User's Manual

Target Board Kit S1JA (TB-S1JA)

User's Manual

Renesas Synergy™ Platform
Synergy Tools & Kits
Kits: TB-S1JA v1.0

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

• Ensure attached cables do not lie across the equipment.

• Reorient the receiving antenna.

• Increase the distance between the equipment and the receiver.

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

• Power down the equipment when not in use.

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

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

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

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

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

The Renesas Synergy™ Target Board Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

Renesas Synergy™ Platform

Target Board Kit S1JA (TB-S1JA)

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1. Overview

The Target Board Kit S1JA (TB-S1JA) enables developers get started with initial firmware development and evaluation of the Synergy Software Package (SSP) on the S1JA MCU Group.

- Renesas Synergy™ S1JA Microcontroller Group
  - R7FS1JA783A01CFM
  - 64-pin Low Profile Quad Flat Pack (LQFP) package
  - 48 MHz Arm® Cortex®-M23 core (Armv8-M architecture) with Arm MPU
  - 32 KB SRAM
  - 256 KB code flash memory
  - 8 KB data flash memory
- Connectivity
  - A Device USB connector for the Main MCU
  - S124 MCU based SEGGER J-Link® On-Board (OB) interface for debugging and programming of the S1JA MCU. A 10-pin JTAG/SWD interface is also provided for connecting optional external debuggers and programmers.
  - Two PMOD connectors, allowing use of appropriate PMOD compliant peripheral plug-in modules for rapid prototyping
  - Pin headers for access to power and signals for the Main MCU
- Multiple clock sources
  - Main MCU oscillator crystals, providing precision 12.000 MHz and 32,768 Hz reference clocks
  - Additional low-precision clocks are available internal to the Main MCU
- MCU reset push-button switch
- MCU boot configuration jumper
- General purpose I/O ports
  - One jumper to allow measuring of Main MCU current
  - Copper jumpers on PCB bottom side for configuration and access to selected MCU signals
- Operating voltage
  - External 5V input through the Debug USB connector supplies the on-board power regulator, which provides 3.3V to power the Target Board logic and interfaces. External 5V or 3.3V may be also supplied through alternate locations on the Target Board.
- A two-color board status LED indicating availability of regulated power and connection status of the J-Link interface
- A red User LED, controlled by the Main MCU firmware
- A User Push-Button switch, User Capacitive Touch Button sensor, and an optional User Potentiometer, all of which are controlled by the Main MCU firmware

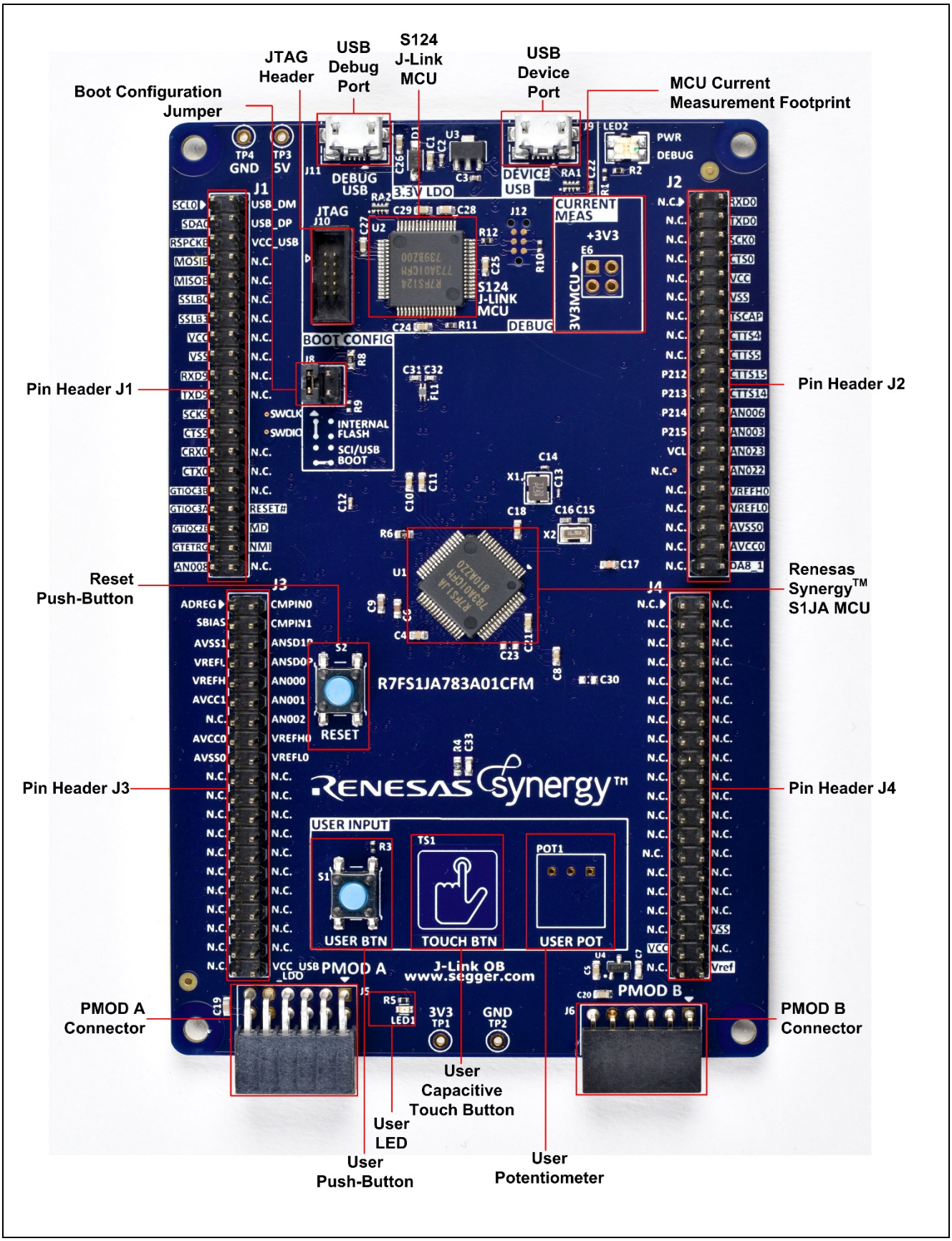


Figure 1. TB-S1JA Top Side

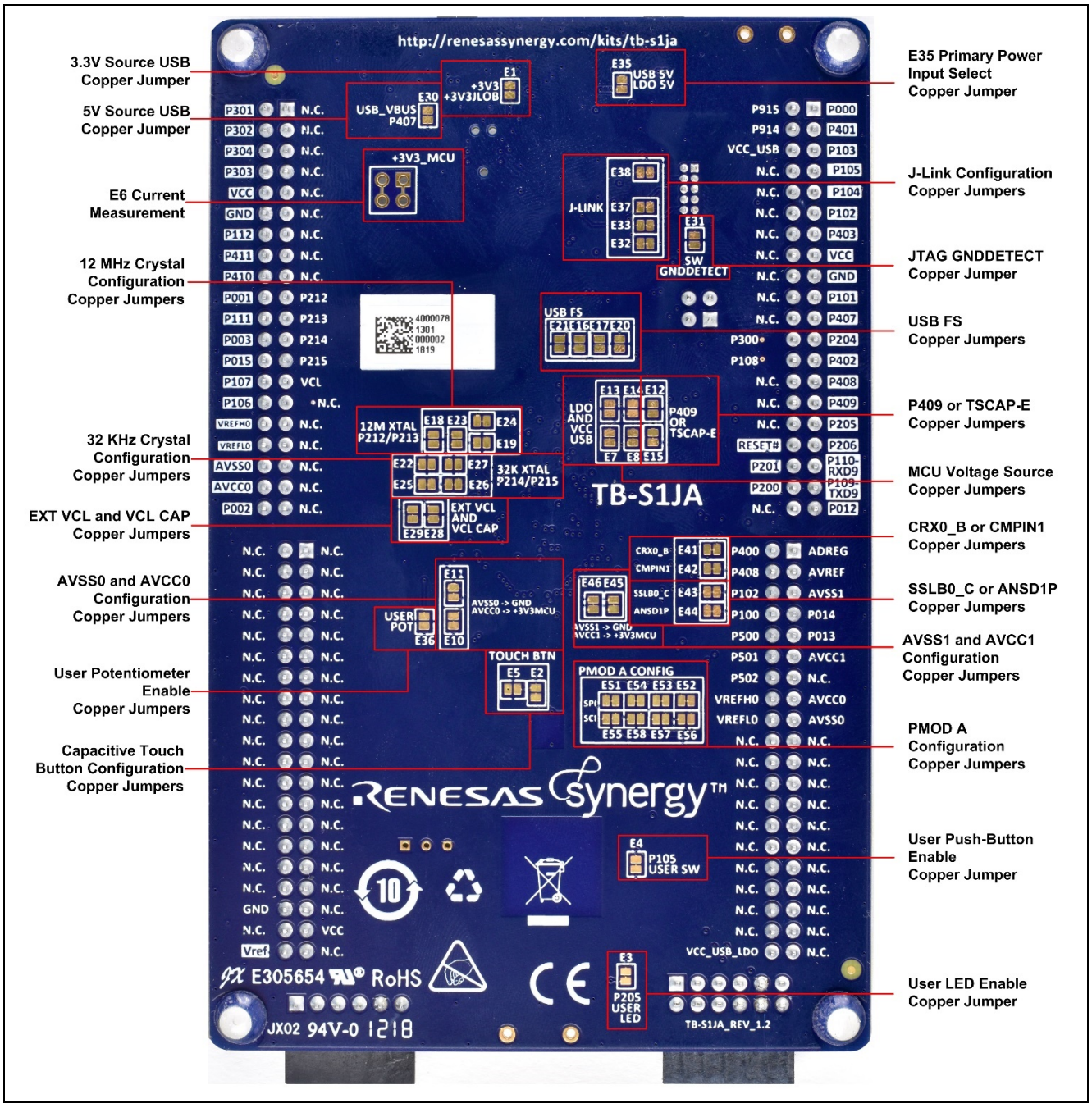


Figure 2. TB-S1JA Bottom Side

2. Kit Contents

The following components are included in the Target Board Kit (TB-S1JA):

