User's Manual

RX140 Group

Fast Prototyping Board for RX140 Microcontroller Group
FPB-RX140 v1 User's Manual

Renesas RX Family
RX100 Series

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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.
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.

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Precautions

This Fast Prototyping 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 and any sensitive equipment. Its use outside the laboratory, classroom, study area, or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

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 fulfil the regulatory standards for an end product.

Proprietary Notice

Renesas RX Family

FPB-RX140 v1 User's Manual

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List of Abbreviations and Acronyms

Table 1. List of Abbreviations and Acronyms

Abbreviation	Full Form
BoM	Bill of Materials
CS	Chip Select
CTS	Clear to Send
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EU	European Union
FPB	Fast Prototyping Board
GPIO	General Purpose Input Output
I^2C (or IIC)	Inter-Integrated Circuit
IDE	Integrated Development Environment
I/F	Interface
INT	Interrupt
I/O	Input/Output
IRQ	Interrupt Request
LED	Light Emitting Diode
LFQFP	Lead Free Quad Flat Package
MCU	Micro Controller Unit
MISO	Master In Slave Out
MOSI	Master Out Slave In
NC	Not Connected
PWM	Pulse Width Modulation
RIIC	Renesas I^2C
RSPI	Renesas SPI
RTC	Real Time Clock
RTS	Request to Send
RXD	Receive Data
S12ADE	12-bit Analog to Digital Converter
SCI	Serial Communications Interface
SCK	Serial Clock
SCL	Serial Clock Line
SDA	Serial Data Line
SMD	Surface Mount Device
SPI	Serial Peripheral Interface
TXD	Transmit Data
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

1. Board Overview

The FPB-RX140 v1, a Fast Prototyping Board for the RX140 MCU, enables users to seamlessly evaluate the features of the RX140 MCU and develop embedded systems applications using the e² studio IDE. Users can use on-board features along with their choice of popular ecosystem add-on modules to bring their big ideas to life.

The key features of the FPB-RX140 v1 are categorized in two groups (consistent with the architecture of the board) as follows:

MCU Native Pin Access

- R5F51406BGFN *1 MCU (referred to as RX MCU)
  - Max 48 MHz, 32-bit RX CPU (RXv2)
  - 256 KB Code Flash, 8 KB Data Flash, 64 KB RAM
  - 80-pin, LFQFP package
- Native pin access through 2 x 40-pin male headers (not fitted)
- RX MCU current measurement point for precision current consumption measurement
- RX MCU on-chip oscillators as main clock
- Providing 32.768 kHz crystal oscillator as sub clock

System Control and Ecosystem Access

- Two 5 V input sources
  - USB
  - External power supply (using 2-pin header [not fitted])
- On-board debugger / programmer (E2 emulator On Board (referred as E2OB, FINE Interface))
- User LEDs and switches
  - Two User LEDs (green)
  - Power LED (green) indicating availability of regulated power
  - Debug LED (yellow) indicating the debug connection
  - One User switch
  - One Reset switch
- Two popular ecosystem expansions
  - Two Digilent Pmod™ (Type-2A [expanded SPI], Type-3A [expanded UART] and Type-6A [expanded I²C]) connectors
  - Arduino® (Uno R3) connector

*1: R5F51406BGFN has a built in encryption module.

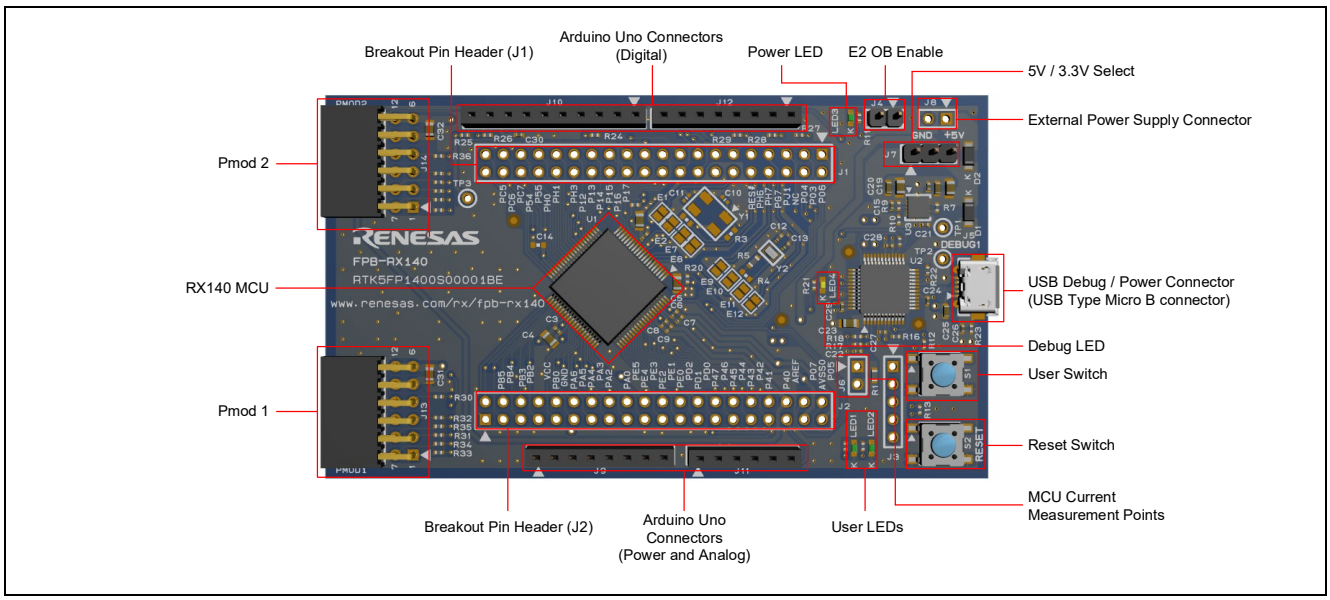

Figure 1. FPB-RX140 v1 Top Side

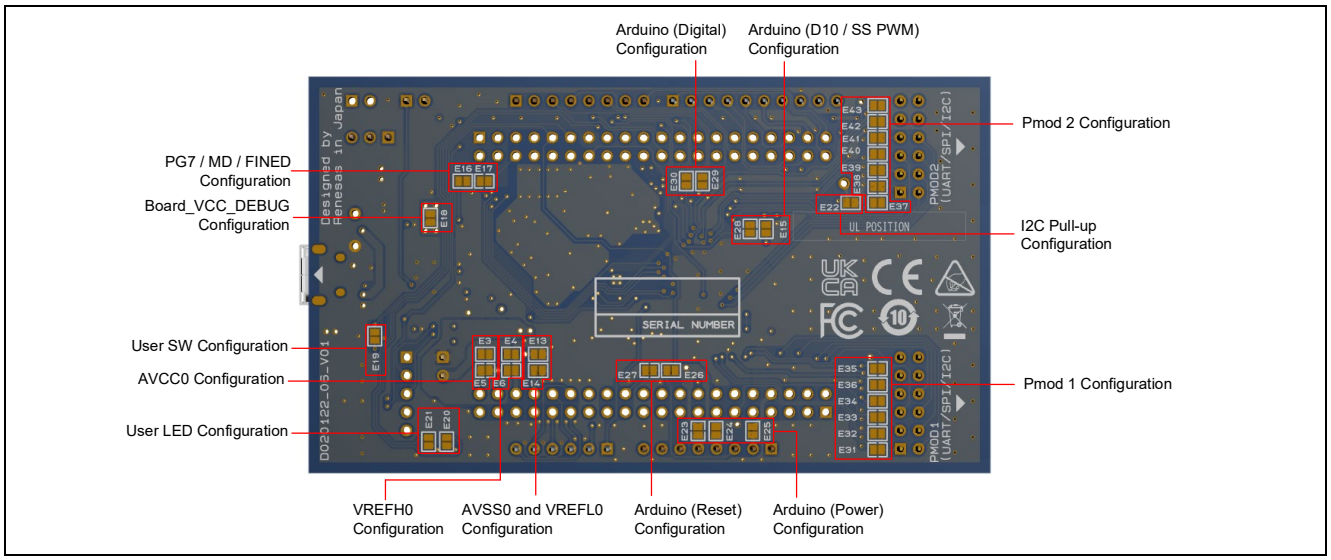

Figure 2. FPB-RX140 v1 Bottom Side

1.1 Assumptions and Advisory Notes

1. It is assumed that the user has a basic understanding of microcontrollers and embedded systems hardware.
2. An Integrated Development Environment (IDE) such as e^2 studio is required to develop embedded applications on FPB-RX140 v1.

