User’s Manual

RENESAS

RA6E1 Group

Fast Prototyping Board for RA6E1 Microcontroller Group
FPB-RA6E1 v1
User’s Manual

Renesas RA Family
RA6 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.
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   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.).
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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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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.

Renesas RA Family

FPB-RA6E1 v1

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Glossary

Table 1. List of Abbreviations and Acronyms

BoM	Bill of Materials
ETM	Embedded Trace Module
FPB	Fast Prototyping Board
FSP	Flexible Software Package
GPIO	General Purpose Input Output
I^2C (or IIC)	Inter-Integrated Circuit
IDE	Integrated Development Environment
I/O	Input/Output
IRQ	Interrupt Request
LDO	Low Dropout
LED	Light Emitting Diode
LQFP	Low-profile Quad Flat Pack
MCU	Micro Controller Unit
MISO	Master In Slave Out
MOSI	Master Out Slave In
NC	Not Connected
PMOD™	Peripheral Module
PWM	Pulse Width Modulation
RXD	Receive Data
SCI	Serial Communications Interface
SCL	Serial Clock Line
SDA	Serial Data Line
SMD	Surface Mount Device
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
SWD	Serial Wire Debug
TXD	Transmit Data
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

1. Board Overview

The FPB-RA6E1, a Fast Prototyping Board for the RA6E1 MCU Group, enables users to seamlessly evaluate the features of the RA6E1 MCU group and develop embedded systems applications using Flexible Software Package (FSP) and the e^2 studio IDE. Users can use on-board features along with their choice of popular ecosystems add-ons to bring their big ideas to life.

The key features of the FPB-RA6E1 board are categorized in two groups (consistent with the architecture of the board) as follows:

MCU Native Pin Access

- R7FA6E10F2CFP MCU (referred to as RA MCU)
- 200 MHz, Arm® Cortex®-M33 core
- 1 MB Code Flash, 8 KB Data Flash, 256 KB SRAM
- 100-pin, LQFP package
- Native pin access through 2 x 50-pin male headers (not fitted)
- MCU current measurement point for precision current consumption measurement
- Multiple clock sources - Low-precision (~1%) clocks are available internal to the RA MCU. RA MCU oscillator and sub-clock oscillator crystals, providing precision 24.000 MHz (not fitted) and 32,768 Hz reference clocks are also available

System Control and Ecosystem Access

- Two 5 V input sources
  - USB (Debug, Full Speed)
  - External power supply (using 2-pin header) (not fitted)
- Built-in SEGGER J-Link Emulator On-Board programmer/debugger (SWD)
- User LEDs and buttons
  - Two User LEDs (green)
  - Power LED (green) (not fitted) indicating availability of regulated power
  - Debug/power LED (yellow) indicating power and the debug connection
  - One User button
  - One Reset button
- Two popular ecosystem expansions
  - Two Digilent Pmod™ (SPI, UART) connectors (not fitted)
  - Arduino™ (Uno R3) connectors
- MCU boot configuration jumper (not fitted)

