

SmartFusion SOM (System-On-Module) Baseboard Hardware Architecture

Version 1.02

Preliminary

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1. Introduction

This document is the Technical Specification for the Emcraft Systems SOM (System-On-Module) baseboard (SOM-BSB).

The SOM-BSB is intended to provide a hardware platform for the evaluation of and initial custom product development with the Emcraft Systems SOM SmartFusion product.

The SOM-BSB can be powered either from the USB port or from a separate external 5 volt power supply.

All the unused pins of the SOM are routed to a breadboard area on the SOM-BSB, which facilitates hardware and software prototyping.

The SOM-BSB comes complete with the hardware schematics and Bill of Materials (BOM) file, facilitating the design of custom baseboard hardware for the Emcraft Systems SOMs.

2. Hardware Platform

This section defines the hardware platform of the SOM-BSB.

2.1. Overview

The SOM-BSB implements the following hardware facilities:

- Two 80-pin SOM connectors;
- USB interface using USB/UART bridge connected to the UART0 port of the SOM;
- 10/100 Ethernet interface and RJ-45 connector;
- Microsemi FlashPro JTAG interface, for programming of the SmartFusion device on the SmartFusion SOM;
- LDO regulator for conversion of the USB +5 V to the +3.3 V SOM power supply;
- Lithium battery for the Real Time Clock on the SOM;
- Reset push button;
- Reset-out LED;
- User push button connected to GPIO on the SOM;
- Power Good LED indicating presence of the +3.3 V SOM power;
- Two user-controlled LEDs connected to GPIO on the SOM;
- Unused SOM signals available on the breadboard area. Additionally, the baseboard area provides a 25x8 2 mm pitch unconnected through-holes array for user prototyping;
- Possibility to provide necessary power supply voltages (+5 V, +3.3 V, +1.5 V for the power-optimized SOM operation, battery voltage) from external sources through dedicated pads of the breadboard area.

2.2. Functional Block Diagram

Figure 1 is the functional block diagram of the SOM-BSB.

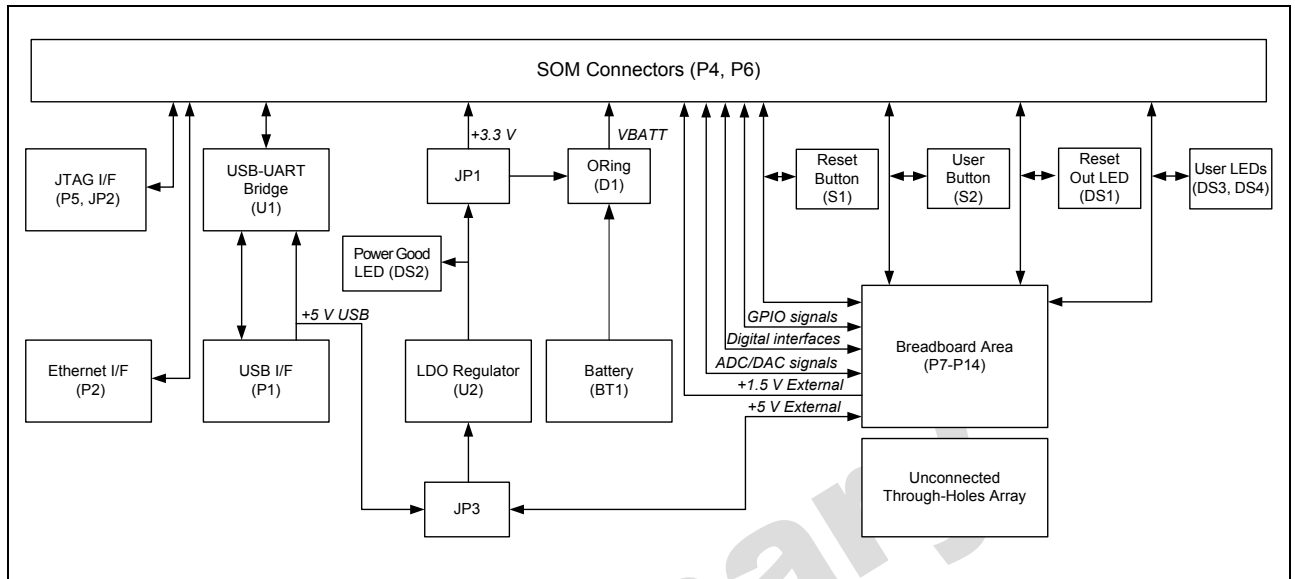


Figure 1: SOM-BSB Functional Block Diagram

2.3. SOM Connectors

The SOM-BSB provides two Hirose DF40 series connectors for the connection to the SOM. The connectors are 80-pin, 0.4 mm pitch receptacles, providing 4 mm stacking height.