2. Box Contents

The following components are included in the box:

1. FPB-RX140
2. Printed Quick Start Guide

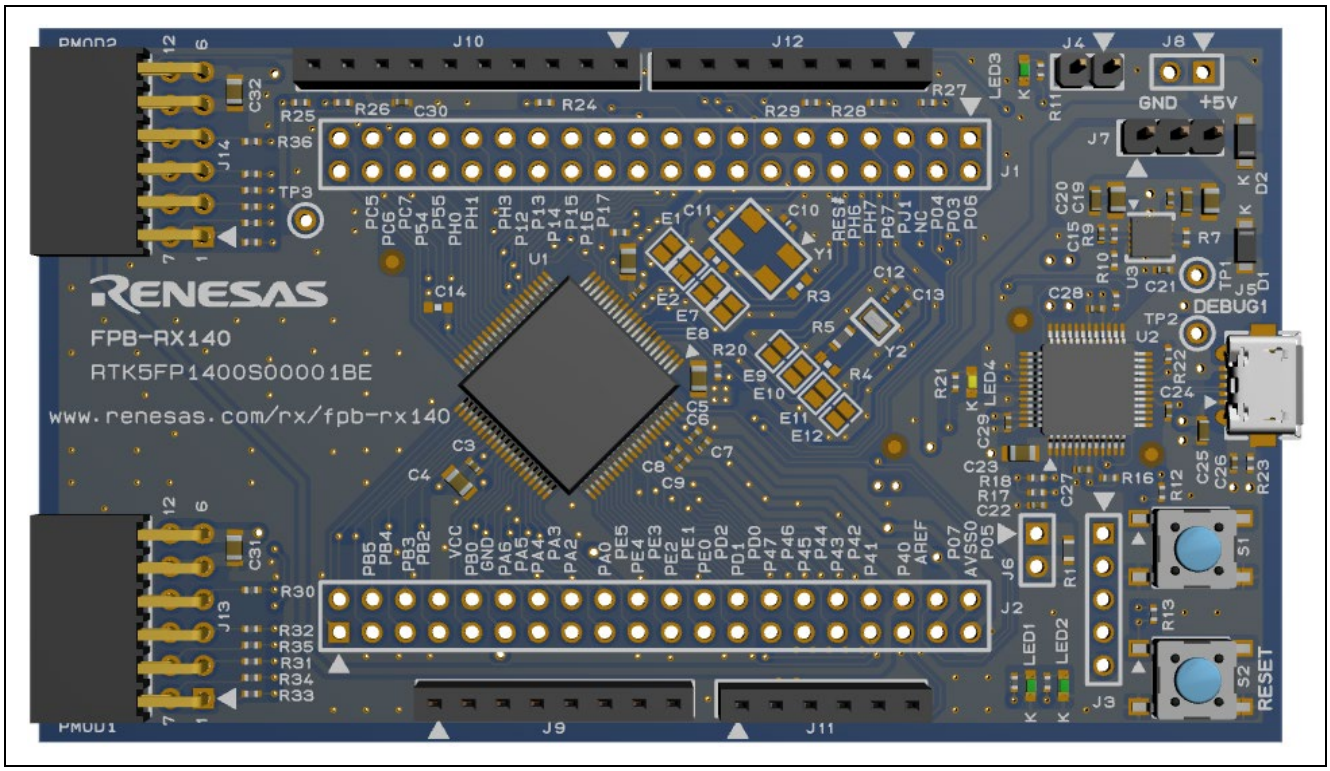

Figure 3. FPB-RX140 v1

3. Ordering Information

- FPB-RX140 v1 orderable part number: RTK5FP1400S00001BE

  Note: The underlined character in the orderable part number represents the kit version.

4. Hardware Architecture and Default Configuration

4.1 Board Architecture

The FPB-RX140 v1 is designed with an architecture similar to other boards in the FPB series. Alongside the RX MCU there is an on-board programmer / debugger, pin headers for access to all the pins on the RX MCU, a power supply regulator, some LEDs and switches, and several ecosystem I/O connectors (Pmod and Arduino).

Table 2. Board Architecture

Category	Features	Function present on all similar boards	Functionality is:
MCU Native Pin Access	RX MCU, breakout pin headers for all RX MCU I/O and power, 2-pin header for RX MCU current measurement (not fitted)	Yes	MCU dependent
System Control and Ecosystem Access	Power, debugger, user LEDs and switch, reset switch, ecosystem connectors, boot configuration	Yes	Same or similar across other FPB boards

4.2 Block Diagram

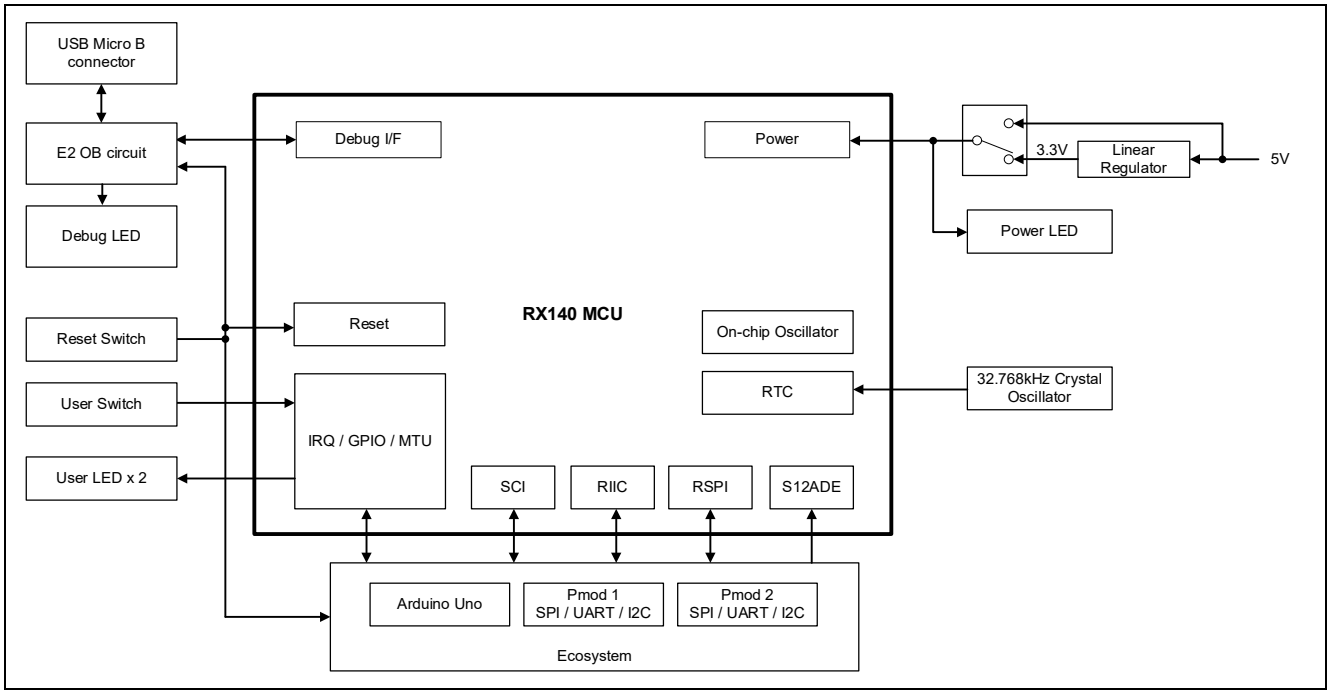

Figure 4. FPB-RX140 v1 Block Diagram

4.3 Component Placement Location and Dimension

Reference number for components on the FPB-RX140 v1 is shown below.

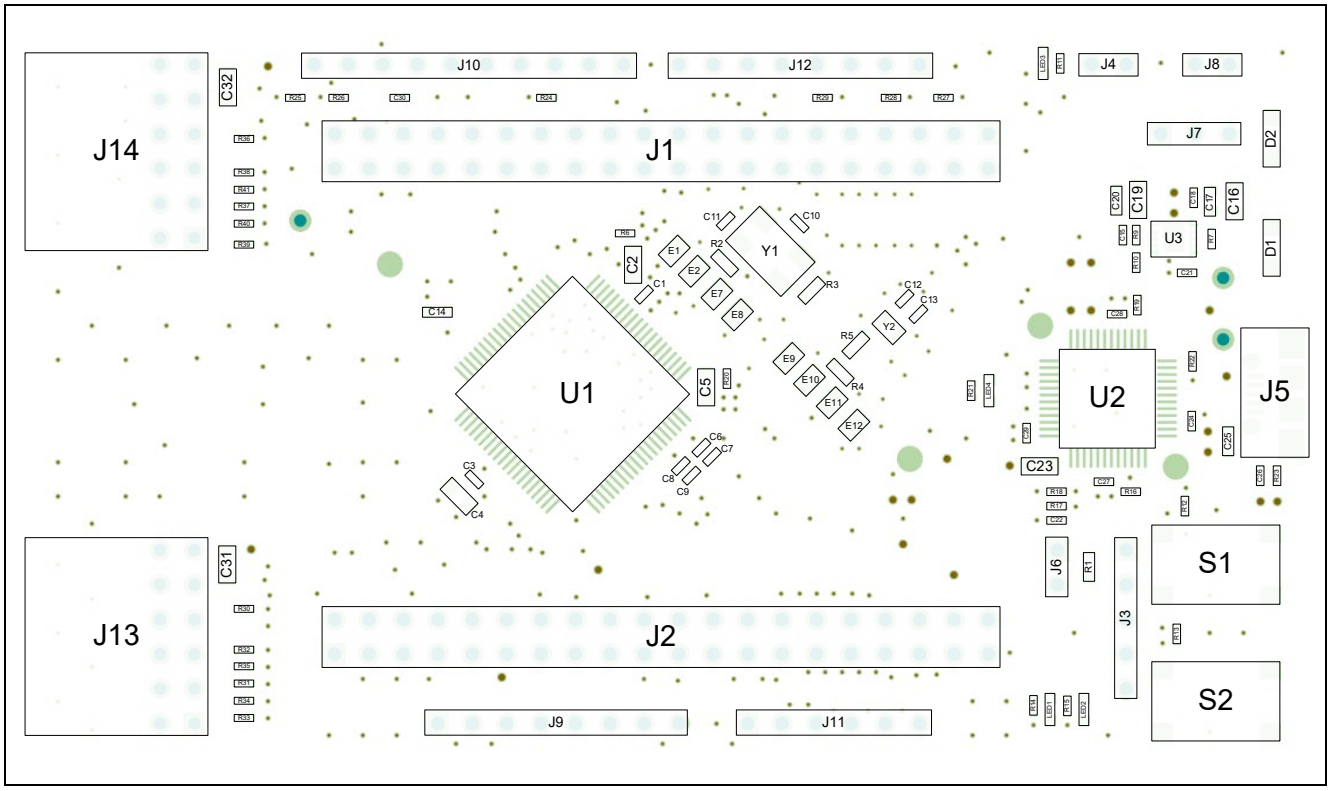

Figure 5. Reference number for components on the FPB-RX140 v1 (top side)