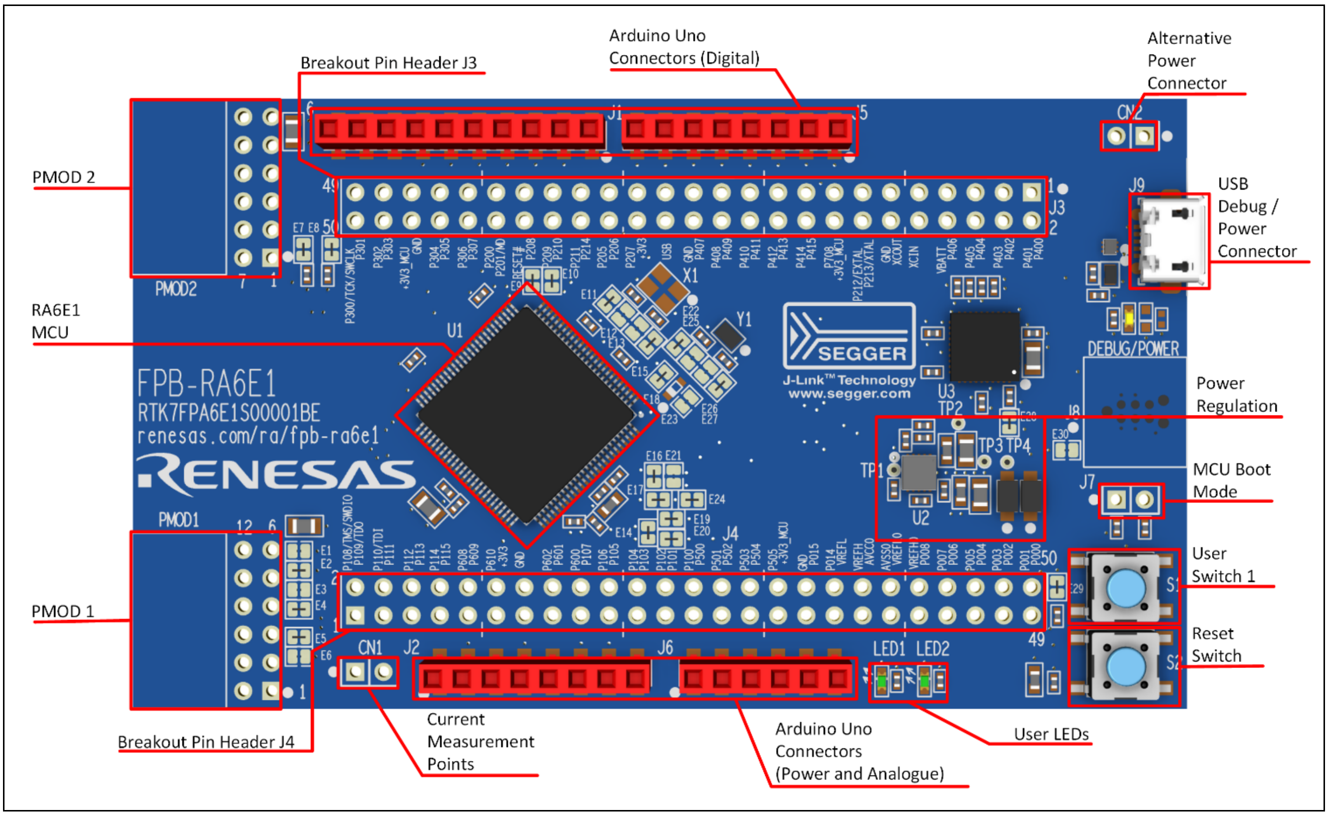


Figure 1. FPB-RA6E1 Board Top Side

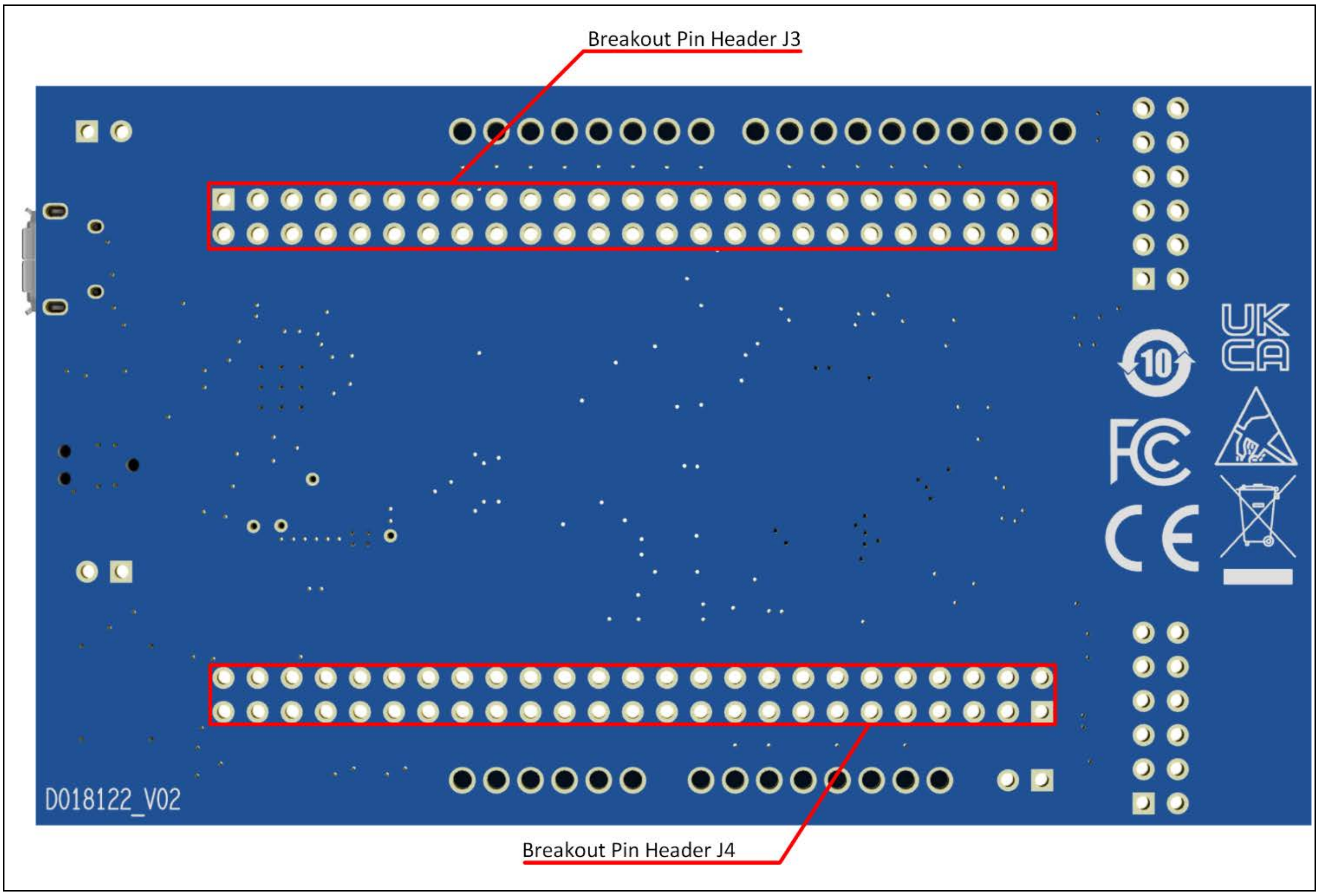


Figure 2. FPB-RA6E1 Board Bottom Side

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 *FPB-RA6E1 Quick Start Guide* to get acquainted with the board.
3. Flexible Software Package (FSP) and Integrated Development Environment (IDE) such as e^2 studio are required to develop embedded applications on FPB-RA6E1 board.
4. Instructions to download and install software, import example projects, build them and program the FPB-RA6E1 board are provided in the tutorial manual.

2. Box Contents

The following components are included in the box:

1. FPB-RA6E1 v1 board
2. Printed Quick Start Guide

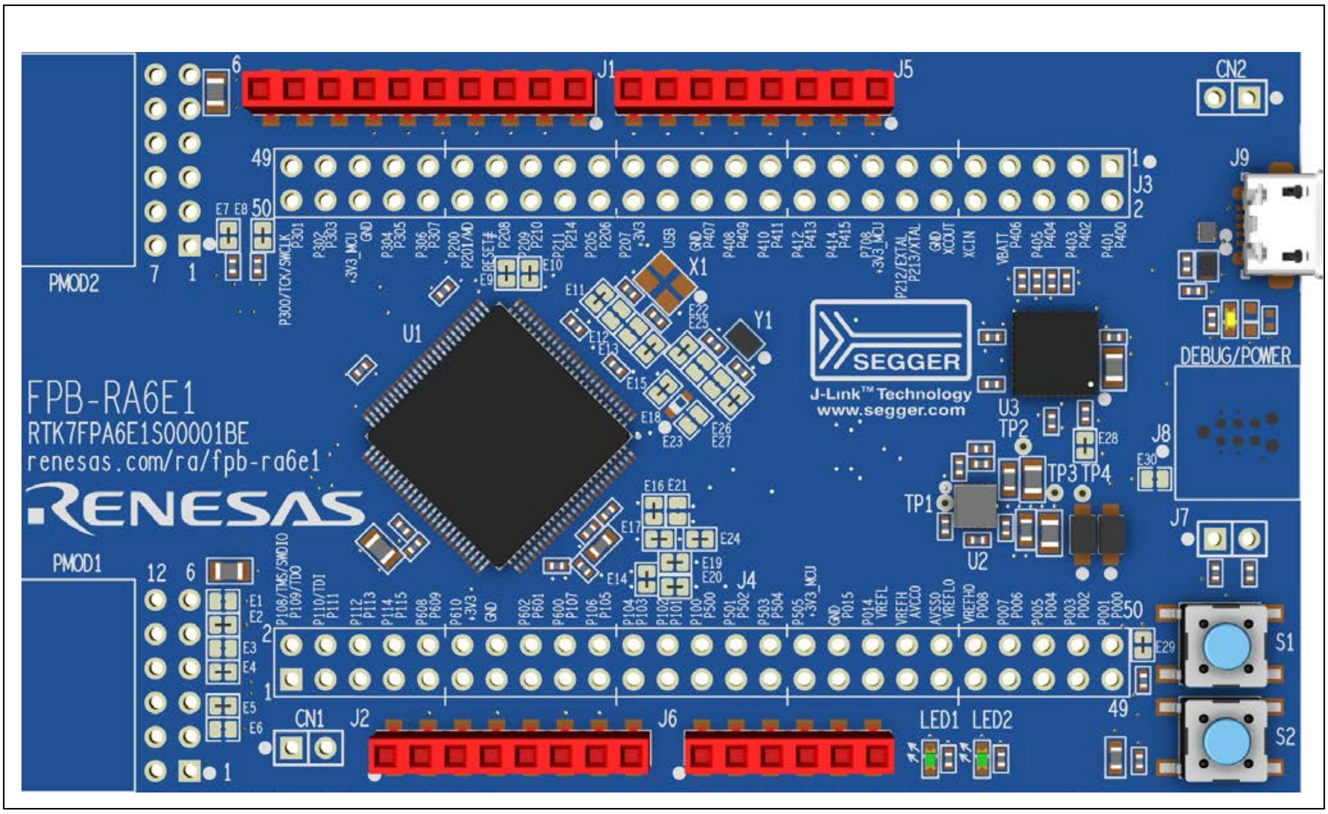


Figure 3. FPB-RA6E1 Board

3. Ordering Information

- FPB-RA6E1 v1 orderable part number: RTK7FPA6E1S00001BE

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

- FPB-RA6E1 board dimensions: 55 mm (width) x 95 mm (length)

4. Hardware Architecture and Default Configuration

4.1 Board Architecture

The FPB-RA6E1 board is designed with an architecture similar to other boards in the FPB series. Alongside the MCU there is an on-board programmer, pin headers for access to all the pins on the MCU, a power supply regulator, some LEDs and switches, and several ecosystem I/O connectors (Pmod and Arduino).