2.4. USB Interface

The SOM-BSB provides USB interface on the type B mini USB connector (P1).

The interface is provided using an FTDI FT232RL USB-UART bridge. The FT232RL UART TX and RX pins are connected to the SOM serial console UART port.

2.5. Ethernet Interface

The SOM-BSB provides a 10/100 Ethernet interface using the P2 connector. This is an RJ-45 Ethernet port providing 10 Mbit (10BASE-T) and 100 Mbit (100BASE-TX) protocols.

The SOM-BSB provides two status LEDs integrated in the P2 connector. The LEDs are:

- Yellow, used to indicate the 10/100 Mbit link status when lit
- Green, used to indicate RX/TX activity when blinking.

The LEDs are connected on the SOM-BSB between the SOM outputs and +3.3 V power plane.

2.6. JTAG Interfaces

2.6.1. Microsemi FlashPro JTAG Interface

The SOM-BSB provides a JTAG interface on the P5 connector for use with the Microsemi FlashPro device for programming of the SmartFusion cSoC on the SmartFusion SOM.

The connector is a standard 10-pin JTAG port fully compatible with the Microsemi FlashPro3/4 devices.

Jumpers on the JP2 header set the mode of the SmartFusion JTAG controller and connect +3.3 V from the output of the LDO regulator to the programming supply voltage pin and the JTAG controller supply voltage pin on the SmartFusion.

The default settings of JP2 are: 1-2 open, 3-4 closed. For further details on the JP2 settings, see section 4.

2.7. Power

The SOM-BSB receives the +5 V power from the USB connector. Additionally, it is possible to supply an external +5 V power through the dedicated pad P10.2 of the SOM-BSB breadboard area. Configuration of the +5 V input power supply is defined by the JP3 header. The default settings of the JP3 are: 1-3 open, 2-4 closed. For further details on the JP3 settings, see section 4.

The +3.3 V supply voltage for the SOM and other components of the SOM-BSB is derived from the +5 V input voltage using a TPS73733DCQ LDO regulator. The regulator dissipates approximately 1 Watt and is mounted on a heatsink. The SOM-BSB provides a green Power Good LED that indicates presence of the +3.3 V power on the output of the LDO regulator.

It is possible to turn the LDO regulator off for debug purposes. To do so, the control signal `VCC3_EN` (P10.6 pad of the SOM-BSB breadboard area) must be connected to the ground.

For power-optimized SOM operation, it is possible to apply an external +1.5 V power through the dedicated pad P9.2 of the SOM-BSB breadboard area. When an external +1.5 V is applied to the SOM-BSB, the control signal `1V5_EN` (P9.5 pad of the breadboard area) must be connected to the ground.

2.8. RTC Backup Power

The SOM-BSB provides a CR2016 lithium Coin Cell battery as a backup power source for the SmartFusion RTC (Real Time Counter). The battery is installed in a 20 mm retainer. To satisfy the UL requirements, a series resistor and a Shottky diode are connected to the battery. The diode protects the battery from the reverse current. The resistor limits the battery abnormal charge current to a safe level (10 mA for the CR2016), should the protective diode get destructed.

The VBATT nominal voltage is +3 V. The SmartFusion RTC requires a backup supply power of +2.7 V to +3.63 V.

With a SOM installed on the SOM-BSB and the lithium battery present and connected to the SOM, and with the USB cable disconnected from the P1 connector or the +3.3 V LDO regulator turned off, the SmartFusion RTC is powered from the backup power source.

If the RTC backup power is not required, the lithium battery can be removed.

2.9. Reset Button

The SOM-BSB provides the S1 reset button used to trigger a hardware reset of the SOM.

2.10. Reset LED

The Reset LED indicates the status of the `nRESET_OUT` signal of the SOM. The LED is lit when `nRESET_OUT` is low.

2.11. User Button and User LEDs

The SOM-BSB provides the S2 user button and the DS3 and DS4 user LEDs as a simple input/output interface for testing and demonstration purposes.

For further details, refer to sections 5 and 6.

2.12. Breadboard Area

All unused signal pins of the SOM are available on the breadboard area marked as P7-P14. For further details, refer to section 3.6.

Additionally, the breadboard area provides a 25x8 2 mm pitch unconnected through-holes array for user prototyping.

3. Connectors

This section provides a full pin definition of all connectors available on the SOM-BSB.