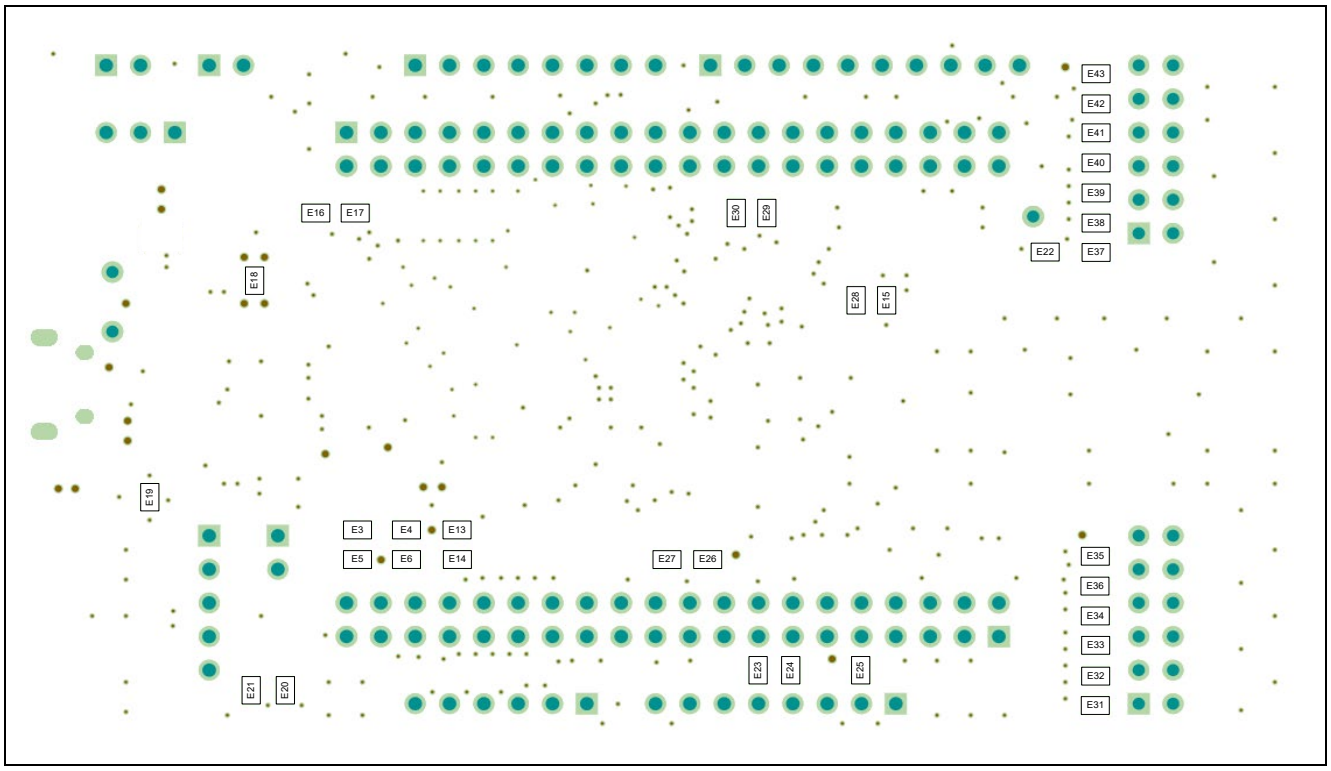

Figure 6. Reference number for components on the FPB-RX140 v1 (bottom side)

Dimension of the FPB-RX140 v1 is shown below.

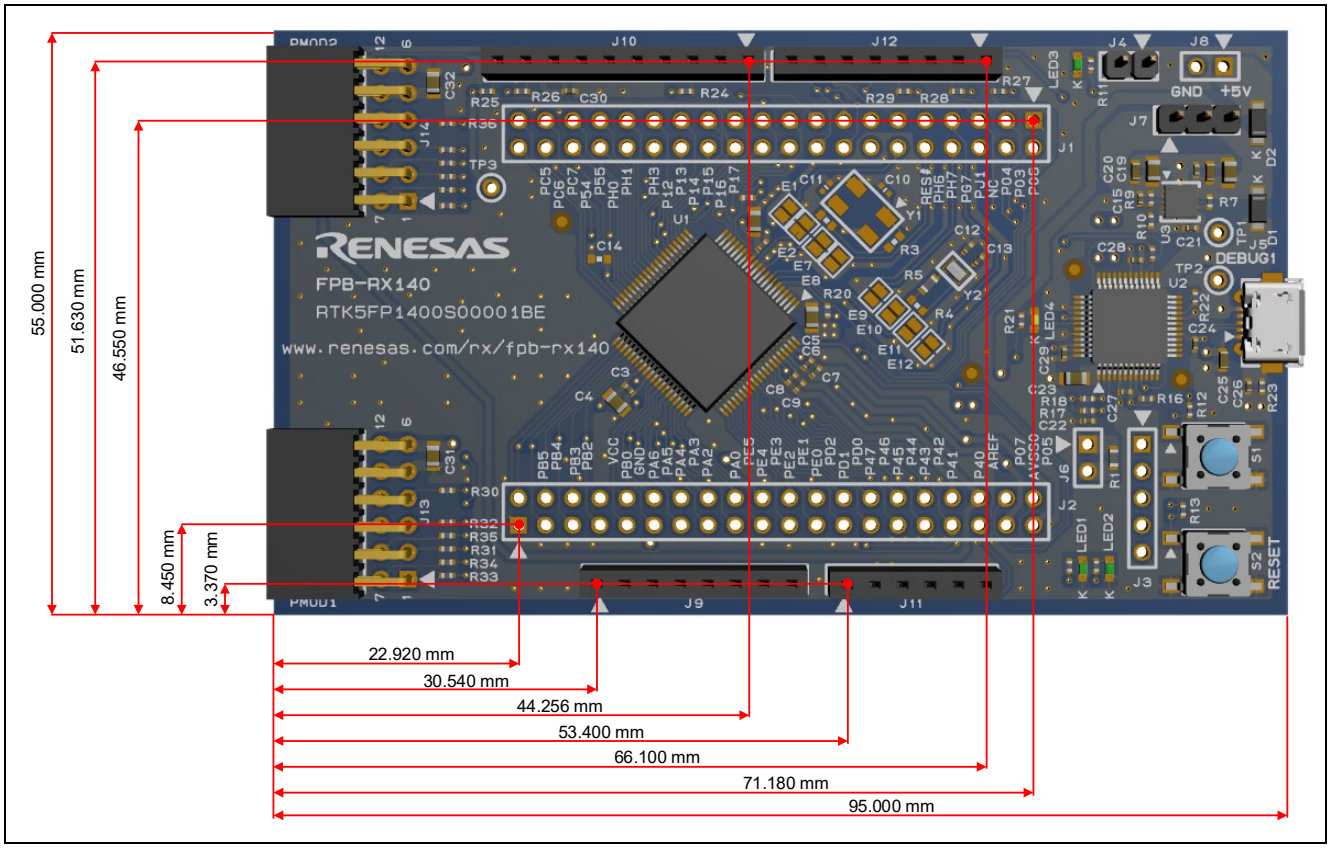

Figure 7. Dimension of the FPB-RX140 v1

4.4 Jumper Settings

Two types of jumpers are provided on the FPB-RX140 v1.

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.

4.4.1 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 by one of three methods:

- 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 0Ω SMD resistor may be placed across the two pads to short the pads together by soldering.

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).

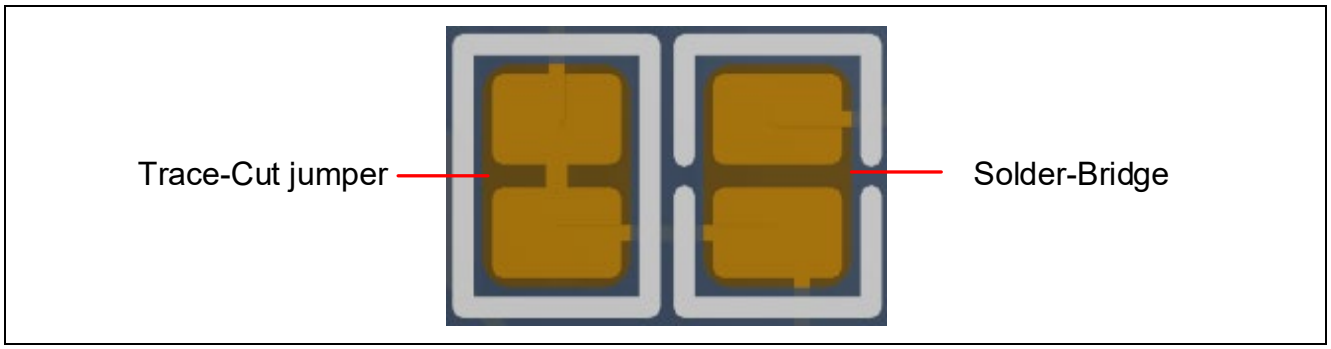

Figure 8. Copper Jumpers

4.4.2 Traditional Pin Header Jumpers

These jumpers are traditional small pitch jumpers that require an external shunt to open/close them. The traditional pin header jumpers on the FPB-RX140 v1 are 0.1” (2.54 mm) pitch headers and use compatible 2.54 mm shunt jumpers.