Board Functionality	**Features**	**Function present on all similar boards**	**Functionality is:**
MCU Native Pin Access	RA MCU, breakout pin headers for all MCU I/O and power, current measurement	Yes	MCU dependent
System Control and Ecosystem Access	Power, debugger, user LEDs and switches, reset switch, ecosystem connectors, boot configuration	Yes	Same or similar across other FPB boards

4.2 Block Diagram

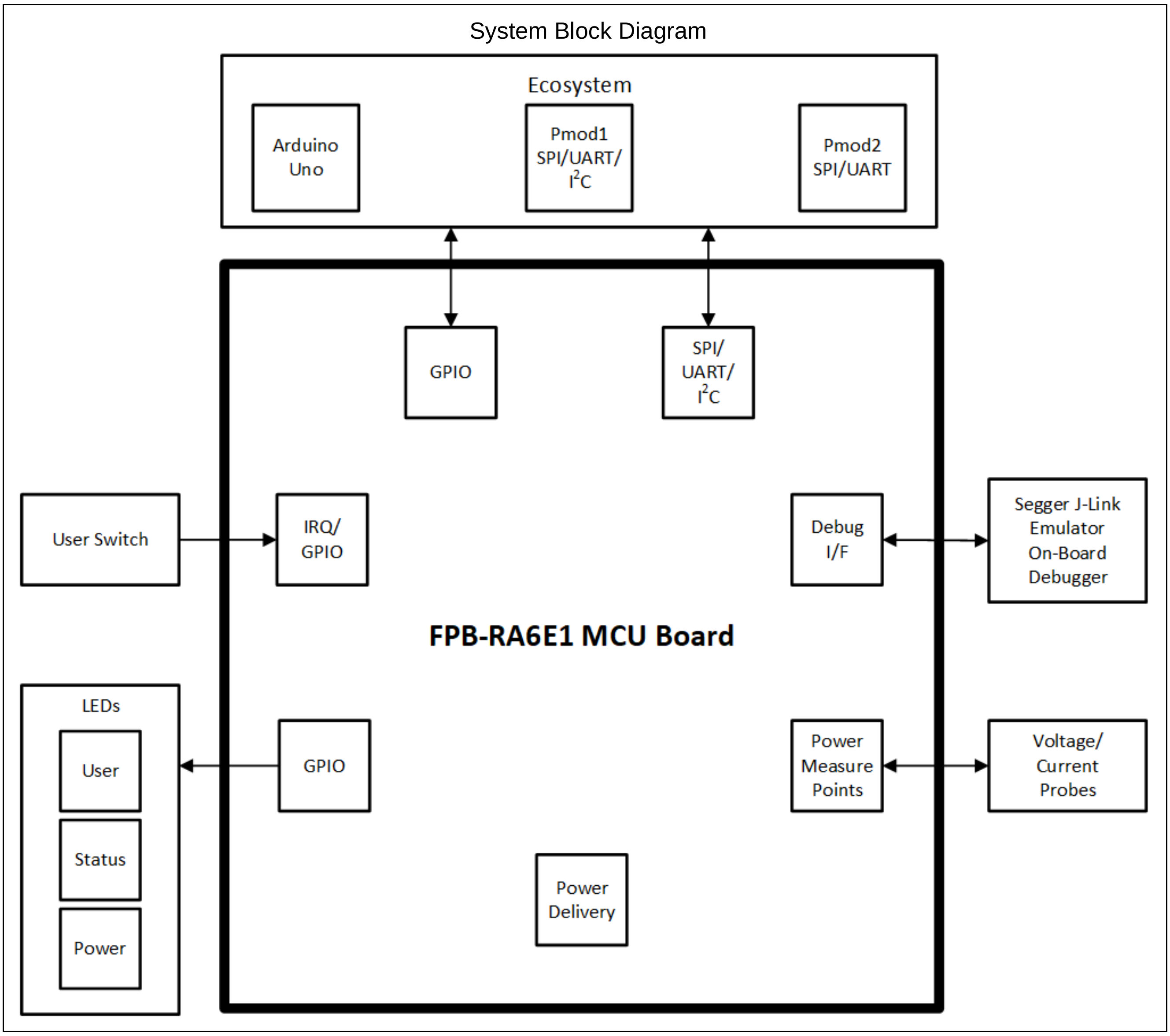


Figure 4. FPB-RA6E1 Board Block Diagram

4.3 Jumper Settings

Two types of jumpers are provided on the FPB-RA6E1 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 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 SMD 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).

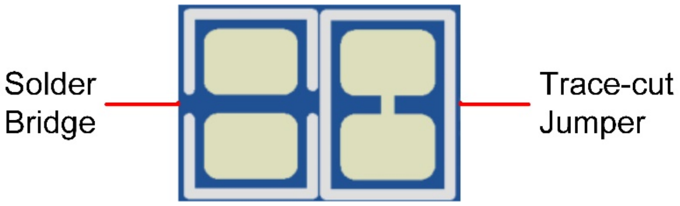


Figure 5. Copper Jumpers

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 FPB-RA6E1 board are 0.1” (2.54 mm) 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 FPB-RA6E1 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 kits.

Table 2. Default Jumper Settings

Location	Circuit Group	Default Open/Closed	Function
E1	Pmod1 Power	Open	Connects +3.3 V to Pmod1 pin 6 and pin 12
E2	Pmod1 Power	Closed	Connects +5.0 V to Pmod1 pin 6 and pin 12
E3	Pmod1 SPI	Open	Connects P102 (RSPCKA) to Pmod 1 pin 4
E4	Pmod1 I^2C	Closed	Connects P401 (SDA0) to Pmod 1 pin 4
E5	Pmod1 I^2C	Closed	Connects P400 (SCL0) to Pmod 1 pin 3
E6	Pmod1 SPI	Open	Connects P100 (MISOA/RXD0) to Pmod 1 pin 3

Location	Circuit Group	Default Open/Closed	Function
E7	I²C SCL0	Closed	Connects SCL0 (P400) to 2.2K pull-up R1
E8	I²C SDA0	Closed	Connects SDA0 (P401) to 2.2K pull-up R2
E9	LED2	Closed	Connects LED2 to P407
E10	LED1	Closed	Connects LED1 to P408
E11	MCU Clock	Closed	Connects J3 pin 14 to MCU pin 14 (P212/EXTAL)
E12	MCU Clock	Open	Connects 24MHz crystal to MCU pin 14 (P212/EXTAL)
E13	MCU Clock	Open	Connects 24MHz crystal to MCU pin 13 (P213/XTAL)
E14	MCU Power	Closed	Connects AVCC0 (MCU pin 88) to VREFH (MCU pin 87)
E15	MCU Clock	Closed	Connects J3 pin 13 to MCU pin 13 (P213/XTAL)
E16	MCU Power	Closed	Connects AVCC0 (MCU pin 88) to VREFH0 (MCU pin 91)
E17	MCU Power	Closed	Connects VREFL0 (MCU pin 90) to AVSS0 (MCU pin 89)
E18	MCU Power	Closed	Connects MCU pin 8 (VBATT) to +3.3 V
E19	MCU Power	Closed	Connects AVSS0 (MCU pin 89) to GND
E20	MCU Power	Closed	Connects AVCC0 (MCU pin 88) to +3.3 V
E21	MCU Power	Open	Connects Arduino J1 pin 8 to VREFH0 (MCU pin 91)
E22	MCU Clock	Closed	Connects J3 pin 11 to MCU pin 11 (XCOUT)
E23	MCU Power	Open	Bypass diode D1 to connect J3 pin 8 directly to MCU pin 8 (VBATT)
E24	MCU Power	Closed	Connects VREFL (MCU pin 86) to AVSS0 (MCU pin 89)
E25	MCU Clock	Open	Connects 32.768KHz crystal to MCU pin 11 (XCOUT)
E26	MCU Clock	Open	Connects 32.768KHz crystal to MCU pin 10 (XCIN)
E27	MCU Clock	Closed	Connects J3 pin 10 to MCU pin 10 (XCIN)
E28	Debugger	Closed	Connects P201/MD to P300/TCK/SWCLK
E29	Switch S1	Closed	Connects User Switch 1 to MCU P205
E30	Debugger	Open	Connects the debugger reset pin to ground to disable the debugger
J7	MCU Boot Mode	Open Closed	Configures the MCU for Single-chip mode Configures the MCU for SCI boot mode
R3	MCU Power	Fitted	Connects +3.3 V to MCU. Remove when testing MCU current draw

5. System Control and Ecosystem Access

The FPB-RA6E1 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-RA6E1 board is designed for +5 V operation. An on-board Low Dropout (LDO) 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 RA MCU and other peripheral features.