- 1x TB-S1JA board
- 1x USB Type-A to USB Micro-B cable

3. Getting Started with Embedded Application Development on TB-S1JA

To develop and execute embedded applications on the TB-S1JA using the Synergy Platform, Synergy Software Package and development tools are required to be installed on your computer.

Step 1: Create My Renesas Account (if you do not have one already)

You need a **My Renesas** account to download software, development tools, and application projects. Log in to or Sign up for a **My Renesas** account at www.update.renesas.com/SSO/login.

Step 2: Download and Install Synergy Software Package and Development Tools

The Synergy Software Package, J-Link USB drivers, and one of the two supported tool chains are bundled and available as single downloadable file as follows:

A. **IAR Platform Installer** installs Synergy Software Package and IAR Embedded Workbench® for Renesas Synergy™ IDE with IAR complier and J-Link USB drivers.
Download from www.renesas.com/synergy/ewsynergy.

B. **e² studio Platform Installer** installs Synergy Software Package and e² studio for Synergy IDE with IAR complier and J-Link USB drivers.
Download from www.renesas.com/synergy/e2studio.

Note: The TB-S1JA uses J-Link® On-board (OB) debug interface. While J-Link drivers are necessary to establish debug connection between the host PC and the TB-S1JA, they are not required to run the Out-of-Box (OoB) Demonstration (Blinky) Application that the TB-S1JA comes pre-programmed with. Refer to the *TB-S1JA Quick Start Guide* for more details.

Step 3: Explore Existing Application Projects for the TB-S1JA

Renesas provides several application projects to demonstrate different capabilities of the S1JA MCU Group. These application projects can also serve as a good starting point for you to develop your custom applications. Application projects available for the TB-S1JA are listed at http://www.renesas.com/synergy/tb-s1ja.

Notes: 1. Every application project includes the project files, an application note, and instructions to import the application project.
2. On downloading the application project from the website to your computer, the application projects have to be built using one of the two supported tool chains before they can be downloaded on to the TB-S1JA board.

4. TB-S1JA Hardware Details

4.1 Jumpers and DIP Switch Settings

4.1.1 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 SMT resistor, size 0805, 0603, or 0402, may be placed across the two pads and soldered in place. A zero-ohm resistor shorts the pads together.

The silk screen overlay printing around a solder-bridge jumper is a box with a gap in the lines adjacent to the isolation region between the pads.

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.)

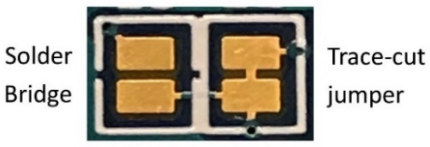


Figure 3. Copper Jumpers

4.1.2 Default Board Configuration

The following table describes the default settings for each jumper on the TB-S1JA Target Board. This includes traditional pin jumpers (J*x* designation) and copper jumpers (E*x* designation.)

The Circuit Group for each jumper is the designation found in the board schematic. Functional details for many of the listed jumpers may be found in Section 4.4, Connectivity and Settings, and section 4.6, Additional Features.

Table 1. Default Jumper Settings

Location	Circuit Group	Default Open/Closed	Function
J8	MCU Mode Config	Shunt on pins 1-2	Sets the MCU Mode to boot from Internal Flash
E18	12M Crystal	Open	Connects P213/XTAL on MCU to J2-21
E19		Open	Connects P212/EXTAL on MCU to J2-19
E23		Closed	Connects 12.000 MHz Crystal to MCU
E24		Closed	Connects 12.000 MHz Crystal to MCU
E1	3.3V Linear Regulator	Closed	Alternate 3.3 V source (+3V3JLOB)
E22	32K Crystal	Open	Connects P215/XCIN on MCU to J2-25
E25		Closed	Connects 32.768 kHz Crystal to MCU
E26		Closed	Connects 32.768 kHz Crystal to MCU
E27		Open	Connects P214/XCOUT on MCU to J2-23
E10	AVCC0-> +3V3MCU	Closed	Connects +3V3MCU to AVCC0
E11	AVSS0->GND	Closed	Connects Ground to AVSS1

Location	Circuit Group	Default Open/Closed	Function
E2	Capacitive Touch Button	Closed	Enable/Disable Capacitive Touch Button (connects P001 on MCU to Capacitive Touch Button)
E5		Open	Connects P001 on MCU to J2-20
E28	EXT VCL and VCL CAP	Open	Connects VCL to MCU
E29		Closed	Connects MCU pin 15 (VCL) to capacitor
E32	J-Link	Closed	Connects the S124 MCU to the J-Link signal JLED
E33		Closed	Connects the S124 MCU to the J-Link signal RESET#
E37		Closed	Connects the S124 MCU to the J-Link signal P100/SWDIO
E38		Closed	Connects the S124 MCU to the J-Link signal P300/SWCLK
E35	J-Link OB USB	Closed	Connects the J-Link OB USB 5V input to the primary 5V->3.3V voltage regulator
E31	JTAG Connector	Open	JTAG Ground Detect. Connects the JTAG connector pin 9 to Ground.
E13	LDO and VCC USB	Open	Connects VCC_USB_LDO to MCU pin 41
E14		Open	Connects VCC_USB_LDO to MCU pin 40
E7		Closed	Connects +3V3MCU to MCU pin 41
E8		Closed	Connects +3V3MCU to MCU pin 40
E12	P409/CAN or TSCAP-E	Open	Connects P409/CAN on MCU to J1-29
E30	USB Device Interface	Closed	Connects the Device USB 5V input to the MCU
E16	USB FS	Closed	Connects P915/USB_DM on MCU to signal USB_N
E17		Closed	Connects P914/USB_DP on MCU to signal USB_P
E20		Open	Connects P914/USB_DP on MCU to signal USBPH_P
E21		Open	Connects P915/USB_DM on MCU to signal USBPH_N
E3	User LED	Closed	Enable/Disable User LED
E36	User Potentiometer	Open	Enable/Disable User Potentiometer
E4	User Push-Button	Closed	Enable/Disable User Push-Button switch
E6	+3V3_MCU	Closed	Dual Jumper. Pins 1 and 3 connect +3V3 to +3V3MCU. Pins 2 and 4 are not used.
E41	CRX0_B (P408) -> J1	Closed	Connects P408 on MCU to J1-27
E42	CMPIN1 (P408) -> J3	Closed	Connects P408 on MCU to J3-4
E43	SSLB0_C (P102) -> J1	Closed	Connects P102 on MCU to J1-11
E44	ANSD1P (P102) -> J3	Closed	Connects P102 on MCU to J3-6
E45	AVCC1 -> +3V3MCU	Closed	Connects +3V3MCU to AVCC1
E46	AVSS1 -> GND	Closed	Connects AVSS1 to Ground