4.4.3 Default Jumper Configuration

The following table describes the default settings for each jumper on the FPB-RX140 v1. This includes copper jumpers (reference number Ex) and traditional pin header jumpers (reference number Jx). This also includes some 0Ω resistors (reference number Rx) because the resistors are used as jumper function.

Function for copper jumper Ex in the table describe function at Closed. The circuit group for each jumper is the reference number 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 kits.

Table 3. Default Jumper Settings

Location	Circuit Group	Default (Open / Closed) (Fitted / Not fitted)	Function
J4	E2OB	Closed	At open, E2 OB is enabled (Debug on-board mode)
			At closed, E2 OB is held in reset (Standalone operation mode)
			Refer to section 5.2
J7	Power Supply	Jumper on pins 1-2	Connect Board_VCC to 3.3 V
E1	MCU	Closed	At closed, connect P36 (EXTAL) to breakout pin header J1
E2	MCU	Open	At closed, connect P36 (EXTAL) to crystal oscillator Y1
E3	MCU	Closed	At closed, connect AVCC0 to Board_VCC
E4	MCU	Closed	At closed, connect PJ6 (VREFH0) to Board_VCC
E5	MCU	Open	At closed, connect AVCC0 to UC_VCC
E6	MCU	Open	At closed, connect PJ6 (VREFH0) to UC_VCC
E7	MCU	Open	At closed, connect P37 (XTAL) to crystal oscillator Y1
E8	MCU	Closed	At closed, connect P37 (XTAL) to breakout pin header J1
E9	MCU	Open	At closed, connect PH6 (XCOUT) to breakout pin header J1
E10	MCU	Closed	At closed, connect PH6 (XCOUT) to crystal oscillator Y2
E11	MCU	Closed	At closed, connect PH7 (XCIN) to crystal oscillator Y2
E12	MCU	Open	At closed, connect PH7 (XCIN) to breakout pin header J1
E13	MCU	Closed	At closed, connect AVSS0 to GND
E14	MCU	Closed	At closed, connect PJ7 (VREFL0) to GND
E15	MCU	Closed	At closed, connect PC4 (TSCAP / MTIOC0A / SSLA) to breakout pin J1 and Arduino Uno (D10 / SS / PWM)
E16	MCU	Closed	At closed, connect PG7 (MD / FINED) to E2 OB
E17	MCU	Open	At closed, connect PG7 (MD / FINED) to breakout pin J1
E18	Power Supply	Closed	At closed, connect Board_VCC to Board_VCC_DEBUG (Do not open this copper jumper)
E19	User LEDs & Switches	Closed	At closed, connect P30 (IRQ0) to User switch S1
E20	User LEDs & Switches	Closed	At closed, connect P20 (MTIOC1A) to LED1
E21	User LEDs & Switches	Closed	At closed, connect P32 (MTIOC0C) to LED2

Location	Circuit Group	Default (Open / Closed) (Fitted / Not fitted)	Function
E22	Arduino Uno	Closed	At closed, connect P16 (SCL0) and P17 (SDA0) to Board_VCC (pull-up)
E23	Arduino Uno	Open	At closed, connect 5.0 V to Arduino Uno (5V)
E24	Arduino Uno	Closed	At closed, connect 3.3 V to Arduino Uno (3.3V)
E25	Arduino Uno	Closed	At closed, connect Board_VCC to Arduino Uno (IOREF)
E26	Arduino Uno	Closed	At closed, connect RES# to Arduino Uno (RESET)
E27	Arduino Uno	Open	At closed, connect PD2 to Arduino Uno (RESET)
E28	Arduino Uno	Open	At closed, connect P34 (MTIOC0A) to Arduino Uno (D10 / SS / PWM)
E29	Arduino Uno	Closed	At closed, connect P20 (MTIOC1A) to Arduino Uno (D5 / PWM)
E30	Arduino Uno	Closed	At closed, connect P30 (IRQ0) to Arduino Uno (D2 / INT)
E31	Pmod 1	Open	At closed, connect PA6 (CTS5#) to Pmod 1 (CTS / CS / INT)
E32	Pmod 1	Closed	At closed, connect PE5 (IRQ5) to Pmod 1 (CTS / CS / INT)
E33	Pmod 1	Open	At closed, connect PA0 to Pmod 1 (TXD / MOSI)
E34	Pmod 1	Closed	At closed, connect PA4 (TXD5 / SMOSI5 / SSDA5) to Pmod 1 (TXD / MOSI)
E35	Pmod 1	Open	At closed, connect PA4 (TXD5 / SMOSI5 / SSDA5) to Pmod 1 (RTS / SCK / SDA)
E36	Pmod 1	Closed	At closed, connect PA1 (SCK5) to Pmod 1 (RTS / SCK / SDA)
E37	Pmod 2	Closed	At closed, connect P14 (CTS1#) to Pmod 2 (CTS / CS / INT)
E38	Pmod 2	Open	At closed, connect P12 (IRQ2) to Pmod 2 (CTS / CS / INT)
E39	Pmod 2	Open	At closed, connect PA2 to Pmod 2 (TXD / MOSI)
E40	Pmod 2	Closed	At closed, connect P26 (TXD1 / SMOSI1 / SSDA1) to Pmod 2 (TXD / MOSI)
E41	Pmod 2	Open	At closed, connect P26 (TXD1 / SMOSI1 / SSDA1) to Pmod 2 (RTS / SCK / SDA)
E42	Pmod 2	Open	At closed, connect P27 (SCK1) to Pmod 2 (RTS / SCK / SDA)
E43	Pmod 2	Closed	At closed, connect P31 (RTS1#) to Pmod 2 (RTS / SCK / SDA)
R1	MCU CURRENT MEASUREMENT	Fitted (Refer to section 6.2 in detail)	At fitted, connect Board_VCC to UC_VCC
			At not fitted, the RX MCU current can be measured over this jumper

5. System Control and Ecosystem Access

The FPB-RX140 v1 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 FPB-RX140 v1 is designed for 5 V operation. An on-board Linear Regulator is used to convert the 5 V supply to a 3.3 V supply. The 3.3 V supply is used to power the RX MCU and other peripheral features by default.

The 3.3 V supply is used to power the RX MCU and other peripheral features by shorting pin 1 and 2 of the pin header jumper J7. The 5 V supply is used to power the RX MCU and other peripheral features by shorting pin 2 and 3 of the pin header jumper J7.

RX MCU specifies power-on VCC rising gradient. When suppling the 5 V to the RX MCU, the power-on VCC rising gradient depends on capability of the power supply that supplies 5 V to the FPB-RX140 v1 because input 5 V to the FPB-RX140 v1 is supplied to the RX MCU through the reverse protection diode.

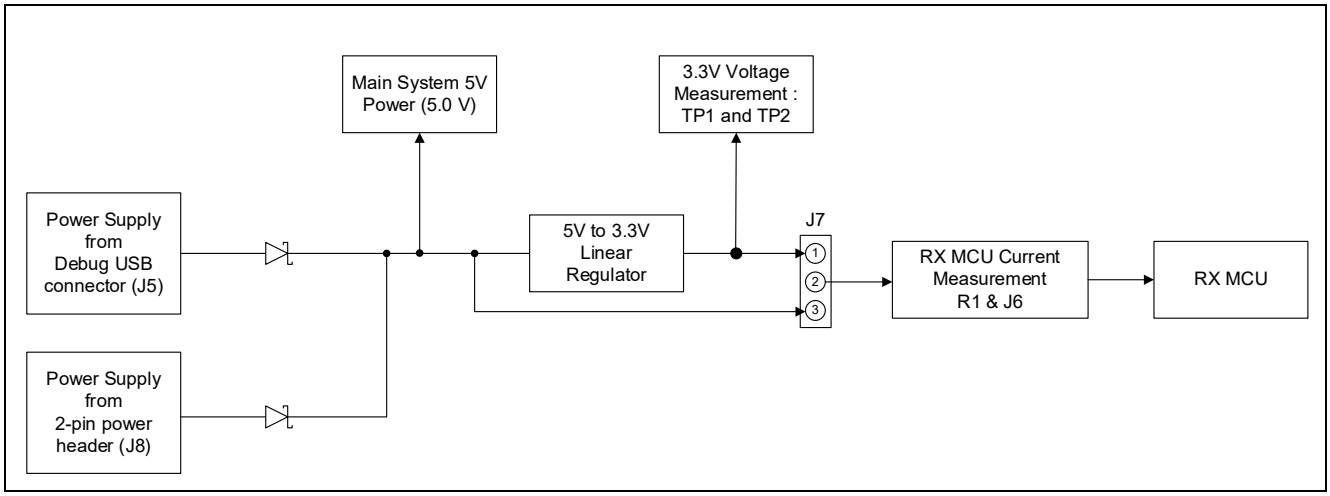

Figure 9. Power Supply

5.1.1 USB

5 V may be supplied from a host PC to the USB connector (J5) labelled DEBUG1 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.

5.1.2 Header Connector J8

5 V may be supplied from an external power supply to connector J8. J8 is a standard 2-pin header on a 0.1” (2.54 mm) pitch. Pin 1 is 5 V, and pin 2 is GND. Power from this source is connected to the main system 5 V power. Reverse current protection is provided between J8 and the main system 5 V power.