5.1.1 Power Supply Options

This section describes the different ways in which FPB-RA6E1 board can be powered.

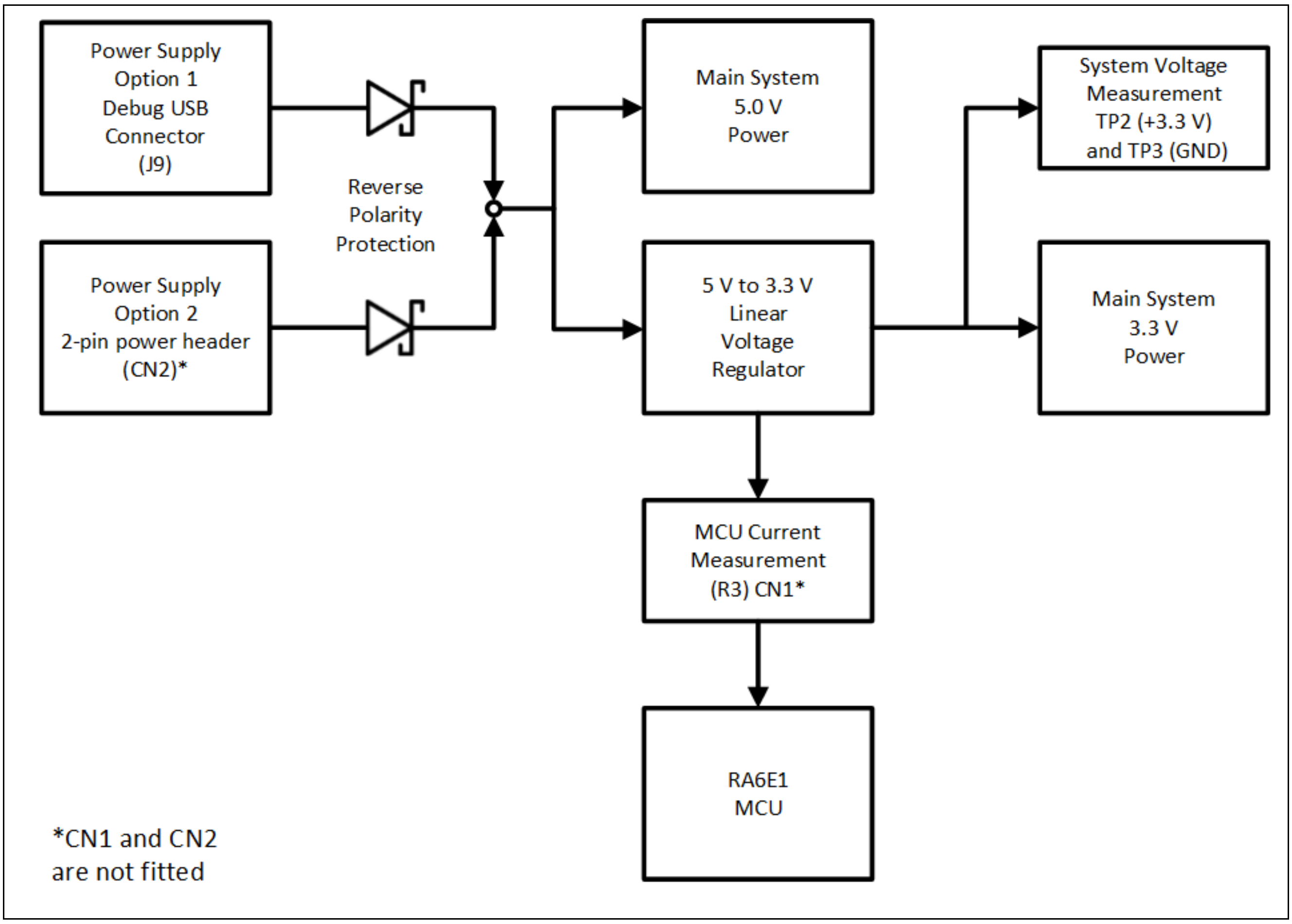


Figure 6. Power Supply Options

The MCU can be operated at a lower voltage than 3.3 V by removing the current measurement resistor and powering the MCU via TP2.

Note: Other changes to the circuit where interfaces or pull-up resistors are used may also need to be removed. Please review the schematic carefully before making these changes.

5.1.1.1 Option 1: Debug USB

5 V may be supplied from an external USB host to the USB debug connector (J9). 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: Header Connector CN2

5 V may be supplied from an external power supply to connector CN2 (not fitted). CN2 is a standard 2-pin header on a 0.1” (2.54 mm) pitch. Pin 1 is GND, and pin 2 is +5 V. Power from this source is connected to the main system 5 V power. Reverse current protection is provided between CN2 and the main system 5 V power.

5.1.2 Power Supply Considerations

The on-board LDO regulator which supplies +3.3 V has a built-in current limit of 2.0 A. Make sure the total current required by the RA MCU, any active on-board features, and any connected peripheral devices does not exceed this limit.

Note: The total current available from a typical USB host is 100 mA before enumeration, and 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 green LED (not fitted) next to the DEBUG/POWER legend will illuminate. The yellow DEBUG/POWER LED will also illuminate.

5.2 Debug and Trace

The FPB-RA6E1 board can be programmed and debugged using the built-in SEGGER J-Link Emulator On-Board debugger.

5.2.1 SEGGER J-Link Emulator On-Board

Debug USB micro-B connector (J9) connects the SEGGER J-Link debugger to an external USB full speed host, allowing re-programming and debugging of the target RA MCU firmware.

The J-Link Emulator On-Board debugger connects to the target RA MCU using the SWD interface.

Table 3. Debug USB Connector

Debug USB Connector		**FPB-RA6E1**
Pin	**Description**	**Signal/Bus**
J9-1	+5 VDC	+5V_USB_DBG
J9-2	Data-	SEGGER J-Link On-Board Data-
J9-3	Data+	SEGGER J-Link On-Board Data+
J9-4	USB ID, jack internal switch, cable inserted	NC
J9-5	Ground	GND

A yellow indicator, DEBUG/POWER, shows the visual status of the debug interface. When the FPB-RA6E1 board is powered on, and the DEBUG/POWER LED is blinking, it indicates that the SEGGER J-Link Emulator On-Board debugger is not connected to a programming host. When the DEBUG/POWER LED is on solid, it indicates that it is connected to a programming interface. When the DEBUG/POWER LED is flickering, it indicates that data is being transferred between the SEGGER J-Link Emulator On-Board debugger and the programming host.