5. Hardware Layout

5.1 System Block Diagram

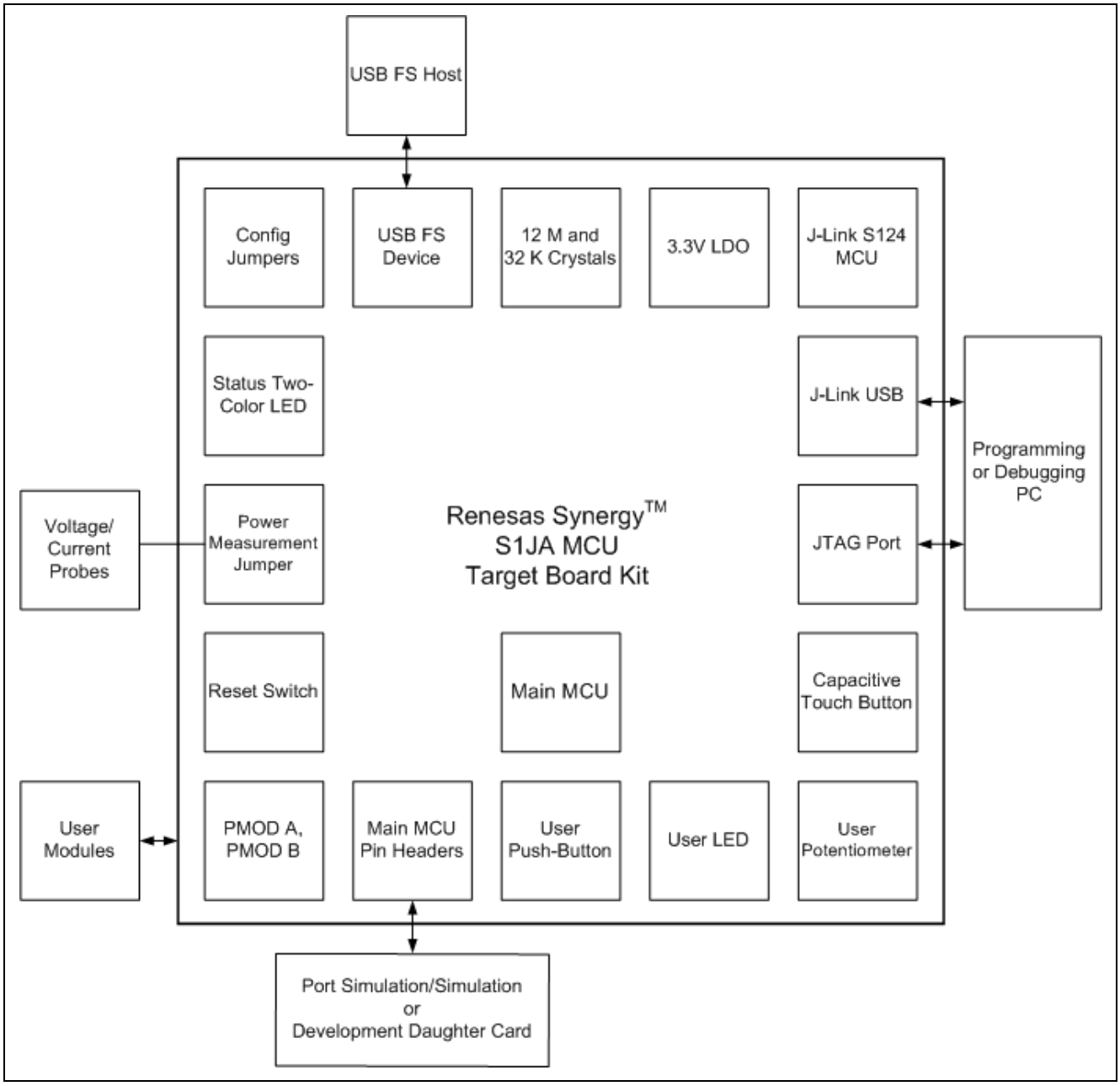


Figure 4. TB-S1JA Block Diagram

5.2 Power Requirements

TB-S1JA is designed for 3.3 V operation. This also means that 5 V PMOD devices cannot be used together with the TB-S1JA unless they are powered separately.

The total current available from the LDO regulator for all connected circuits is 600 mA or less, depending on the 5 V power source used.

5.2.1 Power Supply Options

TB-S1JA can be powered in several different ways as described in this section.

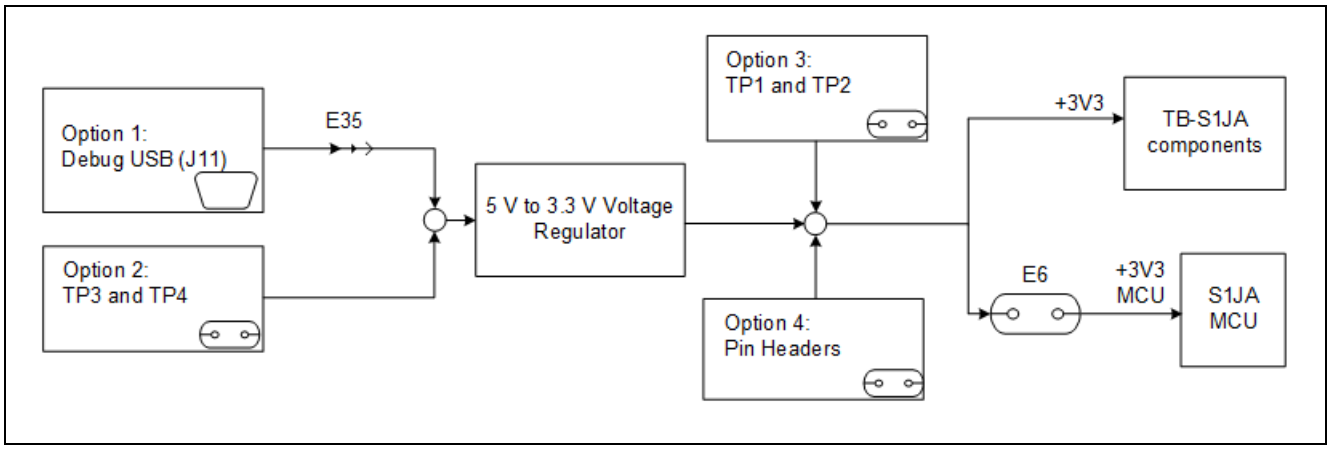


Figure 5. Power Supply Options

5.2.1.1 Option 1: Debug USB (Default)

The default power source is 5 V, supplied from an external USB host to the USB Debug connector labelled **DEBUG USB** on the top surface of the board. A low drop-out regulator (LDO) is used to convert the 5 V signal to 3.3 V, which then is used to power the MCU and any connected devices.

Copper jumper E35 selects the source for the primary power input to the LDO regulator. By default, this jumper is configured to provide power through the Debug USB connector. Copper jumper E35 is closed for this configuration.

5.2.1.2 Option 2: Test Points TP3 and TP4

TB-S1JA can also be powered by installing a 5 V power source across TP3 (positive input) and TP4 (negative input). Copper jumper E35 must be opened to enable powering the board using these test points.

The on-board Low Dropout Regulator (see section 4.3, Major Components) has an input voltage range of +3.3 V to +5.5 V, and a built-in current limit of 600 mA. Make sure any external power source connected to TP3 and TP4 meets these requirements.

Figure 6. USB Debug Connector (J11), TP3, and TP4 on Target Board

5.2.1.3 Option 3: Test Points TP1 and TP2

TB-S1JA can also be powered by installing a 3.3 V source across TP1 (positive input) and TP2 (negative input). Copper jumper E35 must be open to enable powering the board using these test points.

Figure 7. TP1, TP2, and LED1 on Target Board

These test points supply voltage directly to the S1JA MCU, the S124 J-Link MCU, and other on-board circuitry. Use caution to ensure that any voltage connected in this manner meets the power requirements for the active features. Power sources that are outside of the published operating range for the active devices may cause degraded performance or damage the board.

5.2.1.4 Option 4: Pin Headers

TB-S1JA can also be powered through the following pin-headers on the board.

- J1 (pin J1-15 for +3.3V, pin J1-17 for Return)
- J2 (pin J2-10 for +3.3V, pin J2-12 for Return)
- J4 (pin J4-37 for +3.3V, pin J4-36 for Return)

Copper jumper E35 must be open for any of these configurations.

The pin headers supply voltage directly to the S1JA MCU, the S124 J-Link MCU, and other on-board circuitry. Use caution to ensure that any voltage connected in this manner meets the power requirements for the active features. Power sources that are outside of the published operating range for the active devices may cause degraded performance or damage the board.

See Section 4.5, Target Board Pin Headers for more information on the Pin Headers.