5.1.3 Power Supply Considerations

Voltage of Main System 5 V Power will be lower than the power supply voltage because of the forward voltage (max 0.55V@1A) of the reverse current protection diode. Main System 5 V Power supplies to external devices connected to Arduino, Pmod 1 and Pmod 2.

The maximum current that could be supplied to the FPB-RX140 v1 is 1 A including current consumption of external boards which are connected to the ecosystem connectors and the breakout pin headers.

5.1.4 Power-up Behavior

When powered, the Power LED (LED3) colored green turns on and blinky example project which is pre-programmed starts and User LED1 and LED2 start blinking.

5.2 Debug and Programming

The FPB-RX140 v1 can be debugged and programmed using the E2 OB.

The FPB-RX140 v1 supports Debug on-board mode in which can debug and program by E2 OB circuit and Standalone operation mode in which RX MCU operates as standalone by disabling E2 OB circuit. The mode can be configured by pin header jumper J4.

Table 4. Operating mode

J4	Operating mode
Open	Debug on-board mode
Jumper on pins 1-2	Standalone operation

Figure 10. Pin header jumper J4

5.2.1 E2 OB

USB DEBUG1 (Type Micro B) connector (J5) connects the E2 OB to a host PC, allowing re-programming and debugging of the RX MCU firmware.

The E2 OB connects to the RX MCU using the FINE interface. Please note that connecting the same host PC to multiple FPB-RX140 v1 is not possible.

Table 5. USB Debug Connector

USB Debug Connector		FPB-RX140 v1
Pin	Description	Signal
J5-1	+5VDC	+5V_USB_DBG
J5-2	Data-	USBDBG_DM
J5-3	Data+	USBDBG_DP
J5-4	USB ID, jack internal switch, cable inserted	NC
J5-5	Ground	GND

A yellow indicator, LED4, shows the status of the debug interface. When the FPB-RX140 v1 is powered, and LED4 is blinking, it indicates that the E2 OB is not connected to a host PC. When LED4 is on solid, it indicates that it is connected to a host PC.

5.2.2 Settings in e² studio and Renesas Flash Programmer

FPB-RX140 v1 needs to be configured in Debug on-board shown in Table 4 when the MCU is debugged or re-programmed with e² studio. Figure 11 shows the settings for e² studio when creating a new project for the FPB-RX140 v1.

[Debug hardware]: Select [E2 Lite (RX)]

[Target Device]: Select [R5F51406]

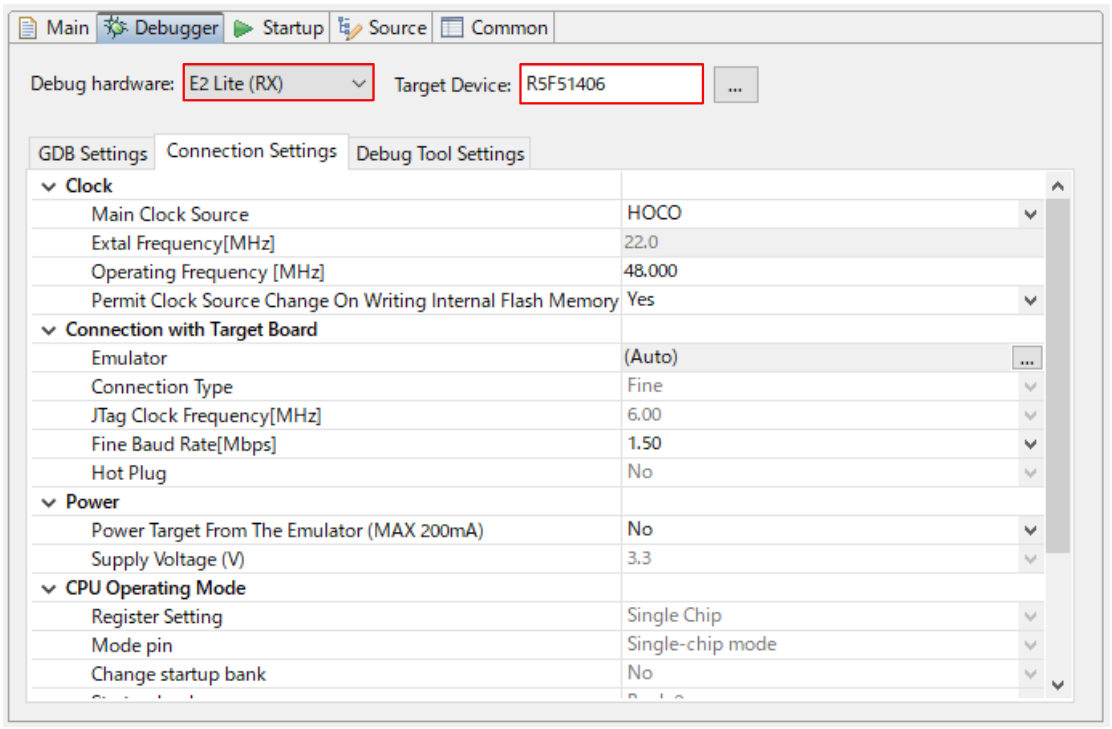

Figure 11. e² Studio Setting

FPB-RX140 v1 needs to be configured in Debug on-board shown in Table 4 when the MCU is re-programmed with Renesas Flash Programmer. Figure 12 shows the settings for Renesas Flash Programmer when creating a new project for the FPB-RX140 v1.

Connect an USB cable between the FPB-RX140 v1 and a host PC and create a new project.

[Microcontroller]: Select [RX100]

[Project Name]: Define project name

[Project Name]: Select project folder location

[Tool]: Select [E2 emulator Lite]

[Tool Details]: Select [FINE]

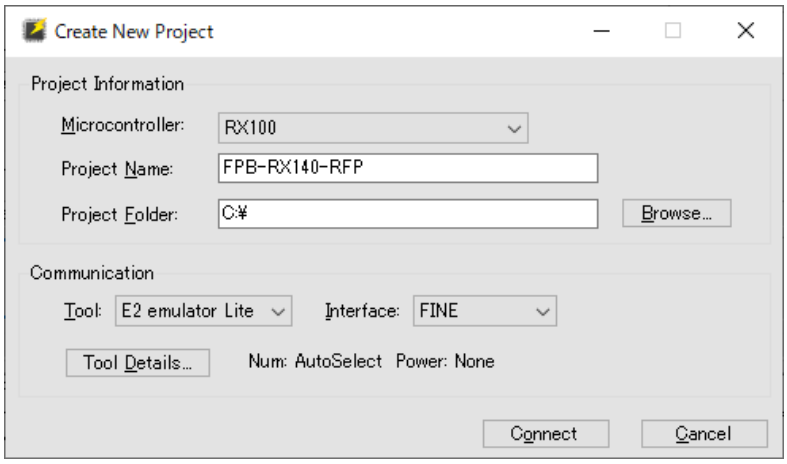

Figure 12. Renesas Flash Programmer Settings

5.3 Ecosystem

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

1. Two Digilent Pmod™ (UART / SPI / I²C) connectors
2. Arduino® (Uno R3) connectors

Note: We do not guarantee connection to all types of third party add-on modules. Confirm the specifications of this product and any third party add-on modules you intend to use.

5.3.1 Digilent Pmod™ Connectors

5.3.1.1 Pmod 1

A 12-pin Pmod Type-2A (expanded SPI), Type-3A (expanded UART) and Type-6A (expanded I^2C) connector is provided at connector J13 labelled PMOD1. At Type-2A, the RX MCU acts as the SPI master, and the connected module acts as an SPI slave device. At Type-6A, the RX MCU acts as a two-wire serial master, and a connected module acts as a two-wire serial slave.

Table 6. Pmod 1 Connector

Pmod 1 Connector				FPB-RX140 v1	Pmod 1 Configuration	
Pin	**Default Type-2A**	**Default Type-3A**	**Option Type-6A**	**Signal**	**Closed**	**Open**
J13-1	CS			PE5 (IRQ5) or PA6 (CTS5#)	*1	
		CTS / GPIO		PA6 (CTS5#) *2	E31	E32
			INT	PE5 (IRQ5)	E32	E31
J13-2	MOSI	TXD		PA4 (TXD5 / SMOSI5 / SSDA5)	E34	E33, E35
			RESET	PA0	E33, E35	E34, E36
J13-3	MISO	RXD	SCL	PA3 (RXD5 / SMISO5 / SSCL5)		
J13-4	SCK	RTS / GPIO		PA1 (SCK5)	E36	E35
			SDA	PA4 (TXD5 / SMOSI5 / SSDA5) *2	E35	E34, E36
J13-5	GND			GND		
J13-6	VCC			Board_VCC		
J13-7	GPIO / INT (slave to master)			PB1 (IRQ4)		
J13-8	GPIO / RESET (master to slave)			PB3		
J13-9	GPIO / CS2			PB5		
J13-10	GPIO / CS3			PB6 / PC0		
J13-11	GND			GND		
J13-12	VCC			Board_VCC		

*1: Connect PE5 (IRQ5) or PA6 (CTS5#) when using Type-2A (CS). Solder copper jumper E32 and cut copper jumper E31 when connecting PE5 (IRQ5). Cut copper jumper E32 and solder copper jumper E31 when connecting PA6 (CTS5#).

*2: Open at shipping.