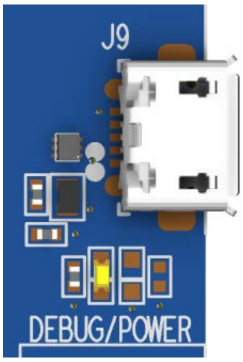


Figure 7. FPB-RA6E1 Debug Interface

5.2.1.1 Debugger Link Settings

Table 4. Debug Link Settings

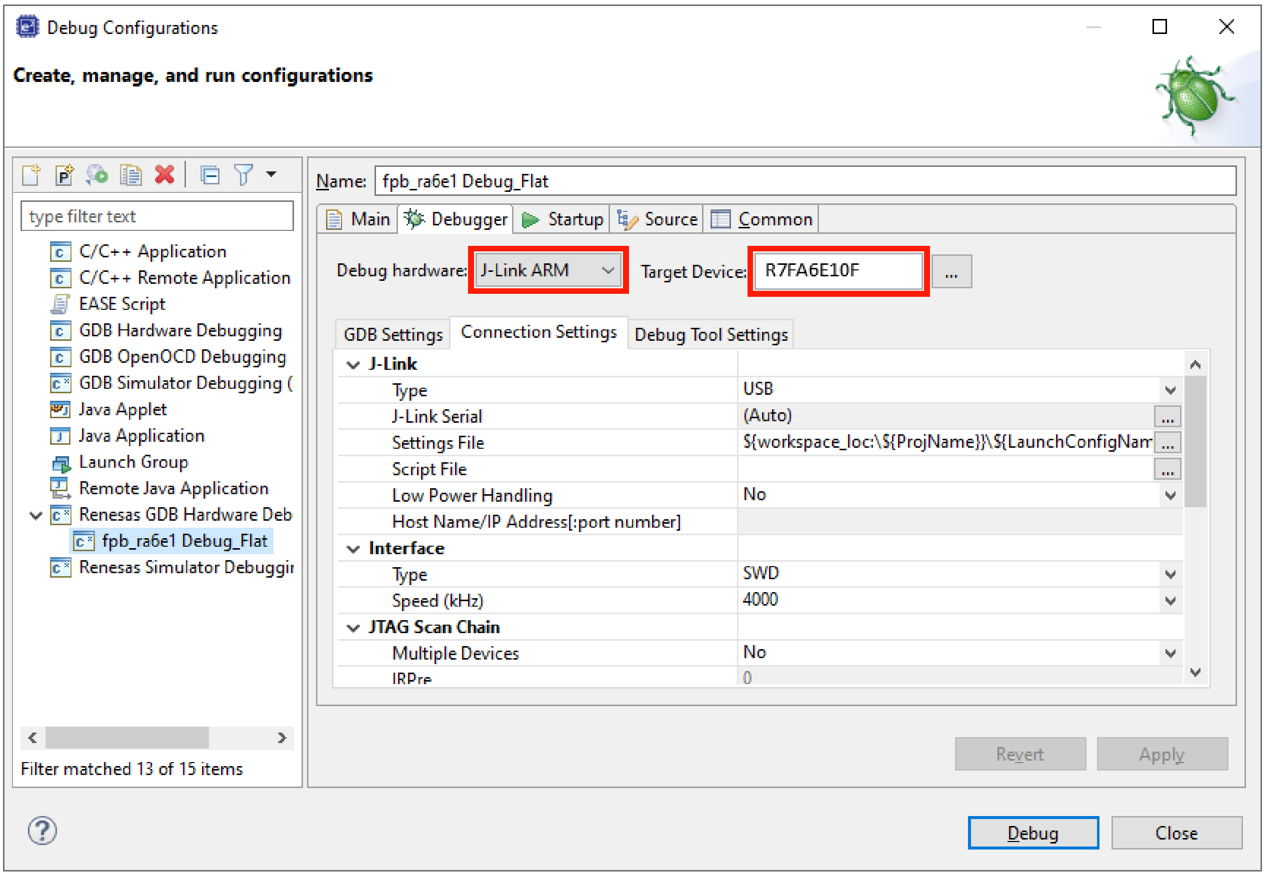
Link	**Setting**	**Function**
E28	Closed Open	Normal debugger operation P201/MD and P300/TCK/SWCLK are not connected
E30	Closed Open	Debugger held in reset (RA6E1 MCU free-running operation) Normal debugger operation

5.2.2 Debugger Settings in e^2 studio

Figure 8 shows the settings for e^2 studio when creating a new project for the FPB-RA6E1 Fast Prototyping Board.

[Debug hardware]: Select [J-Link (ARM)]

[Target Device]: Select [R7FA6E10F]



Name: fpb_ra6e1 Debug_Flat

Debug hardware: J-Link ARM

Target Device: R7FA6E10F

J-Link	
Type	USB
J-Link Serial	(Auto)
Settings File	${workspace_loc:\${ProjName}}\${LaunchConfigNam
Script File	
Low Power Handling	No
Host Name/IP Address[:port number]	
Interface	
Type	SWD
Speed (kHz)	4000
JTAG Scan Chain	
Multiple Devices	No
IRPre	0

Figure 8. e^2 Studio Debugger Settings

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

5.3.1.1 Pmod 1

A 12-pin right angle connector can be fitted at PMOD1. A suitable part is Samtec SSW-106-02-T-D-RA. The connections support Pmod Type-2A (expanded SPI) and Type-3A (expanded UART). The RA MCU acts as the SPI master, and the connected module acts as an SPI slave device. This interface may additionally be re-configured in firmware as several other Pmod types.

Table 5. Pmod 1 Connector

Pmod1 Connector Default			FPB-RA6E1	Pmod 1 Configuration	
Pin	**Description**	**Option Type 6A**	**Signal/Bus**	**Short**	**Open**
PMOD1-1	SS / CTS	NC/INT	P103 (SSLA0/CTS0)		
PMOD1-2	MOSI / TXD	NC/RESET	P101 (MOSIA/TXD0)		
PMOD1-3	MISO / RXD		P100 (MISOA/RXD0)	E6	E5
		SCL	P400 (SCL0)	E5	E6
PMOD1-4	SCK		P102 (RSPCKA)	E3	E4
		SDA	P401 (SDA0)	E4	E3
PMOD1-5	GND		GND		
PMOD1-6	VCC		+3.3 V	E1	E2
			+5.0 V	E2	E1
PMOD1-7	GPIO / INT (slave to master)		P015 (IRQ13)		
PMOD1-8	GPIO / RESET (master to slave)		P014		
PMOD1-9	GPIO / CS2		P105 (GPIO/SSLA2)		
PMOD1-10	GPIO / CS3		P106 (GPIO/SSLA3)		
PMOD1-11	GND		GND		
PMOD1-12	VCC		+3.3 V	E1	E2
			+5.0 V	E2	E1

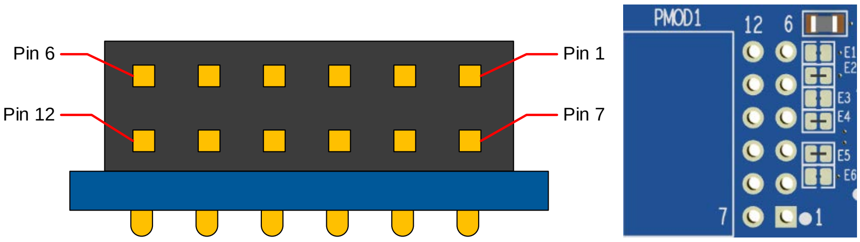


Figure 9. Pmod 1

The default setting of the Pmod 1 interface supports +5 V devices. Please ensure that any Pmod device installed is compatible with a +5 V supply.

