			Port	Pin
I2C Data	P13_I2C_SDA0	J1 Pin 33	P13	33
I2C Clock	P12_I2C_SCL0	J1 Pin 34	P12	34
Interrupt	PE5_IRQ5_IC2_INT#	J2 Pin 23	PE5	73

Table 4-6: Ambient Light Sensor Target Board Connections

4.6.2 Environmental Sensor

The environmental sensor fitted is a Bosch BME680. The 7-bit address for the light sensor on the I2C communications line is 0x76. **Table 4-7** describes the connections of the Light Sensor peripheral. Please refer to the Bosch website for further information concerning this peripheral.

Function	Signal Name	Target Board Connection	MCU	
			Port	Pin
I2C Data	P13_I2C_SDA0	J1 Pin 33	P13	33
I2C Clock	P12_I2C_SCL0	J1 Pin 34	P12	34

Table 4-7: Environmental Sensor Target Board Connections

4.6.3 Inertial Sensor

The Inertial sensor fitted is a Bosch BMI680. The 7-bit address for the light sensor on the I2C communications line is 0x68. 2 open-collector interrupt lines with pullups to TARGET_3V3 connect to the IRQ6 and IRQ7 on the Target Board MCU for alarm or monitoring applications. **Table 4-8** describes the connections of the Light Sensor peripheral. Please refer to the Bosch website for further information concerning this peripheral.

Function	Signal Name	Target Board Connection	MCU	
			Port	Pin
I2C Data	P13_I2C_SDA0	J1 Pin 33	P13	33
I2C Clock	P12_I2C_SCL0	J1 Pin 34	P12	34
Interrupt1	PE6_IRQ6_IC4_INT1	J2 Pin 22	PE6	72
Interrupt2	PE7_IRQ7_IC4_INT2	J2 Pin 21	PE7	71

Table 4-8: Inertial Sensor Target Board Connections

4.7 QSPI Flash

The Cloud Option Board provides 32Mbit QSPI Flash ROM for the Target Board. The device used is a Macronix MX25L3233F. Please see the Macronix website for details concerning the MX25L3233F device. **Table 4-9** describes the connections of the QSPI Flash to the RX Target Board.

Function	Signal Name	Target Board Connection	MCU	
			Port	Pin
Device Select	PD4_QSSL#	J2 Pin 32	PD4	82
SIO0	PD6_QIO00	J2 Pin 30	PD6	80
SIO1	PD7_QIO01	J2 Pin 29	PD7	79
SIO2	PD2_QIO02	J2 Pin 34	PD2	84
SIO3	PD3_QIO03	J2 Pin 33	PD3	85
Clock	PD5_QSPCLK	J2 Pin 31	PD5	81

Table 4-9: QSPI Device Connections to Target MCU

4.8 USB Function

The Cloud Option Board implements a USB Function connection for the RX Target Board. The connection is made on USB micro-B connector CN6. The USB VBUS signal for the target board MCU (to start device enumeration) is provided by the resistor network as shown in Figure 4-3. There is also an option to provide the VCC_USB directly to the MCU via option link R6, but this link is not fitted. Connection details for USB Function are detailed in **Table 4-10**.

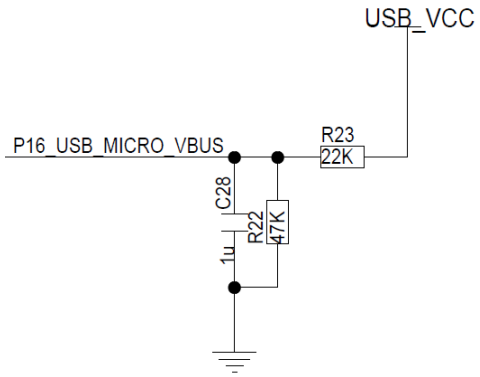

Figure 4-3 : USB_VBUS signal to Target Board MCU

Note that the USB connection USB_VCC is by default configured to provide the supply for VCC3V3, in conjunction with the USB/Serial connection CN18. Refer to section 4.4 for further details of the power supply scheme.

USB Connection	Signal Name	Target Board Connection	MCU	
			Port	Pin
USB VBUS	VCC_USB Via Link R6 (Not Fitted)	J1 Pin 35	PH3	35
	P16_USB_MICRO_VBUS	J2 Pin 32	P16	30
DM	PH2_USB_MICRO_DM	J2 Pin 30	PH2	36
DP	PH1_USB_MICRO_DP	J2 Pin 29	PH1	37
ID	-	-	-	-
GROUND				

Table 4-10: USB Function Connections to Target MCU

4.9 Grove Connectivity

The Cloud Option Board provides the option to connect to Grove compatible devices by providing interfaces for Grove Analogue, Grove UART and Grove I2C modules*1. All Grove connections take their power supply from the VCC3V3 supply not TARGET_3V3, in order to be able to supply higher current if required.

4.9.1 Grove Analogue

The primary analogue input connects to AN0 on the Target Board MCU. The secondary analogue input connects to AN1 on the Target Board MCU. Connection details are shown in **Table 4-11**.

Grove Pin	Function		Signal Name	Target Board Connection	MCU	
					Port	Pin
1	An	Primary Analogue Input	P40_GROVE_ADC0	J2 Pin 45	P40	95
2	An + 1	Secondary Analogue Input	P41_GROVE_ADC1	J2 Pin 43	P41	93
3	Vcc	3.3V Power for Grove module	VCC3V3	-	-	-
4	Gnd	Ground		-	-	-

Table 4-11: Grove Analogue Connections to Target MCU

4.9.2 Grove UART

The Grove UART connects to SCI channel 6 on the Target Board MCU. No handshaking lines are supported. Connection details are shown in **Table 4-12**.

Grove Pin	Function		Signal Name	Target Board Connection	MCU	
					Port	Pin
1	RX	Serial Receive	P33_GROVE_RXD6	J1 Pin 17	P33	17
2	TX	Serial Transmit	P32_GROVE_TXD6	J1 Pin 18	P32	18
3	Vcc	3.3V Power for Grove module	VCC3V3	-	-	-
4	Gnd	Ground		-	-	-

Table 4-12: Grove UART Connections to Target MCU

4.9.3 Grove I2C

The Grove I2C connects to the SCI channel 9 on the Target Board MCU. Connection details are shown in **Table 4-13**.

Grove Pin	Function		Signal Name	Target Board Connection	MCU	
					Port	Pin
1	SCL	I2C Clock	PB6_GROVE_SSCL9	J2 Pin 4	PB6	54
2	SDA	I2C Data	PB7_GROVE_SSDA9	J2 Pin 3	PB7	53
3	Vcc	3.3V Power for Grove module		-	-	-
4	Gnd	Ground		-	-	-

Table 4-13: Grove I2C Connections to Target MCU

*1 The Grove Connectors are not fitted as standard. For connector details and further information on the Grove system, refer to the seeed website: http://wiki.seeedstudio.com/Grove_System/

5. Additional Information

Technical Support
For details on the RX65N Group, RX651 Group microcontrollers, refer to the RX65N Group, RX651 Group Hardware Manual.

For details on the RX231 Group, RX230 Group microcontrollers, refer to the RX231 Group, RX230 Group Hardware Manual.

For details on the RX130 Group, refer to the RX130 Group Hardware Manual.

For details on the RX assembly language, refer to the RX Family Software Manual.

The latest information is available from the WEB site https://www.renesas.com/rx65n-cloud.

Technical Contact Details

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