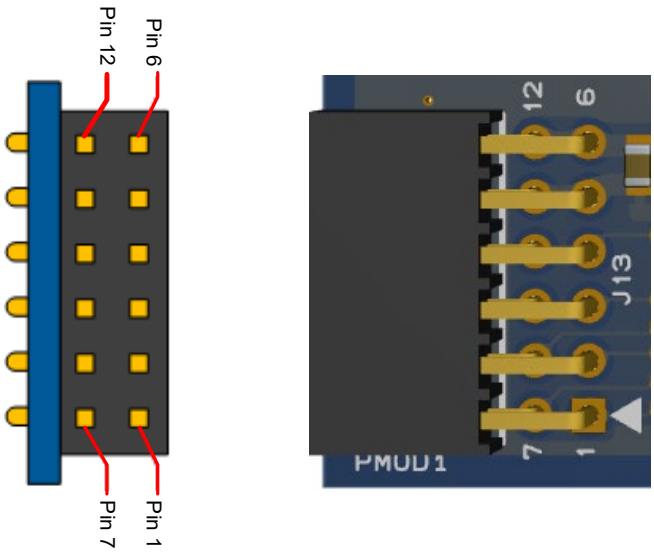

Figure 13. Pmod 1 Connector

Pmod Type-6A Operation

The option for Type-6A (I^2C) can be configured at Pmod 1 and supports 3.3 V / 5 V devices. To configure the FPB-RX140 v1 to use the I^2C devices with 3.3 V / 5 V operation, configure the copper jumpers using Table 6. Following figure shows the copper jumpers to use the I^2C devices.

Note: VCC power that supplies to J13-Pin6 and Pin12 is Board_VCC same as RX MCU power. Board_VCC voltage is selectable either 3.3 V or 5 V by configuring pin header J7.

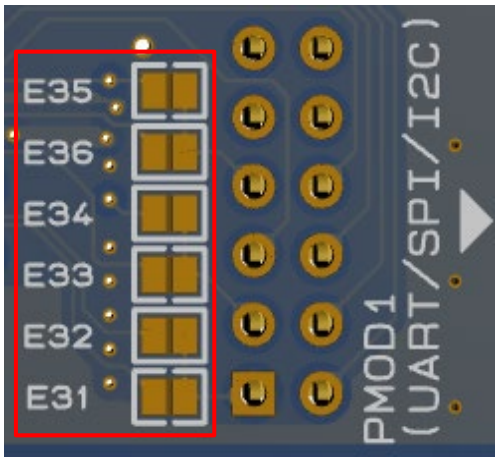

Figure 14. Pmod 1 Copper Jumpers (bottom side)

5.3.1.2 Pmod 2

A 12-pin Pmod Type-2A (expanded SPI), Type-3A (expanded UART) and Type-6A (expanded I^2C) connector is provided at connector J14 labelled PMOD2. At Type-2A, the RX MCU acts as the SPI master, and the connected module acts as an SPI slave device. At Type-6A, the RX MCU acts as a two-wire serial master, and a connected module acts as a two-wire serial slave.

Table 7. Pmod 2 Connector

Pmod 2 Connector				FPB-RX140 v1	Pmod 2 Configuration	
Pin	**Option Type-2A**	**Default Type-3A**	**Option Type-6A**	**Signal**	**Closed**	**Open**
J14-1	CS	CTS / GPIO		P14 (CTS1#)	E37	E38
			INT	P12 (IRQ2) *1	E38	E37
J14-2	MOSI	TXD		P26 (TXD1 / SMOSI1 / SSDA1)	E40	E39, E41
			RESET	PA2	E39, E41	E40, E42, E43
J14-3	MISO	RXD	SCL	P15 (RXD1 / SMISO1 / SSCL1)		
J14-4	SCK			P27 (SCK1) *1	E42	E41, E43
		RTS / GPIO		P31 (RTS1#)	E43	E41, E42
			SDA	P26 (TXD1 / SMOSI1 / SSDA1) *1	E41	E40, E42, E43
J14-5	GND			GND		
J14-6	VCC			Board_VCC		
J14-7	GPIO / INT (slave to master)			P13 (IRQ3)		
J14-8	GPIO / RESET (master to slave)			PB2		
J14-9	GPIO			PB0		
J14-10	GPIO			PA5		
J14-11	GND			GND		
J14-12	VCC			Board_VCC		

*1: Open at shipping.

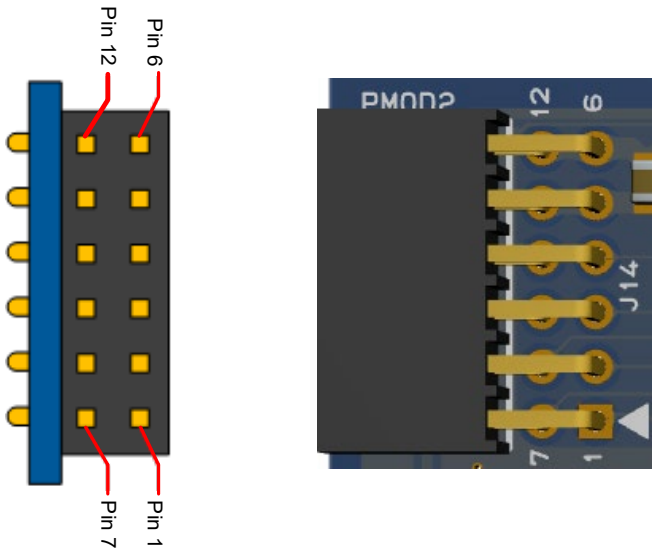

Figure 15. Pmod 2 Connector

Pmod Type-6A Operation

The option for Type-6A (I^2C) can be configured at Pmod 2 and supports 3.3 V / 5 V devices. To configure the FPB-RX140 v1 to use the I^2C devices with 3.3 V / 5 V operation, configure the copper jumpers using Table 7. Following figure shows the copper jumpers to use the I^2C devices.

Note: VCC power that supplies to J14-Pin6 and Pin12 is Board_VCC same as RX MCU power. Board_VCC voltage is selectable either 3.3 V or 5 V by configuring pin header J7.

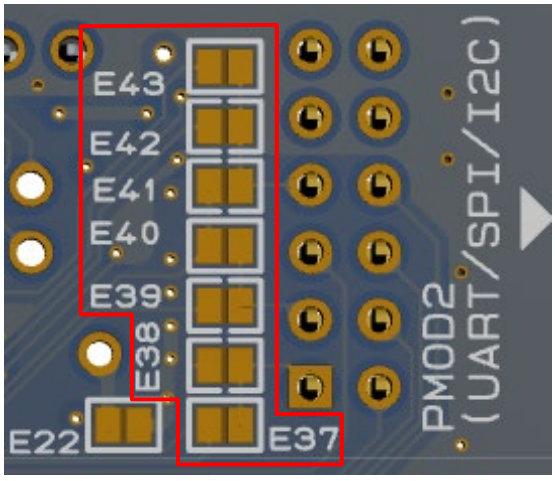

Figure 16. Pmod 2 Copper Jumpers (bottom side)

5.3.2 Arduino® Connector

Arduino Uno R3 compatible connector interface is provided at connector J9, J10, J11 and J12.

Table 8. Arduino Uno Connections

Arduino Compatible Connector		FPB-RX140 v1	Arduino Configuration	
Pin	Description	Signal	Closed	Open
J9-1	NC	NC		
J9-2	IOREF	Board_VCC	E25	
J9-3	RESET	RES#	E26	E27
		PD2 *5	E27	E26
J9-4	3.3V	3.3 V	E24	
J9-5	5 V	5 V *5	E23	
J9-6	GND	GND		
J9-7	GND	GND		
J9-8	VIN	NC		
J11-1	A0	P40 (AN000)		
J11-2	A1	P41 (AN001)		
J11-3	A2	P42 (AN002)		
J11-4	A3	P43 (AN003)		
J11-5	A4	P44 (AN004)		
J11-6	A5	P45 (AN005)		
J12-1	D0 / RX	PD1 (RXD6)		
J12-2	D1 / TX	PD0 (TXD6)		
J12-3	D2 / INT	P30 (IRQ0) *1	E30	
J12-4	D3 / INT / PWM	PH2 (MTIOC4C / IRQ1)		
J12-5	D4	P21		
J12-6	D5 / PWM	P20 (MTIOC1A) *2	E29	
J12-7	D6 / PWM	PJ1 (MTIOC3A)		
J12-8	D7	PC3		
J10-1	D8	PC2		
J10-2	D9 / PWM	PE4 (MTIOC4A)		
J10-3	D10 / SS / PWM	PC4 (MTIOC0A / SSLA0) *4	E15	E28
		P34 (MTIOC0A) *5	E28	E15
J10-4	D11 / MOSI / PWM	PC6 (MTIOC3C / MOSIA)		
J10-5	D12 / MISO	PC7 (MISOA)		
J10-6	D13 / SCK	PC5 (RSPCKA)		
J10-7	GND	GND		
J10-8	AREF	AREF *6		
J10-9	SDA	P17 (SDA0) *3		
J10-10	SCL	P16 (SCL0) *3		

*1: The signal is shared with User switch S1.

*2: The signal is shared with user LED1.

*3: I^2C pull up can be disconnected by cutting copper jumper E22.

*4: The signal is shared with TSCAP. Cut copper jumper E15 when a capacitor is fitted on C14.

*5: Open at shipping.

*6: The signal is connected to VREFH0 pin of the RX140 MCU.