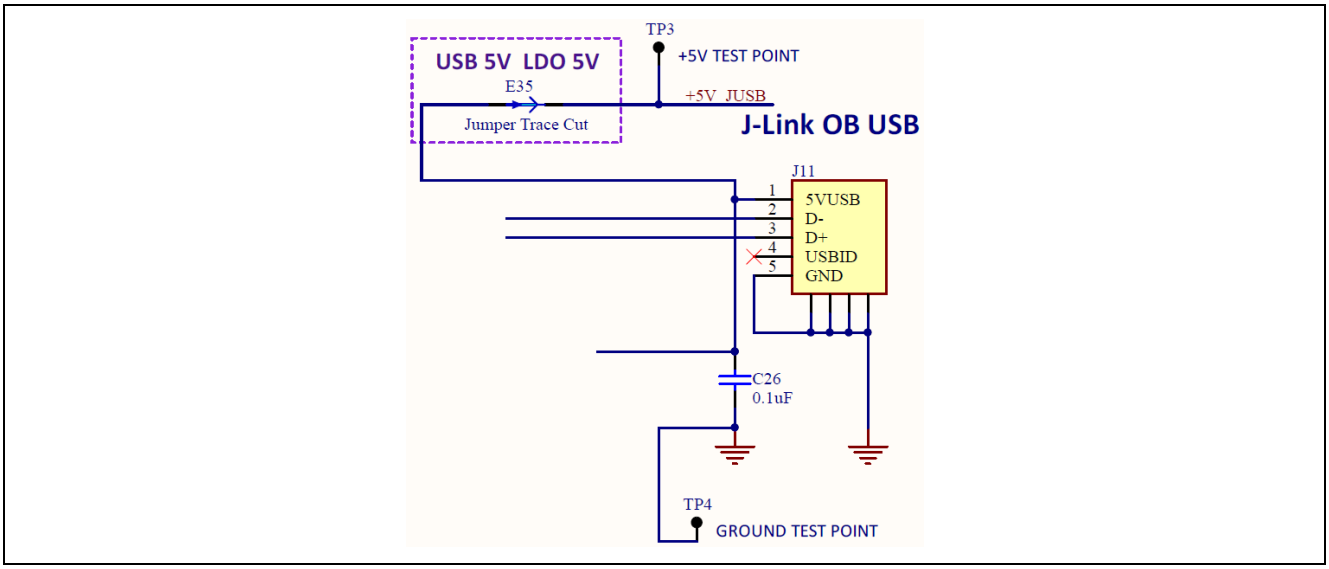


Figure 8 5 V Power Input Circuit

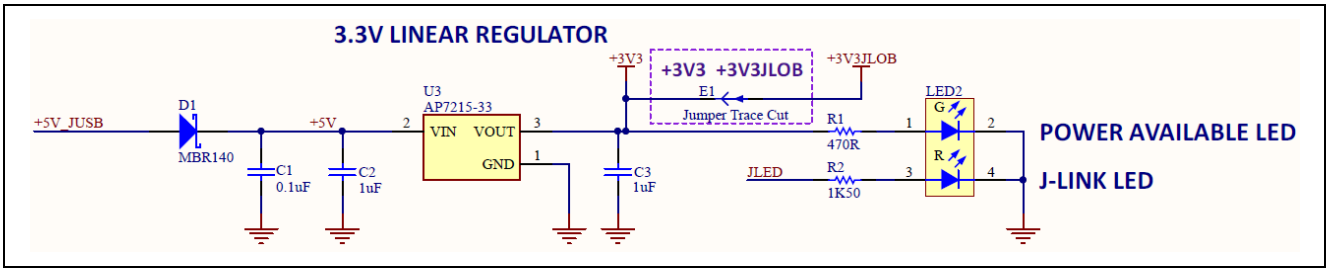


Figure 9. 3.3 V Power Regulator Circuit

5.2.2 Powering up the Board

When powered, the green LED to the right of the DEVICE USB connector (LED2) lights up.

The red LED in the same LED package functions as a status indicator for the J-Link On-Board debug interface on the board. If both LEDs in the LED2 package are lit, LED2 appears orange.

Figure 10. LED2 on Target Board (Top Side)

5.2.3 Measuring Current Consumption

Pads 1 and 3 of copper jumper E6, which is a trace-cut jumper, allow measurement of +3V3 MCU supply current. Trace is connected by default and should be cut to enable power measurement. Care must be taken when cutting the trace to not cause damage to PCB layers below the trace.

The actual current consumed by the S1JA MCU is dependent on many factors, including ambient temperature, internal clock speed, input voltage level, and device activity. The actual current consumed by the MCU can vary from less than 1 mA to nearly 40 mA. Refer to the *S1JA User's Manual* for more information on the electrical characteristics of the MCU.

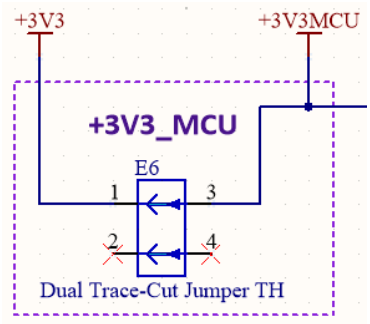


Figure 11. MCU Current Measurement Circuit

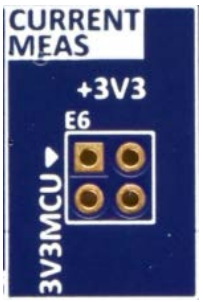


Figure 12. E6 on Target Board (Top Side)

Figure 13. E6 on Target Board (Bottom Side)

Once the shorting traces have been removed, there are several options to measure current:

- Pins can be installed that allow connection of a precision multi-meter or bench meter, or leaded current shunt to allow oscilloscope or data logger connection. When not measuring current, this allows easily installed and removed shunts to be used to short the jumper terminals.
- Another option is to install current sense resistors between pads 1 and 3 for +3V3MCU. Precision non-inductive film or foil resistors are recommended for use in this application, and the value of each resistor should be carefully considered.

  For example, if the expected current requirement for the +3V3 MCU supply voltage is 10 mA, and the user would expect to measure a 10 mV drop across the current measurement resistor, then a 1.0-ohm resistor should be selected and installed. The actual value selected should be based on the operating conditions of the MCU for the specific user application and the sensitivity of the measurement equipment used.

5.3 Major Components

- Main MCU
  - Renesas Synergy™ S1JA MCU device, part number R7FS1JA783A01CFM#AA0 (U1)
- J-Link MCU
  - Renesas Synergy™ S124 MCU device, part number R7FS124773A01CFM#AA0 (U2)
- USB Connectors
  - FCI, part number 10118192-0001LF (J9, J11)
    - Micro USB 2.0 Female connector
    - Primary communication with Main MCU and J-Link MCU
- Push-Buttons
  - C&K, part number PTS645SM43SMTR92 LFS (S1, S2)
    - Momentary push-button switch
    - Used for system reset and user defined functions
- LDO Regulator
  - Diodes Inc., part number AP7215-33YG-13 (U3)
    - Low-drop out linear regulator
    - Generates system 3.3 V from J-Link USB 5 V input
- PMOD A Connector
  - Samtec, part number SSW-106-02-F-D-RA (J5)
    - 12-pin right angle connector for PMOD A
- PMOD B Connector
  - Samtec, part number SSW-106-02-FM-S-RA (J6)
    - 6-pin right angle connector for PMOD B
- Pin Headers
  - Sullins, part number PRPC020DAAN-RC (J1, J2, J3, J4)
    - 40 position pin header, 0.1” pitch
    - Provides signal breakout and access for Main MCU signals
- System LED
  - Dialight, part number 598-8610-207F (LED2)
    - Dual color red/green LED
    - System status indicator for power and J-Link status
- User LED
  - Lite-On, part number LTST-C191KRKT (LED1)
    - User defined
    - Single color red LED as needed for user environment
- User Potentiometer
  - Bourns, part number 3352T-1-1-3LF (POT1)
    - User defined
    - Provides variable resistance as needed for user environment

5.4 Connectivity and Settings

Throughout this section, feature configuration using copper jumpers is described. See section 3.1.1, Copper Jumpers for information on using copper jumpers.

5.4.1 Device USB

The DEVICE USB Micro-B connection jack connects the Main MCU to an external USB Host, FS capable, allowing communications for testing and use of the Main MCU firmware. Power for the Target Board cannot be received from this connector. The DEVICE USB interface can detect the presence of power from the USB Host PC. USB Host power received at the DEVICE USB interface is not connected to the Target Board 5 V power bus.

Table 2. DEVICE USB Connector (J9)

USB Device Connector		TB-S1JA
Pin	**Description**	**Signal/Bus**
1	+5VDC, connected to a sense voltage 2/3 divider to allow Main MCU sensing of Host presence	+5VUSB P407/USB_VBUS = 2/3(5VUSB)
2	Data-	P915/USB_DM
3	Data+	P914/USB_DP
4	USB ID, jack internal switch, cable inserted	N.C.
5	Ground	GND

Connections in Table 2 are based on the condition of copper jumpers E16, E17, E20, E21, and E30 matching their as-manufactured status. As manufactured, E16 and E17 are closed, E20 and E21 are open, and E30 is closed.

Alternatively, the Device USB signals to the Main MCU may be connected to MCU Pin Header J1. To enable this configuration, copper jumpers E16 and E17 should be open, and E20 and E21 should be closed.

5.4.2 Debug USB

The DEBUG USB Micro-B connection jack connects the S124 J-Link MCU to an external USB Host, FS capable, allowing re-programming and debugging of the Main MCU firmware. Power for the Target Board may be received from this connector.

The J-Link OB interface is multiplexed with the JTAG interface, and can collectively be referred to as the Programming Interface. While the J-Link OB interface and the JTAG interface do not conflict, the J-Link OB signals may be isolated from the programming interface by changing the associated copper jumpers.

J-Link Disconnect Copper Jumpers E32, E33, E37, and E38 connect the J-Link signals to the MCU programming interface. To isolate the J-Link signals from the JTAG interface, the copper jumpers must be open. To allow use of the J-Link interface, each copper jumper must be closed.