Pmod Type 6A Operation

Pmod 1 can be configured to support proposed Pmod Type 6A connector specification supporting I^{2}C connections. There is also an alternative 3.3 V power source option. In order to configure Pmod 1 for Type 6A operation, modify the trace cut jumpers as described in Table 5. The trace cut jumpers are shown in Figure 10.

Note: Exercise caution while modifying power source trace jumpers, E1 and E2. Permanent damage to the FPB-RA6E1 board and/or connected modules may result.

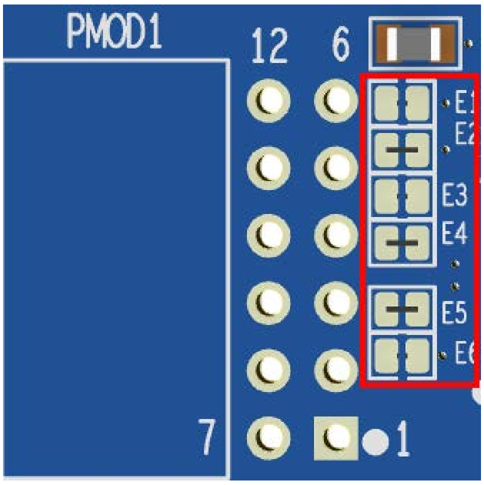


Figure 10. Pmod 1 Solder Bridge and Trace Cut Jumpers

5.3.1.2 Pmod 2

A 12-pin right angle connector can be fitted at PMOD2. A suitable part is Samtec SSW-106-02-T-D-RA. The RA MCU acts as the SPI master, and the connected module acts as an SPI slave device. This interface may additionally be re-configured in firmware as several other Pmod types.

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

Table 6. Pmod 2 Connector

Pmod 2 Connector		**FPB-RA6E1**
Pin	**Description**	**Signal/Bus**
PMOD2-1	SS / CTS	P301 (SS9/CTS9)
PMOD2-2	MOSI / TXD	P109 (MOSI9/TXD9)
PMOD2-3	MISO / RXD	P110 (MISO9/RXD9)
PMOD2-4	SCK	P111 (SCK9)
PMOD2-5	GND	GND
PMOD2-6	VCC	+3.3 V
PMOD2-7	GPIO / INT (slave to master)	P304 (IRQ9)
PMOD2-8	GPIO / RESET (master to slave)	P112
PMOD2-9	GPIO / CS2	P410
PMOD2-10	GPIO / CS3	P303
PMOD2-11	GND	GND
PMOD2-12	VCC	+3.3 V

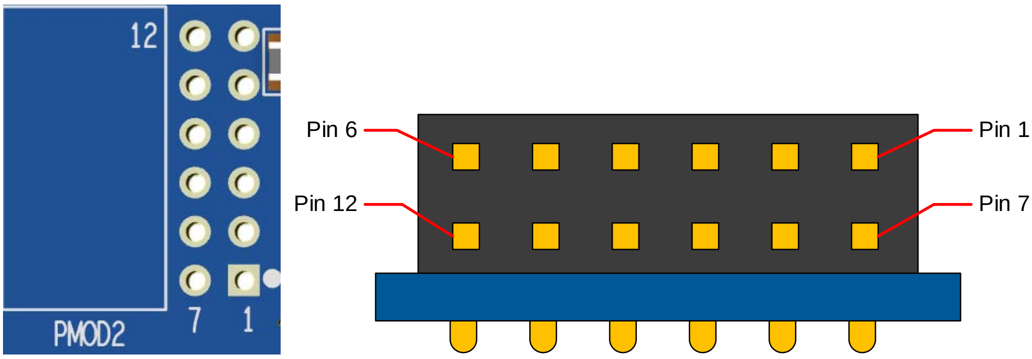


Figure 11. Pmod 2

5.3.2 Arduino™ Connector

An Arduino Uno R3 compatible connector interface is provided.

Table 7. Arduino Uno Connections

Arduino Compatible Connector		FPB-RA6E1
Pin	**Description**	**Signal/Bus**
J2-1	NC	NC
J2-2	IOREF	+3.3 V
J2-3	RESET	P014
J2-4	3.3 V	+3.3 V
J2-5	5 V	+5 V
J2-6	GND	GND
J2-7	GND	GND
J2-8	VIN	NC
J6-1	A0	P000 (AN000)
J6-2	A1	P001 (AN001)
J6-3	A2	P002 (AN002)
J6-4	A3	P003 (AN003)
J6-5	A4	P004 (AN004)
J6-6	A5	P008 (AN008)
J5-1	D0 / RXD	P110 (RXD9)
J5-2	D1 / TXD	P109 (TXD9)
J5-3	D2 / INT0	P409 (IRQ6)
J5-4	D3 / INT1 / PWM	P104 (IRQ1/GTIOC1B)
J5-5	D4	P107
J5-6	D5 / PWM	P105 (GTIOC1A)
J5-7	D6 / PWM	P303 (GTIOC7B)
J5-8	D7	P113
J1-1	D8	P402
J1-2	D9 / PWM	P302 (GTIOC4A)
J1-3	D10 / SPI_SS / PWM	P103 (SSLB0/GTIOC2A)
J1-4	D11 / SPI_MOSI / PWM	P101 (MOSIB/GTIOC5A)
J1-5	D12 / SPI_MISO	P100 (MISOB)
J1-6	D13 / SPI_SCK	P102 (RSPCKB)
J1-7	GND	GND
J1-8	AREF	ARDUINO/VREFH0
J1-9	I²C SDA	P401 (SDA0)
J1-10	I²C SCL	P400 (SCL0)