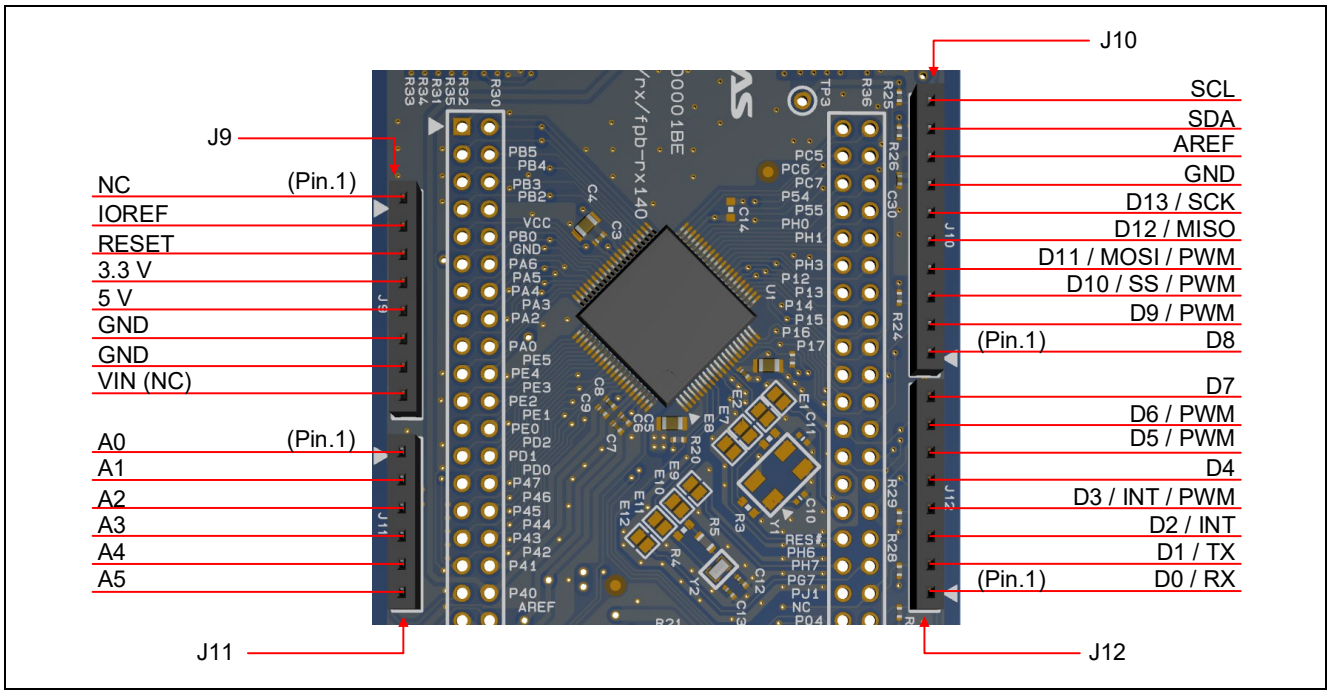

Figure 17. Arduino Uno Connectors

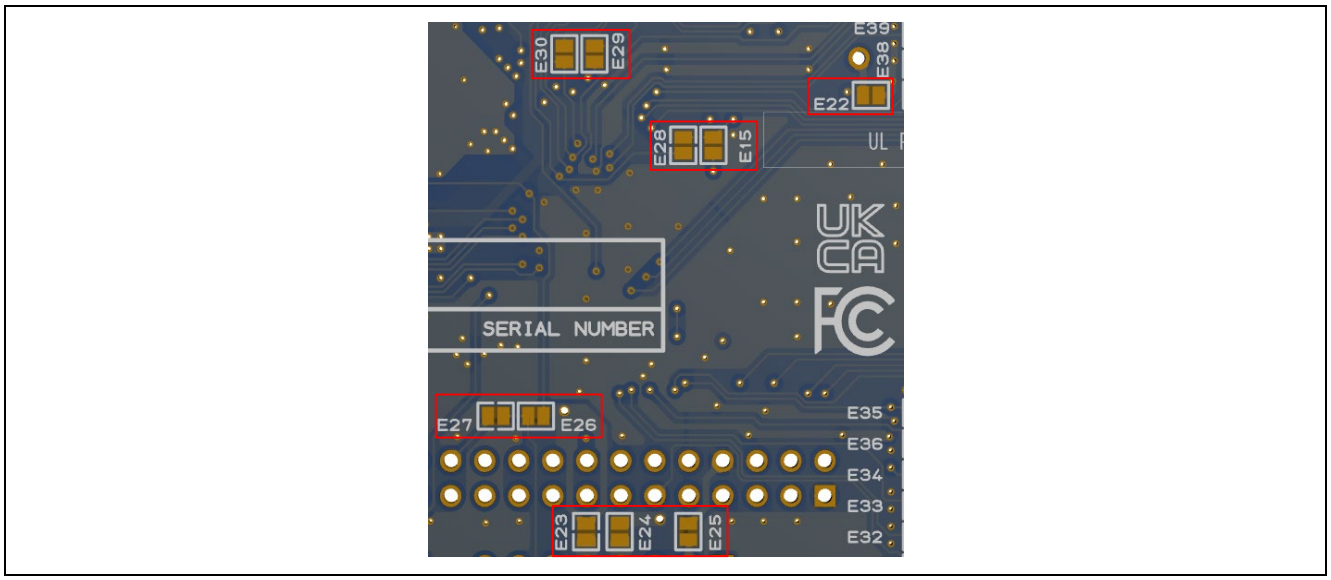

Figure 18. Arduino Uno Copper Jumpers (bottom side)

Arduino Shield Considerations

AREF (J10-Pin8) output from Arduino Shield is connected to VREFH0 (Analog reference voltage supply pin for the 12-bit A/D converter) of RX MCU, however, Board_VCC is connected to VREFH0 at default condition. When Arduino AREF supplies power to VREFH0, the user must disconnect VREFH0 from Board_VCC power. Copper jumper E4 is provided on the FPB-RX140 v1 to disconnect VREFH0 from on-board Board_VCC power.

The FPB-RX140 v1 can supply 5 V power to J9-Pin5 of Arduino Shield by soldering copper jumper E23, however, some of the RX MCU pins which are connected to Arduino Shield are not 5 V tolerant. When the FPB-RX140 v1 supplies 5 V power to Arduino Shield, however Board_VCC = 3.3 V, the user must confirm the RX140 Group User's Manual: Hardware and the specification of Arduino Shield you intend to use.

5.4 Miscellaneous

5.4.1 LED

Four LEDs are provided on the FPB-RX140 v1.

Functions of the LEDs on the FPB-RX140 v1 is described in the following table. User LEDs turn on when RX MCU ports output high level.

Table 9. FPB-RX140 v1 LED Functions

LED			FPB-RX140 v1	Configuration	
Designator	**Color**	**Function**	**Signal**	**Closed**	**Open**
LED1	Green	User LED	P20 (MTIOC1A) *1	E20	
LED2	Green	User LED	P32 (MTIOC0C)	E21	
LED3	Green	Power LED	Board_VCC		
LED4	Yellow	Debug LED	E2 OB circuit		

*1: The signal is shared with Arduino (D5 / PWM).

The User LEDs may be isolated from the RX MCU so that the associated ports can be used for other purposes. To disconnect LED1 from P20 (MTIOC1A), copper jumper E20 must be open. To disconnect LED2 from P32 (MTIOC0C), copper jumper E21 must be open.

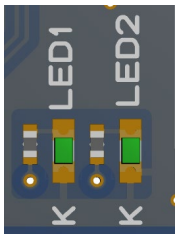

Figure 19. User LEDs (top side) and Copper Jumpers (bottom side)

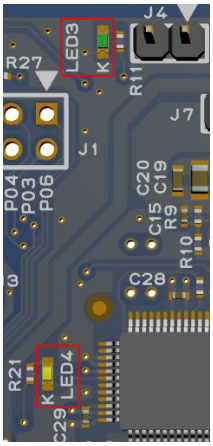

Figure 20. Power LED and Debug LED

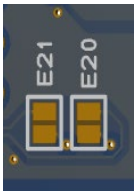

Figure 21. User LEDs Copper Jumpers (bottom side)

5.4.2 User and Reset Switches

Two miniature, momentary, mechanical push-button type SMD switches are mounted on the FPB-RX140 v1.

Pressing the reset switch (S2) generates a reset signal to reset the RX MCU.

Table 10. FPB-RX140 v1 Switches

Switch			FPB-RX140 v1	Configuration	
Designator	**Function**	**Button Color**	**Signal**	**Closed**	**Open**
S1	User switch	Blue	P30 (IRQ0) *1	E19	
S2	Reset Switch	Blue	RES#		

*1: The signal is shared with Arduino (D2 / INT).

The User switch S1 may be isolated from the RX MCU, so that the associated port can be used for other purposes. To disconnect S1 from P30 (IRQ0), trace cut jumper E19 must be open.