J-Link MCU Power Copper Jumper, E1, connects the main +3.3V power to the J-Link +3.3V power. The default condition for E1 is closed, which connects the J-Link MCU power to the main +3.3V power. If J-Link signals are disconnected, the power to the J-Link MCU should also be removed by changing E1 to open.

Table 3. DEBUG USB Connector (J11)

DEBUG USB Connector		TB-S1JA
Pin	**Description**	**Signal/Bus**
1	+5VDC	+5V_JUSB
2	Data-	U2 USB_DM (U2-18)
3	Data+	U2 USB_DP (U2-19)
4	USB ID, jack internal switch, cable inserted	N.C.
5	Ground	GND

5.4.3 SWD (JTAG)

A 10-pin Cortex Debug Connector is provided at J10.

Note: S1JA MCU does not have JTAG support, only SWD.

Table 4. SWD (JTAG) Connector (J10)

JTAG Connector		TB-S1JA
Pin	**SWD pin name**	**Signal/Bus**
1	VTref	+3V3
2	SWDIO	U1 P108/SWDIO (U1-33)
3	GND	GND
4	SWCLK	U1 P300/SWCLK (U1-32)
5	GND	GND
6	N.C.	N.C.
7	N.C.	N.C.
8	N.C.	N.C.
9	GNDDetect	N.C. (short E31 to connect to GND)
10	nSRST	U1 RESET# (U1-25)

The Cortex® Debug Connector is fully described in the Arm® CoreSight™ Architecture Specification.

The J-Link MCU Power copper jumper and J-Link Disconnects copper jumpers may be open for proper operation of the SWD interface to prevent interactions with the J-Link MCU. See section 4.4.2, Debug USB for details.

If a SWD (JTAG) adapter is in use that properly interprets the Arm® Cortex® 10-pin Debug connector assignment of pin 9 to GND, SWD GNDDetect copper jumper E31 should be closed. If the SWD adapter used is one of several that may be confused or damaged by the presence of GND at pin 9, E31 should be open (as shipped).

The J-Link OB interface is multiplexed with the SWD interface, and can collectively be referred to as the Programming Interface. While the J-Link OB interface and the SWD interface do not conflict, the J-Link OB signals may be isolated from the programming interface by changing the copper jumpers as described in section 4.4.2, Debug USB.

5.4.4 LEDs

Two LEDs are provided on the TB-S1JA Target Board. Target Board U1 is the Main MCU, and directly controls LED1. See Figure 6 for LED1 location, Figure 9 for LED2 location, Figure 13 for LED1 circuit, and Figure 8 for LED2 circuit. Target Board U2 is the J-Link MCU, and controls the red LED in LED2.

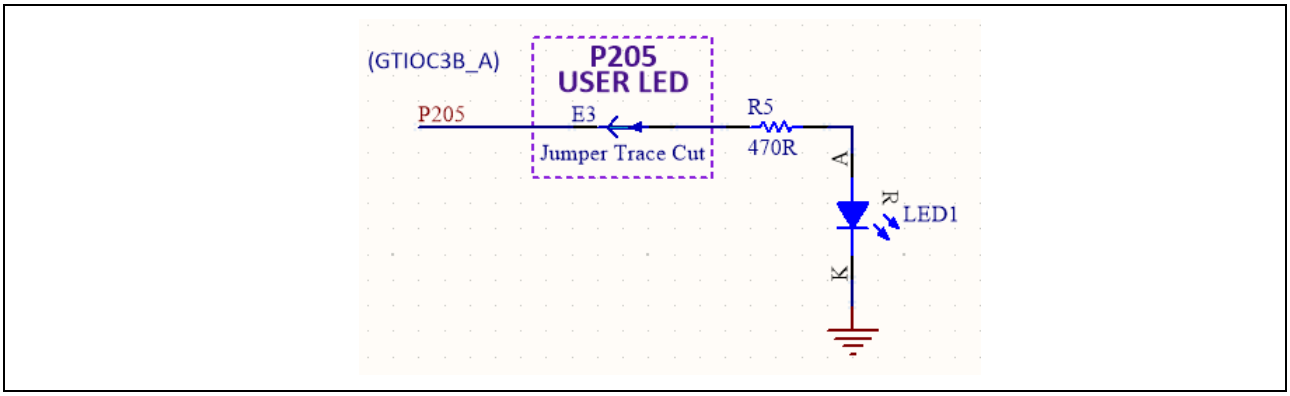


Figure 14. LED1 Control Circuit

The behavior of the LEDs is described in the following table.

Table 5. Target Board LED Functions

Designator	Color	Function	MCU control port	MCU pin
LED1	Red	User LED	U1 P205	U1-23
LED2	Red	J-Link Indicator	JLED (U2 P103)	U2-45
LED2	Green	3.3V Power Available	+3V3	N.A.

To disconnect the User LED from the MCU signal P205, copper jumper E3 must be open.

5.4.5 Switches

Two miniatures, momentary, mechanical push-button type SMT switches are mounted on the Target Board. Pressing the RESET Switch generates a reset signal to restart the Main MCU. To disconnect the User Switch from the MCU signal P206/IRQ6_A, copper jumper E4 must be open.

Note: The correct port number for User SW (E4) is P206 as shown in the following schematic diagram. The board photograph (v1.2) showing P105 for the User SW (E4) (snippet shown to the right) is incorrect and should be P206 instead.

Table 6. Target Board Switches

Designator	Function	MCU Control Port	MCU Pin
S1	User Switch	U1 P206/IRQ6_A	U1-22
S2	MCU Reset Switch	RESET#	U1-25

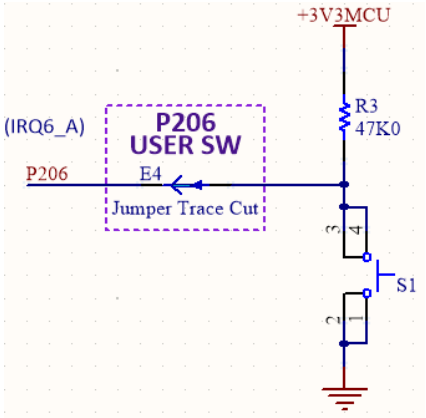


Figure 15. User Switch Circuit

Figure 16. User Switch (S1) on Target Board

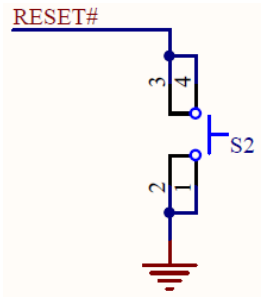


Figure 17. Reset Switch Circuit

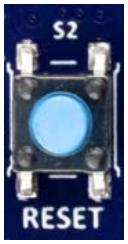


Figure 18. Reset Switch (S2) on Target Board

5.4.6 PMOD A

A 12-pin PMOD type 2A connector is provided at PMOD A. The interface is powered for 3.3 V modules only. The Main 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.

Signals on PMOD A are shared with the Main MCU pin header J2. Care must be taken to ensure that shared signals are not used concurrently.

Table 7. PMOD A Connector (J5)

PMOD A Connector		**TB-S1JA**
Pin	**Description**	**Signal/Bus**
1	SS (low to select slave)	U1 P112, SSLA0_B (U1-36)
2	MOSI	U1 P303, MOSIA_B (U1-29)
3	MISO	U1 P304, MISOA_B (U1-28)
4	SCK	U1 P111, RSPCKA_B (U1-35)
5	GND	GND
6	VCC	+3V3
7	INT (slave to master)	U1 P301, IRQ5_A (U1-31)
8	RESET (master to slave)	U1 P015, GPIO (U1-52)
9	Not Specified	U1 P107, GPIO (U1-41)
10	Not Specified	U1 P106, GPIO (U1-42)
11	GND	GND
12	VCC	+3V3

Limits of the 3.3 V regulator on the Target Board, and limits of the power source supplying that regulator (especially for USB Host devices), including the to-be-connected PMOD device, must be considered prior to connecting a module to a PMOD connector.

5.4.7 PMOD B

A 6-pin PMOD type 4 connector is provided at PMOD B. The interface is powered for 3.3 V modules only. The Main MCU acts as the UART DCE, and the connected module acts as the UART DTE. This interface may additionally be re-configured in firmware as some other PMOD types.

Signals on PMOD B are shared with Main MCU pin header J1 and J2. Care must be taken to ensure that shared signals are not used concurrently.

Table 8. PMOD B Connector (J6)

PMOD B Connector		TB-S1JA
Pin	**Description**	**Signal/Bus**
1	CTS (from module)	U1 P410, CTS0_A (U1-13)
2	TXD	U1 P411, TXD0_F (U1-12)
3	RXD	U1 P204, RXD0_C (U1-24)
4	RTS (from Main MCU)	U1 P401, GPIO (U1-2) (for RTS by Main MCU firmware)
5	GND	GND
6	VCC	+3V3

Limits of the 3.3V regulator on the Target Board, and limits of the power source supplying that regulator (especially for USB Host devices), including the to-be-connected PMOD device, must be considered prior to connecting a module to a PMOD connector.