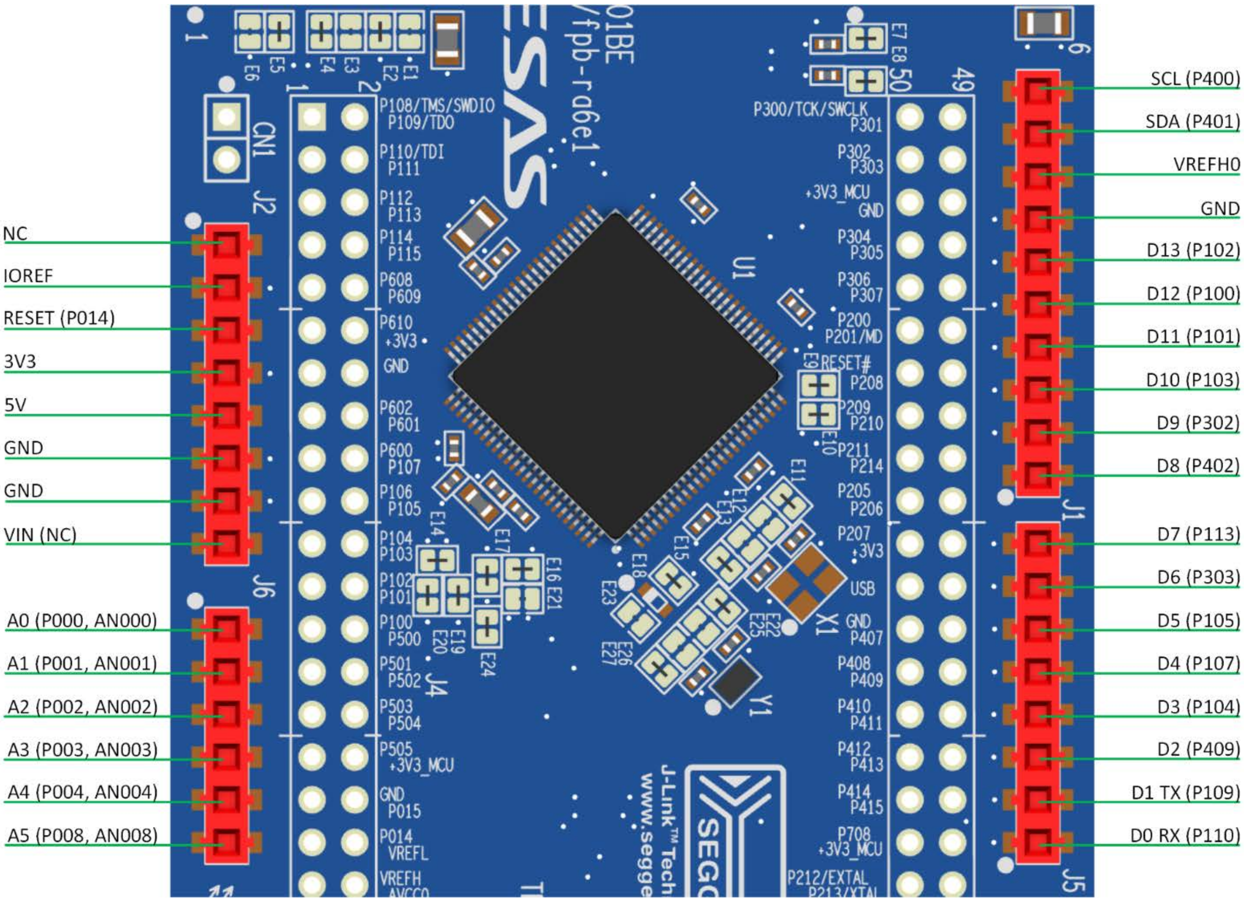


Figure 12. Arduino Uno Connectors

5.4 Miscellaneous

5.4.1 User and Power LEDs

Three LEDs are provided on the FPB-RA6E1 board. The fourth LED (POWER) can also be fitted if desired. A suitable part is Würth Elektronik 732-4971-1-ND.

Behaviour of the LEDs on the FPB-RA6E1 board is described in the following table.

Table 8. FPB-RA6E1 Board LED Functions

Designator	Colour	Function	MCU Control Port
LED1	Green	User LED	P408
LED2	Green	User LED	P407
POWER	Green	Power on indicator (not fitted)	+3.3 V
DEBUG/POWER	Yellow	Debug/power LED	SEGGER J-Link On-Board Debugger MCU

The User LEDs may be isolated from the main MCU so that the associated ports can be used for other purposes. To disconnect LED1 from P408, trace cut jumper E10 must be open. To disconnect LED2 from P407, trace cut jumper E9 must be open.

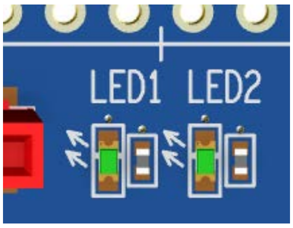


Figure 13. User LEDs

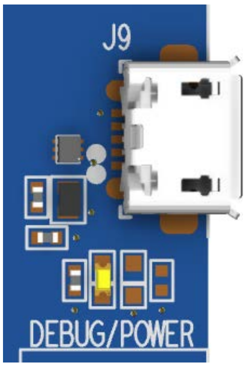


Figure 14. Power LED

5.4.2 User and Reset Switches

Two miniature, momentary, mechanical push-button type SMD switches are mounted on the FPB-RA6E1 board.

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

Table 9. FPB-RA6E1 Board Switches

Designator	Function	MCU Control Port
S1	User Switch	P205 (IRQ1)
S2	MCU Reset Switch	RESET#

The User Switch S1 may be isolated from the MCU, so that the associated port can be used for other purposes. To disconnect S1 from P205, trace cut jumper E29 must be open.

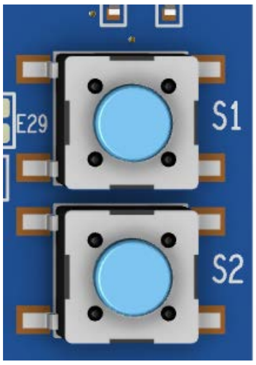


Figure 15. Reset (S2) and User Switch (S1)

5.4.3 MCU Boot Mode

A two-pin header (J7) can be fitted to select the boot mode (P201) of the RA MCU. For normal operation (single-chip mode), leave J7 open. To enable SCI boot mode, place a jumper on J7.

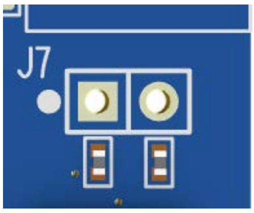


Figure 16. Boot Mode Jumper (J7)

5.4.4 MCU Clocks

The board is fitted with a RA MCU sub-clock oscillator crystal, providing a precision 32,768 Hz reference clock. The option has also been provided to fit an RA MCU oscillator crystal, providing a precision 24.000 MHz reference clock. A recommended part is the Diodes Incorporated FL2400022.

6. MCU Native Pin Access

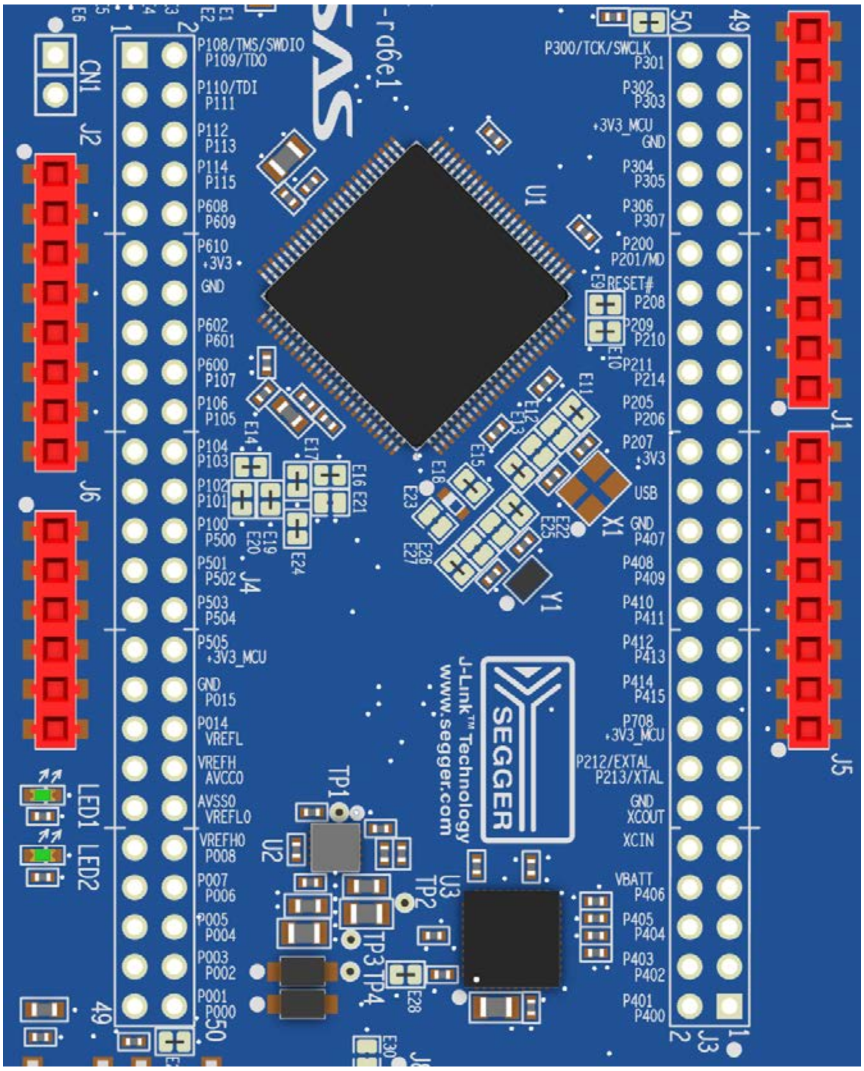


Figure 17. Native Pin Access J3 and J4

6.1 Breakout Pin Headers

The FPB-RA6E1 board pin headers (not fitted), J3 and J4, provide access to all RA MCU interface signals, and to voltages for all RA MCU power ports. Each header pin is labelled with the voltage or port connected to that pin. Refer to the RA6E1 MCU Group User’s Manual for details of each port function, and the FPB-RA6E1 board schematic for pin header port assignments.