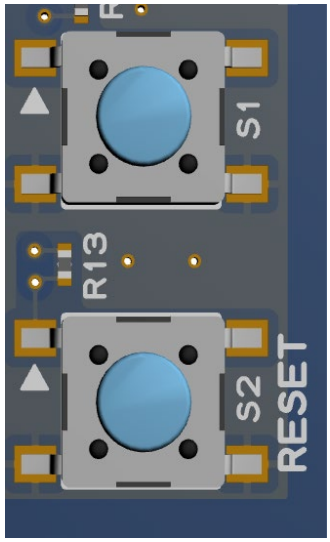

Figure 22. Reset (S2) and User Switch (S1)

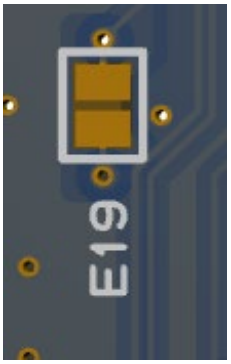

Figure 23. User Switch S1 Copper Jumper (bottom side)

6. MCU Native Pin Access

6.1 Breakout Pin Headers

The FPB-RX140 v1 pin headers (not fitted), J1 and J2, provide access to RX MCU interface signals. Each header pin is labelled with the power or port connected to that pin (Some header pins aren't labelled because of not enough space.). Refer to the RX140 MCU User's Manual: Hardware for details of each port function, and the FPB-RX140 v1 schematic for pin header port assignments.

The placement of the breakout pin headers allows for a standard 2.54 mm (0.100") breadboard to be placed on both pin headers. This can be used for prototyping and testing of custom circuitry for use with the RX MCU.

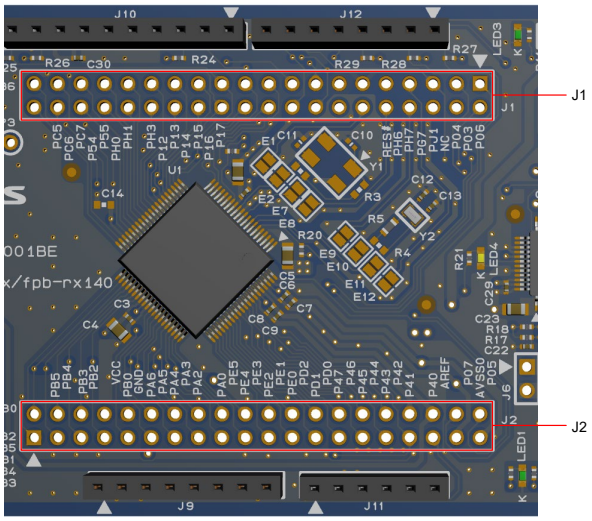

Figure 24. Breakout Pin Headers J1 and J2

6.2 MCU Current Measurement

Two pin header J6 (not fitted) is provided on the FPB-RX140 v1 to measure the RX MCU current.

Resistor R1 is 0Ω (SMD 0603). It should be removed in order to measure the current consumption using an ammeter connected between the pin header pins.

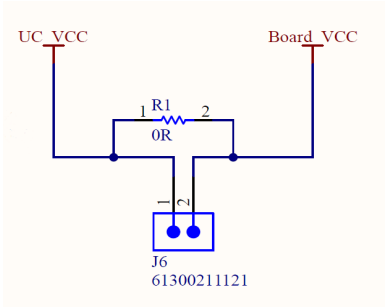

Figure 25. RX MCU Current Measurement Circuit

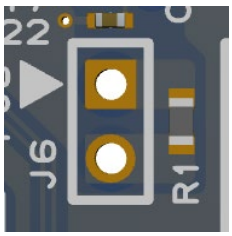

Figure 26. RX MCU Current Measurement Pin Header J6 and R1

7. Recommended Components

Table 11 lists recommended part numbers for the components that can be fitted as required.

Table 11. Recommended Components

Designator(s)	Description	Manufacturer	Part Number
Y1	8 MHz Crystal	Abracon	ABM3B-8.000MHZ-10-1-U
J1, J2	40-way male header	Wurth Elektronik	61304021121
J6, J8	2-way male header	Wurth Elektronik	61300211121
R2, R4	1 MΩ Resistor	Yageo	RC0603FR-071ML
R3	0 Ω Resistor	Yageo	RC0603JR-070RL
C10, C11	10 pF Capacitor	Yageo	CC0402JRNPO9BN100
C14	10 nF Capacitor	Yageo	CC0603KRX7R9BB103

8. Certifications

The FPB-RX140 v1 meets the following certifications/standards. See page 4 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 required to take adequate measures to correct this interference.
- UKCA Class A (EMC)

  This product 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.
- WEEE Directive (2012/19/EU) & The Waste Electrical and Electronic Equipment Regulations 2013

The WEEE (Waste Electrical and Electronic Equipment) regulations put responsibilities on producers for the collection and recycling or disposal of electrical and electronic waste. Return of WEEE under these regulations is applicable in the UK and European Union.

This equipment (including all accessories) is not intended for household use. After use the equipment cannot be disposed of as household waste, and the WEEE must be treated, recycled and disposed of in an environmentally sound manner.

Renesas Electronics Europe GmbH can take back end of life equipment. Register for this service at;
https://www.renesas.com/eu/en/support/regional-customer-support/weee

8.3 Safety Standards

- UL 94V-0

9. Design and Manufacturing Information

The design and manufacturing information for the FPB-RX140 v1 is available in the “FPB-RX140 v1 Design Package” available on renesas.com/rx/fpb-rx140.

- Design package file name: fpb-rx140-v1-designpackage.zip
- Design package contents

Table 12. FPB-RX140 v1 Design Package Contents

File Type	Content	File / Folder Name
File (PDF)	Schematics	fpb-rx140-v1-schematics
File (PDF)	Mechanical Drawing	fpb-rx140-v1-mechdwg
File (PDF)	3D Drawing	fpb-rx140-v1-3d
File (PDF)	BoM	fpb-rx140-v1-bom
Folder	Manufacturing Files	Manufacturing Files
Folder	Design Files	Design Files-Altium

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.

FPB-RX140 Resources	renesas.com/rx/fpb-rx140
RX Kit Information	renesas.com/rx/kits
RX Product Information	renesas.com/rx
RX Product Support Forum	renesas.com/rx/forum
RX Videos	renesas.com/rx/videos
RX Kit Feedback and Feature Request	renesas.com/rx/kitfeedback
Renesas Support	renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Feb.2.24	—	Initial release

● 有害物質の含有表
Table of Hazardous Substance

部品名称 Part Name	有害物質 Hazardous Substance					
	鉛 Lead (Pb)	水銀 Mercury (Hg)	カドミウム Cadmium (Cd)	六価クロム Hexavalent Chromium (Cr(VI))	ポリ臭化ビフェニル Polybrominated biphenyls (PBB)	ポリ臭化ジフェニルエーテル Polybrominated diphenyl ethers (PBDE)
筐体 Case	O	O	O	O	O	O
ボード Board	X	O	O	O	O	O
ケーブル Cable	X	O	O	O	O	O
ソケット Socket	X	O	O	O	O	O
ACアダプタ AC-Adapter	X	O	O	O	O	O

本表は SJ/T 11364 の規定により作成したものである。
This form is based on the provisions of the SJ/T 11364.

O: 当該部材の全ての均質材料中における該当有害な物質の含有量がいずれも GB/T 26572 基準に規定する限度量の要求以下であることを表します。
If certain hazardous substances do not exist in this part, then mark “O” for the corresponding column, which indicates that this hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572

X: 少なくとも当該部材のある均質材料中における当該有害な物質の含有量が GB/T 26572 基準に規定する限度量の要求を上回ることを表します。
If certain hazardous substance is contained in this part, then “X” for the corresponding column, which indicates that this hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in GB/T 26572.

このマークは、中華人民共和国で販売される電子情報製品に適用され、マーク中央の数字は環境保護使用期限の年数です。なお、本製品の年数は、通常に使用された場合の年数です。
This mark is applied to EIPs sold in People's Republic of China, and the number in the center indicates the years of the environment-friendly use period. The years for this product is applicable when the product is used normally.

注） この表には電子情報製品全ての添付品を記載しており、製品によっては同梱されていないものがございますのでご了承下さい。

Notice) All of the attached items relating to 'Electronic Information Products' are listed in this table.
Please understand that there is not always bundled all of the items because it depends on the product.

● 製造年の確認方法に関して About Confirmation method of produced year

製品或いは梱包箱に表記された銘板ラベル等から製造年をご確認頂けます。
Please confirm the produced year from nameplate label etc on product body or outer box.

Ex) 2016 年の場合　　Produced 2016

● 有害物质含有情况表
Table of Hazardous Substance

部件名称 Part Name	有害物质 Hazardous Substance					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr(VI))	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
外壳 Case	O	O	O	O	O	O
电路板 Board	X	O	O	O	O	O
连接线 Cable	X	O	O	O	O	O
插座 Socket	X	O	O	O	O	O
AC 适配器 AC-Adapter	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。

This form is based on the provisions of the SJ/T 11364.

O：表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 标准规定的限量要求以下。

If certain hazardous substances do not exist in this part, then mark “O” for the corresponding column, which indicates that this hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572.

X：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 标准规定的限量要求。

If certain hazardous substance is contained in this part, then “X” for the corresponding column, which indicates that this hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in GB/T 26572.

该标识适用于在中华人民共和国境内销售的电子信息产品。本产品的使用年限是组装到整机中，通常情况下能使用的年限。

图形中间的数字表示电子信息产品的环保使用期限。

This mark is applied to EIPs sold in People’s Republic of China, and the number in the center indicates the years of the environment-friendly use period. The years for this product is applicable when the product is used normally.

特别提示）该表中包括在电子情报产品系列产品所有的附件。产品不同时，包装内的附件会有所不同。

Notice) All of the attached items relating to 'Electronic Information Products' are listed in this table.
Please understand that there is not always bundled all of the items because it is depends on a product.

● 识别生产日期的方法 About Confirmation method of produced year

请通过产品或产品外包装箱上的序列号识别生产日期。

Please confirm the produced year from nameplate label etc on product body or outer box.

如）生产日期为2016 年　　Produced 2016

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