5.4.8 User Capacitive Touch Button

A capacitive sensor region for use as a Capacitive Touch button is provided in the board USER INPUT region. A support circuit, TSCAP, is required for proper operation of Capacitive Touch button(s) by the Main MCU. To disconnect the Capacitive Touch Button from the MCU, copper jumper E2 must be open. To connect MCU signal P001 to pin header J3, copper jumper E5 must be closed.

Note: Capacitor C33 is optional. This design does not include a dielectric overlay, so C33 is added to reduce the sensitivity of the Capacitive Touch Button. This capacitor is not required by the MCU specification.

Table 9. Target Board Capacitive Touch Button Sensor

Designator	Function	MCU Control Port	MCU Pin
TS1	Capacitive Touch Button	U1 P001 (TS15)	U1-62
-	TSCAP Support	U1 P409 (TSCAP-E)	U1-14

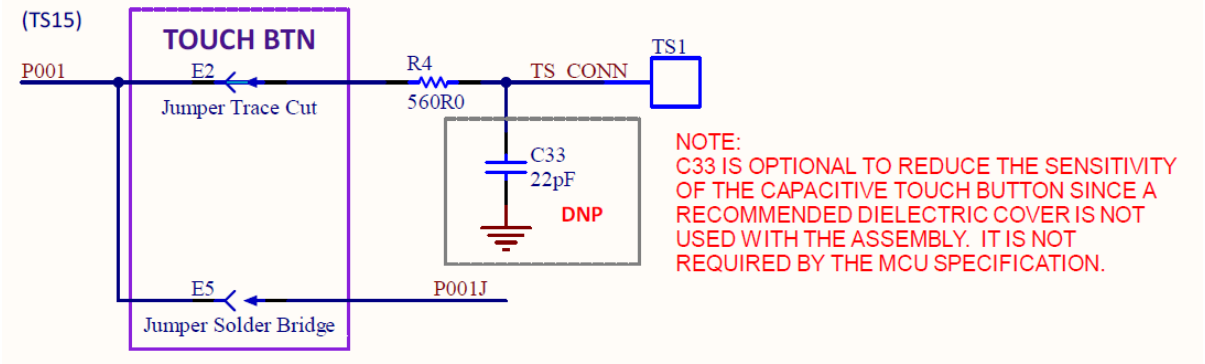


Figure 19. Capacitive Touch Button Circuit

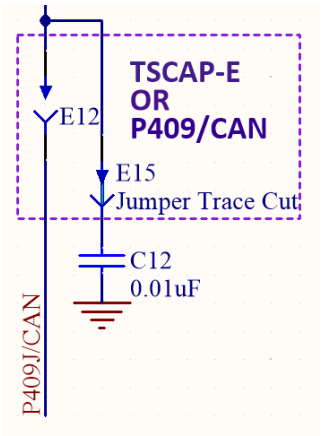


Figure 20. Capacitive Touch TSCAP Circuit

Figure 21. Capacitive Touch Button on Target Board (Top)

5.5 Pin Headers

The Target board pin headers, J1, J2, J3, and J4, provide access to all Main MCU interface signals, and to voltages for all Main MCU power ports.

Fixed Function Pin Assignments

For consistency across all Synergy Target Board Kits, some pin assignments on the headers have **fixed function** signal assignments. This provides specific signals and functions to be at a common pin header location on all Target Boards for a particular Synergy MCU Group (for example, S1/S3/S5/S7) and, where possible, across all Synergy Target Boards.

On TB-S1JA, 40 pins of the pin headers are set aside for **fixed function** assignment. These pins are odd-numbered pins of J1 and even-numbered pins of J2.

Pin Header Fixed Function Pins are labeled on the Target Board with dark text on a white background. Pins that are not Fixed Function pins are labeled with white text on a dark background. On the top side of the board is the functional label for the fixed location. On the bottom side of the board is the port information for the same pin.

Figure 22. Fixed Function Pin Label Example

There are several pins in the headers that are Secondary Fixed Function Pins. These Secondary Fixed Function Pins share common pin assignments with other Target Boards that have Main MCUs with the same functionality. The Secondary Fixed Function Pins are also labeled with the top side having a functional label, and bottom side having a port label.

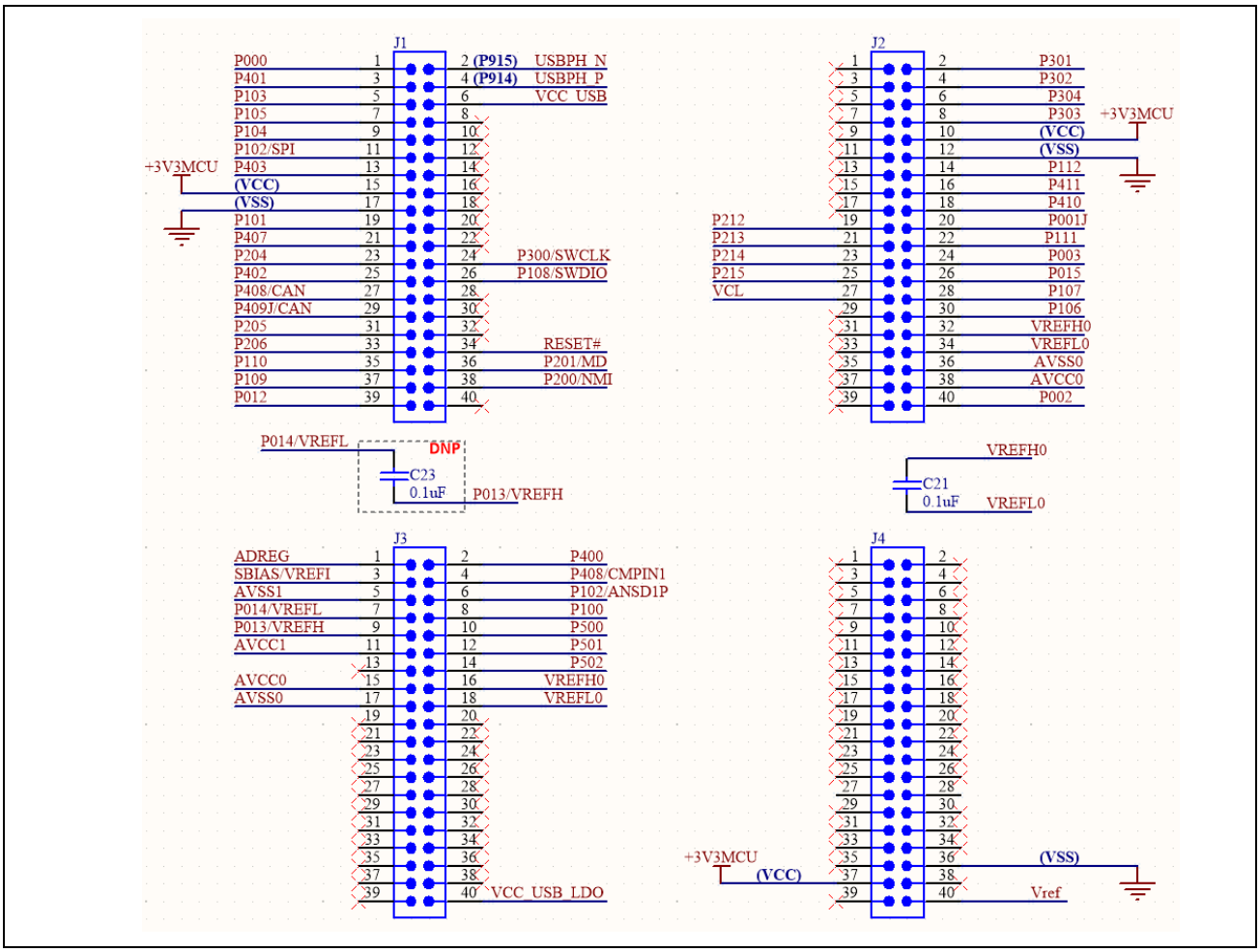


Figure 23. Pin Headers Circuits

5.5.1 Pin Header J1

Pin Header J1 is a 2-column by 20-row through-hole header on 2.54 mm centers.