The placement of the breakout pin headers allows for a standard 2.54 mm (0.100”) centre breadboard to be placed on both pin headers simultaneously. This can be used for prototyping and testing of custom circuitry for use with the RA6E1 MCU.

6.2 MCU Current Measurement

Included near the RA MCU is resistor R3 and test connector CN1 (not fitted) to measure the MCU core current.

Resistor R3 is 0 Ω (SMD 0805) as supplied. It should be removed in order to measure the current consumption using an ammeter connected between CN1 pins 1 and 2.

Alternatively, it could be removed and replaced with a suitable low value resistor (such as 100 mΩ), and then a voltmeter used to measure the voltage between CN1 pins 1 and 2. The current drawn by the MCU can then be calculated using Ohm’s Law.

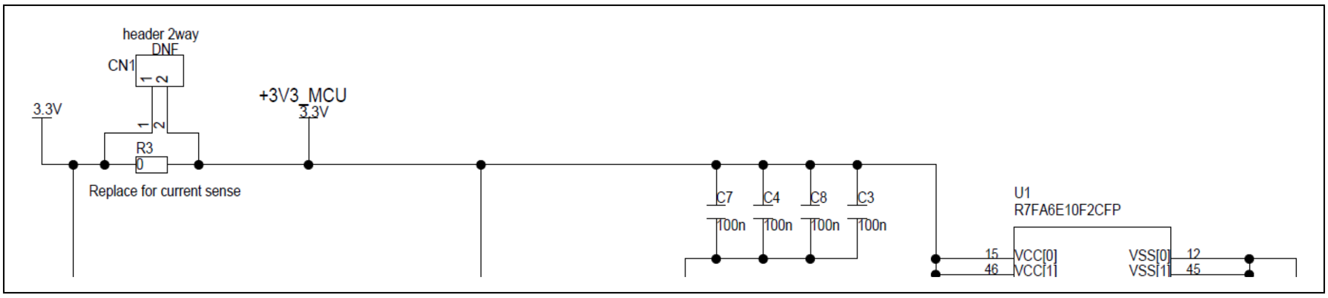


Figure 18. RA +3.3 V Current Measurement Circuit

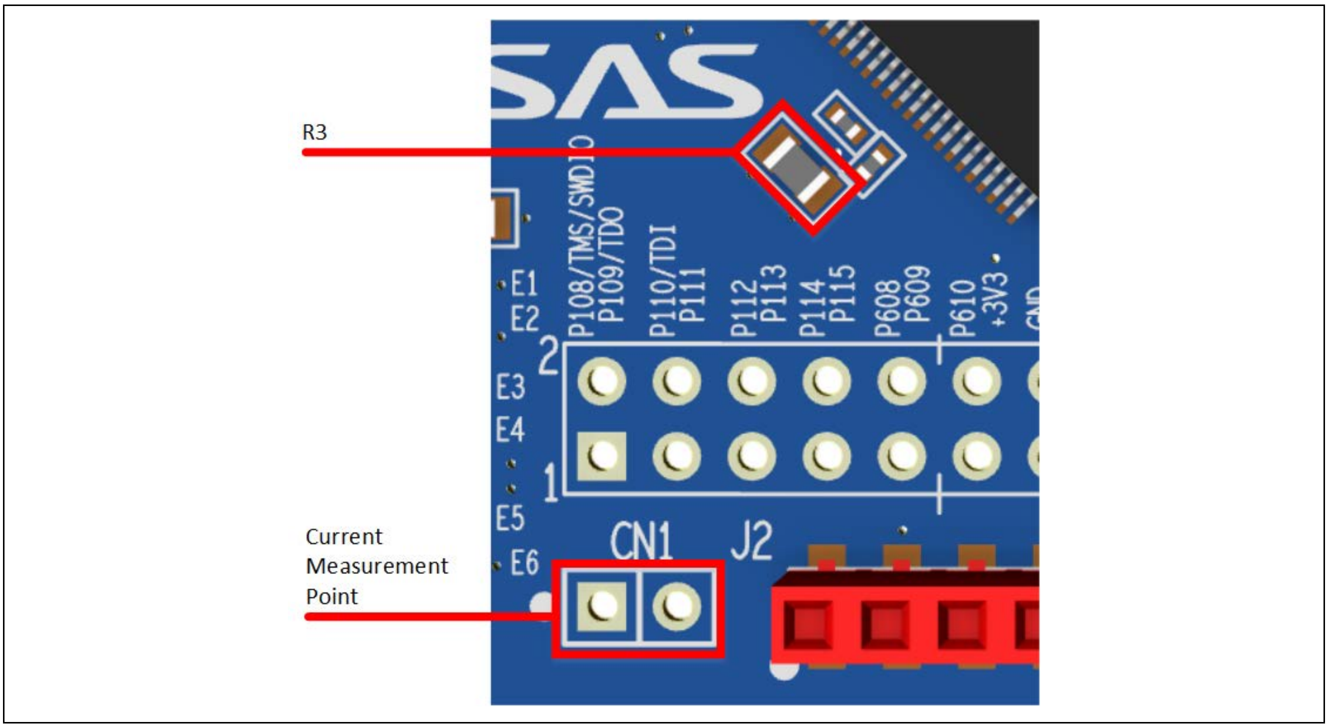


Figure 19. RA MCU +3.3 V Current Measurement Point (CN1) and R3

7. Recommended Parts

Table 10 lists recommended part numbers for optional components that can be fitted as required.

Table 10. Part Numbers

Designator(s)	Description	Manufacturer	Part Number
X1	24MHz Crystal	Diodes Incorporated	FL2400022
J3, J4	50-way male header	Würth Elektronik	613 064 211 21
CN1, CN2, J7	2-way male header	Würth Elektronik	613 002 111 21
PMOD1, PMOD2	12-way female header socket	Samtec	SSW-106-02-T-D-RA
D1	Schottky diode	Toshiba	CES520L3F
POWER	Green 0603 LED	Würth Elektronik	732-4971-1-ND
R23	10K 0402 resistor	Yageo	RC0402FR-0710KL

8. Certifications

The FPB-RA6E1 v1 board 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.
- 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 FPB-RA6E1 v1 kit is available in the “FPB-RA6E1 v1 Design Package” available on renesas.com/ra/fpb-ra6e1.

- Design package file name: fpb-ra6e1-v1-designpackage.zip
- Design package contents

Table 11. FPB-RA6E1 Board Design Package Contents

File Type	Content	File/Folder Name
File (PDF)	Schematics	fpb-ra6e1-v1-schematics
File (PDF)	Mechanical Drawing	fpb-ra6e1-v1-mechdwg
File (PDF)	3D Drawing	fpb-ra6e1-v1-3d
File (PDF)	BoM	fpb-ra6e1-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 RA family of microcontrollers, download tools and documentation, and get support.

FPB-RA6E1 Resources	renesas.com/ra/fpb-ra6e1
RA Product Information	renesas.com/ra
RA Product Support Forum	renesas.com/ra/forum
Renesas Support	renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Sep.07.21	—	Initial release

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