Table 10. Pin Header J1 Pin Assignment

64p S1JA Pin	S1JA Port/Signal	J1 Pins		S1JA Port/Signal	64p S1JA Pin
63	P000/SCL0_C (IIC)	1	2	P915/USB_DM	38
2	P401/SDA0_C (IIC)	3	4	P914/USB_DP	39
45	P103/RSPCKB_C (SPI)	5	6	VCC_USB	40
43	P105/MOSIB_C (SPI)	7	8	(None)	NC
44	P104/MISOB_C (SPI)	9	10	(None)	NC
46	P102/SSLB0_C (SPI)	11	12	(None)	NC
4	P403/SSLB3_A (SPI)	13	14	(None)	NC
11	VCC	15	16	(None)	NC
8	VSS	17	18	(None)	NC
47	P101/RXD9_C (SCI 2nd)	19	20	(None)	NC
16	P407/TXD9_A (SCI 2nd)	21	22	(None)	NC
24	P204/SCK9_B (SCI 2nd)	23	24	P300/SWCLK	32
3	P402/CTS_RTS (SCI 2nd)	25	26	P108/SWDIO	33
15	P408/CRX0_B (CAN)	27	28	(None)	NC
14	P409/CTX0_B (CAN)	29	30	(None)	NC
23	P205/GTIOC3B_A	31	32	(None)	NC
22	P206/GTIOC3A_A	33	34	RES	25
34	P110/RXD9	35	36	P201/MD	26
64	P109/TXD9	37	38	P200/NMI	27
55	P012/AN008	39	40	(None)	NC

Color Key

Primary Fixed Function Pins
Secondary Fixed Function Pins

5.5.2 Pin Header J2

Pin Header J2 is a 2-column by 20-row through-hole header on 2.54 mm centers.

Table 11. Pin Header J2 Pin Assignment

64p S1JA Pin	S1JA Port/Signal	J2 Pins		S1JA Port/Signal	64p S1JA Pin
NC	(None)	1	2	P301/RXD0_B (SCI 1st)	31
NC	(None)	3	4	P302/TXD0_B (SCI 1st)	30
NC	(None)	5	6	P304/SCK0_B (SCI 1st)	28
NC	(None)	7	8	P303/CTS_RTS (SCI 1st)	29
NC	(None)	9	10	VCC	11
NC	(None)	11	12	VSS	8
NC	(None)	13	14	P112/TSCAP_B/CLKOUT_B	36
NC	(None)	15	16	P411/TS04	12
NC	(None)	17	18	P410/TS05	13
20	P212/EXTAL	19	20	P001/TS15	62
19	P213/XTAL	21	22	P111/TS14	35
17	P214/XCOUT	23	24	P003/AN006	60
16	P215/XCIN	25	26	P015/AN003	52
15	VCL	27	28	P107/AN023	41
14	VBATT	29	30	P106/AN022	42
NC	(None)	31	32	VREFH0	59
NC	(None)	33	34	VREFL0	58
NC	(None)	35	36	AVSS0	57
NC	(None)	37	38	AVCC0	56
NC	(None)	39	40	P002/DA8_1	61

Color Key

Primary Fixed Function pins
Secondary Fixed Function pins

5.5.3 Pin Header J3

Pin header J3 is a 2-column by 20-row through-hole header on 2.54 mm centers.

Table 12. Pin Header J3 Pin Assignment

64p S1JA Pin	S1JA Port/Signal	J3 Pins		S1JA Port/Signal	64p S1JA Pin
37	ADREG	1	2	P400/CMPIN0	1
38	SBIAS/AVREF	3	4	P408/CMPIN1	15
40	AVSS1	5	6	P102/ANSD1P	46
53	P014/VREFL	7	8	P100/ANSD0P	48
54	P013/VREFH	9	10	P500/AN000	49
39	AVSS1	11	12	P501/AN001	50
NC	(None)	13	14	P502/AN002	51
56	AVCC0	15	16	VREFH0	59
57	AVSS0	17	18	VFERL0	58
NC	(None)	19	20	(None)	NC
NC	(None)	21	22	(None)	NC
NC	(None)	23	24	(None)	NC
NC	(None)	25	26	(None)	NC
NC	(None)	27	28	(None)	NC
NC	(None)	29	30	(None)	NC
NC	(None)	31	32	(None)	NC
NC	(None)	33	34	(None)	NC
NC	(None)	35	36	(None)	NC
NC	(None)	37	38	(None)	NC
NC	(None)	39	40	VCC_USB_LDO	41

Color Key

Analog Front End Pins
Secondary Fixed Function Pins

5.5.4 Pin Header J4

Pin Header J4 is a 2-column by 20-row through-hole header on 2.54 mm centers.

Table 13. Pin Header J4 Pin Assignment

64p S1JA Pin	S1JA Port/Signal	J4 Pins		S1JA Port/Signal	64p S1JA Pin
NC	(None)	1	2	(None)	NC
NC	(None)	3	4	(None)	NC
NC	(None)	5	6	(None)	NC
NC	(None)	7	8	(None)	NC
NC	(None)	9	10	(None)	NC
NC	(None)	11	12	(None)	NC
NC	(None)	13	14	(None)	NC
NC	(None)	15	16	(None)	NC
NC	(None)	17	18	(None)	NC
NC	(None)	19	20	(None)	NC
NC	(None)	21	22	(None)	NC
NC	(None)	23	24	(None)	NC
NC	(None)	25	26	(None)	NC
NC	(None)	27	28	(None)	NC
NC	(None)	29	30	(None)	NC
NC	(None)	31	(None)	(None)	NC
NC	(None)	33	(None)	(None)	NC
NC	(None)	35	36	VSS	8
11	VCC	37	(None)	(None)	NC
NC	(None)	39	40	Vref 2.048V	Vref

Color Key

Secondary Fixed Function pins
Analog Voltage Reference 2.048V

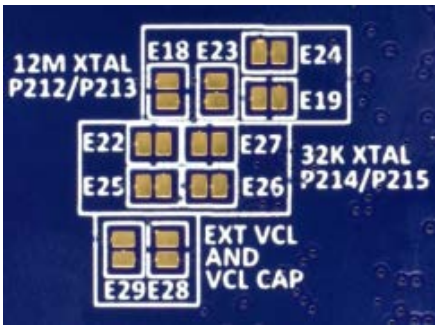
5.6 Additional Features

5.6.1 Analog Reference Voltages

A capacitor C21 and a footprint for installation of capacitor C23 is provided on the Target Board. These two capacitors provide noise-bypass capability for ports VREFH0/VREFL0 and for ports P013(VREFH)/P014(VREFL) respectively. See Figure 22 for the circuit design.

Port pair P013/P014 may be assigned as GPIO, where bypass capacitor C21 would damage signal quality. When P013/P014 are to be assigned as VREFH/VREFL, installation of capacitor C21 can reduce reference voltage noise and improve ADC measurement and DAC output quality.

5.6.2 On-Board Clock Crystals



TB-S1JA includes two precision crystal clock sources. A precision 12.000 MHz crystal is installed at location X1, and a precision 32.768 kHz crystal is installed at location X2. These crystal clock sources are connected to the Main MCU by default.

The MCU pins for the 12 MHz clock crystal may be connected to P212 and P213. To disconnect the 12 MHz crystal, open copper jumpers E23 and E24, and close copper jumpers E18 and E19.

The MCU pins for the 32.768 kHz clock crystal may be connected to P214 and P215. To disconnect the 32.768 kHz crystal, open copper jumpers E25 and E26, and close copper jumpers E22 and E27.

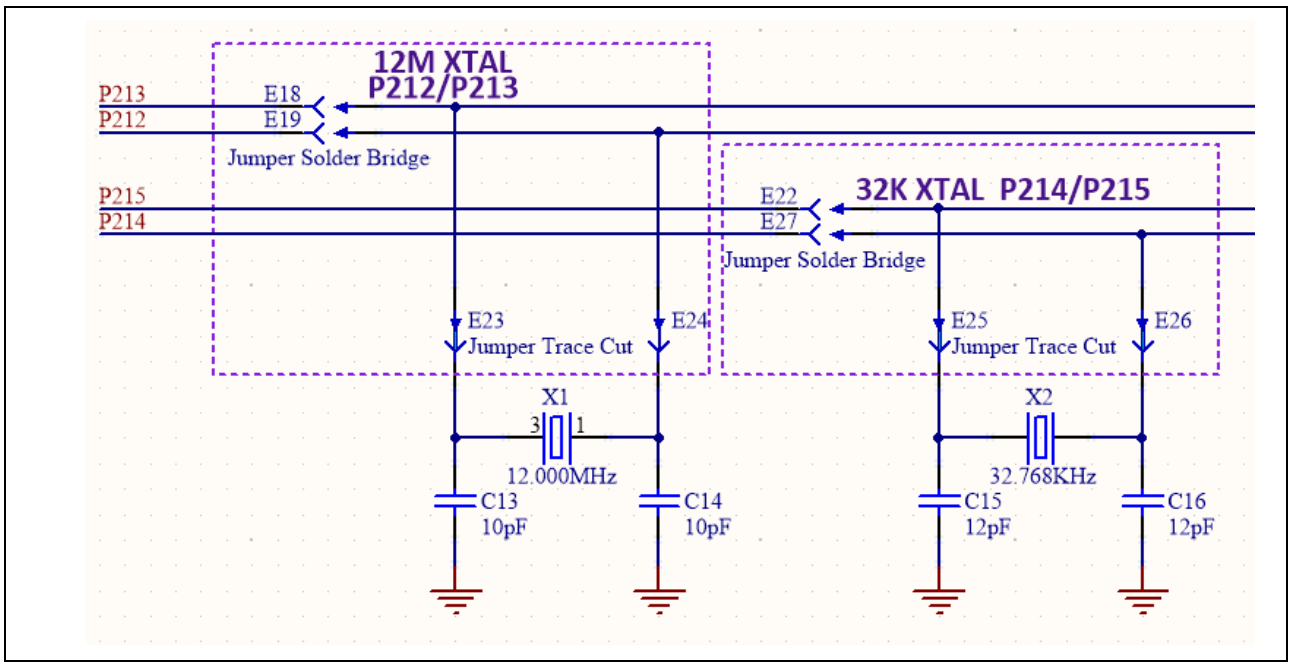


Figure 24. Crystal Clock Sources

5.6.3 User Potentiometer

A footprint for installation of a potentiometer and a recommended noise-bypass capacitor are provided on the Target Board. The footprint was designed for installation of a Bourns P/N 3352T-1-103LF, or equivalent, as the potentiometer, and a Samsung P/N CL10B104KB8NNNC, or similar, as the noise-bypass capacitor.

When the User Potentiometer is installed, copper jumper E36 must be closed to connect the User Potentiometer to the MCU.

Table 14. Target Board User Potentiometer

Designator	Function	MCU Control Port	MCU Pin
POT1	User Potentiometer	U1 P003 (AN006)	U1-60

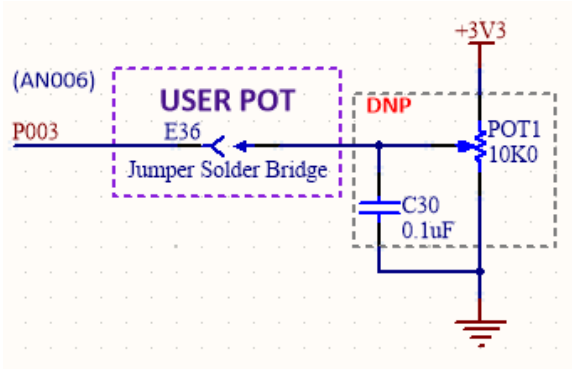


Figure 25. User Potentiometer Circuit

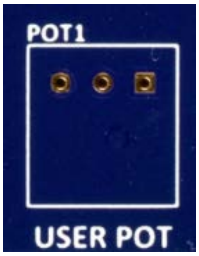


Figure 26. User Potentiometer on Target Board (Top)

5.6.4 Boot Configuration

The BOOT CONFIG jumper, J8, is used to configure the operating mode of the S1JA MCU at boot.

Table 15. Boot Configuration

Boot Configuration	J8 Shunt Location
Normal Boot (default)	Pins 1 and 2
SCI/USB Boot	Pins 1 and 3

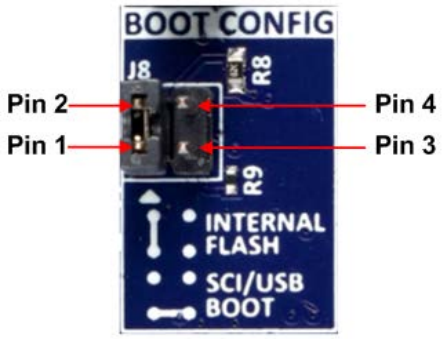


Figure 27. Boot Config Jumper J8

5.6.5 Miscellaneous Signals

5.6.5.1 AVCC0/AVSS0 and AVCC1/AVSS1

By default, AVCC0 and AVCC1 are connected to +3V3MCU, and AVSS0 and AVSS1 are connected to the system ground. To disconnect the reference voltage from AVCC0 and AVSS0, copper jumpers E10 and E11 must be open. To disconnect the reference voltage from AVCC1 and AVSS1, copper jumpers E45 and E46 must be open.

5.6.5.2 VCL

By default, the Main MCU pin VCL is connected to reference capacitor C17. To connect this pin to MCU pin header J2, solder bridge E28 must be closed. To disconnect the reference capacitor C17, copper jumper E29 must be open.

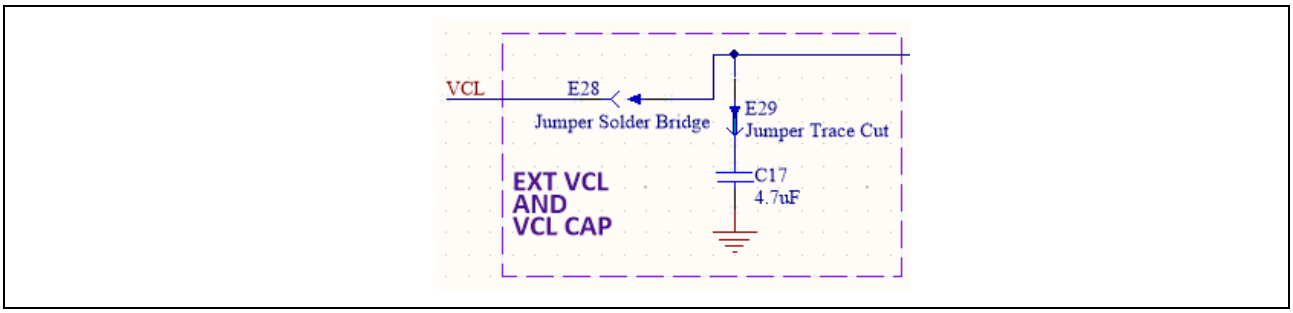


Figure 28. External Capacitor to VCL Circuit

5.6.5.3 VCC_USB_LDO

By default, the Main MCU pin VCC_USB_LDO is connected to the +3V3 MCU supply voltage. Alternatively, this pin may be connected to MCU Pin Header J3. To do this, copper jumper E7 must be open, and copper jumper E13 must be closed.

5.6.5.4 VCC_USB

By default, the Main MCU pin VCC_USB is connected to the +3V3 MCU supply voltage. Alternatively, this pin may be connected to MCU Pin Header J1. To do this, copper jumper E8 must be open, and copper jumper E14 must be closed.

5.6.5.5 Signal P409/CAN

By default, the Main MCU pin P409 is connected to a TSCAP-E capacitor. This pin may be connected to MCU Pin Header J1. To do this, copper jumper E12 must be closed. The TSCAP-E capacitor may be disconnected by making copper jumper E15 open.

6. Certifications

The TB-S1JA meets the following certifications/standards. See the beginning of this User's Manual for the disclaimer and precautions.

6.1 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.

- CE Class A (EMC)

  This product is herewith confirmed to comply with the requirmeents set out in the Council Directives on the Approximation of the laws of the Member States relating to electromagnetic Compatibility Directive 2004/108/EEC.

  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.

6.2 Material Selection, Waste, Recycling and Disposal Standards

- EU RoHS

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

6.3 Safety Standards

- UL 94V-0

7. Design and Manufacturing Information

The design and manufacturing information about the TB-S1JA board are available in the "TB-S1JA v1.3 Design Package" available on renesas.com/synergy/tb-s1ja.

- Design package file name: tb-s1ja-v1.3-designpackage.zip
- Design package contents

File Type	Content	File/Folder Name
File (PDF)	Schematics	tb-s1ja-v1.3-schematics
File (PDF)	Mechanical Drawing	tb-s1ja-v1.3-mechdwg
File (PDF)	3D Drawing	tb-s1ja-v1.3-3d
File (PDF)	BOM	tb-s1ja-v1.3-bom
Folder	Manufacturing Files	Manufacturing Files
Folder	Design Files	Design Files - Altium

Website and Support

Visit the following URLs to learn about key elements of the Synergy Platform, download components and related documentation, and get support.

TB-S1JA Resources	renesas.com/synergy/tb-s1ja
Synergy Software	renesas.com/synergy/software
Synergy Software Package	renesas.com/synergy/ssp
Software add-ons	renesas.com/synergy/addons
Software glossary	renesas.com/synergy/softwareglossary
Development tools	renesas.com/synergy/tools
Synergy Hardware	renesas.com/synergy/hardware
Microcontrollers	renesas.com/synergy/mcus
MCU glossary	renesas.com/synergy/mcuglossary
Parametric search	renesas.com/synergy/parametric
Kits	renesas.com/synergy/kits
Synergy Solutions Gallery	renesas.com/synergy/solutionsgallery
Partner projects	renesas.com/synergy/partnerprojects
Application projects	renesas.com/synergy/applicationprojects
Self-service support resources:	
Documentation	renesas.com/synergy/docs
Knowledgebase	renesas.com/synergy/knowledgebase
Forums	renesas.com/synergy/forum
Training	renesas.com/synergy/training
Videos	renesas.com/synergy/videos
Chat and web ticket	renesas.com/synergy/resourcelibrary

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Nov.01.18	—	Initial release
1.01	Apr.21.20	—	Updates to sections 5.4.8, 6, and 7

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