3.1. SOM-BSB Connectors

Table 1 provides a summary of the SOM-BSB connectors:

Connector	Description
P1	Mini USB Type B connector
P2	RJ45 Ethernet connector
P4, P6	SOM connectors
P5	Microsemi FlashPro JTAG connector
P7-P14	Breadboard area (no actual connectors installed)
BT1	Battery retainer

Table 1: SOM-BSB Connectors

3.2. Mini USB Type B Connector

The P1 USB connector has a standard mini-B receptacle pin-out.

3.3. RJ45 Ethernet Connector

The P2 is a standard RJ45 NIC connector with the following definition:

Pin	Signal
1	TX+
2	TX-
3	RX+
4, 5	Unused pair; terminated on the SOM-BSB
6	RX-
7, 8	Unused pair, terminated on the SOM-BSB

Table 2: Ethernet Connector

3.4. SOM Connectors

For the definition of the two 80-pin SOM connectors (P4 and P6) refer to the *SmartFusion SOM Hardware Architecture* document.

3.5. Microsemi FlashPro JTAG Connector

The P5 is a standard 10-pin Microsemi FlashPro JTAG connector with the following definition:

Pin	Signal	Type	Description
1	JTAG_TCK	In	JTAG clock signal to the SmartFusion.
2, 10	GND	Power	Target ground.
3	JTAG_TDO	Out	JTAG data output from the SmartFusion.
4	NC	No Connection	JTAG mode set input of target MCU.
5	JTAG_TMS	In	JTAG mode select.
6	VJTAG_VPP	Power	Target reference voltage. This signal is connected to the SmartFusion programming voltage on the SmartFusion SOM.
7	VJTAG_VPP	Power	SmartFusion programming voltage. This signal is connected to the target reference voltage on the SmartFusion SOM.
8	JTAG_nTRST	In	JTAG controller reset.
9	JTAG_TDI	In	JTAG data input to the SmartFusion.

Table 3: FlashPro JTAG Connector

3.6. Breadboard Area

The test points in the breadboard area are grouped as PCB patterns for 10x2 2 mm pitch through-hole connectors (P7-P14) with the following definition:

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
1	VCC3	77, 79 of P4	+3.3 V SOM power supply. Output voltage of the SOM-BSB U2 LDO regulator.
2, 8, 10, 12, 14, 16, 18, 20	GND	2, 3, 5, 8, 9, 11, 14, 57, 75, 76 of P4	SOM ground.
3	ADC8	68 of P4	SmartFusion AFE active bipolar prescaler input.
4	ADC17	66 of P4	SmartFusion AFE active bipolar prescaler input.
5	ADC9	64 of P4	SmartFusion AFE active bipolar prescaler input.
6	ADC18	40 of P4	SmartFusion AFE active bipolar prescaler input.
7	ADC10	52 of P4	SmartFusion AFE active bipolar prescaler input.
9	ADC11	48 of P4	SmartFusion AFE active bipolar prescaler input.
11	ADC12	55 of P4	SmartFusion AFE active bipolar prescaler input.
13	ADC13	58 of P4	SmartFusion AFE low side of current monitor/ direct ADC input.
15	ADC14	53 of P4	SmartFusion AFE high side of current monitor/ direct ADC input.

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
17	ADC15	50 of P4	SmartFusion AFE high side of current monitor/ direct ADC input.
19	ADC16	42 of P4	SmartFusion AFE low side of current monitor/ direct ADC input.

Table 4: P7 Breadboard Area Connector

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
1	VCC3	77, 79 of P4	+3.3 V SOM power supply. Output voltage of the SOM-BSB U2 LDO regulator.
2, 4, 6, 8, 10, 12, 14, 16, 18, 19, 20	GND	2, 3, 5, 8, 9, 11, 14, 57, 75, 76 of P4	SOM ground.
3	ADC0	70 of P4	SmartFusion AFE direct ADC input.
5	ADC1	60 of P4	SmartFusion AFE direct ADC input.
7	ADC4	56 of P4	SmartFusion AFE direct ADC input.
9	ADC5	54 of P4	SmartFusion AFE direct ADC input.
11	ADC3	46 of P4	SmartFusion AFE direct ADC input.
13	ADC2	44 of P4	SmartFusion AFE direct ADC input.
15	ADC6	51 of P4	SmartFusion AFE direct ADC input.
17	ADC7	49 of P4	SmartFusion AFE direct ADC input.

Table 5: P8 Breadboard Area Connector

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
1	VCC3	77, 79 of P4	+3.3 V SOM power supply. Output voltage of the SOM-BSB U2 LDO regulator.
2	VCC1V5	78, 80 of P4	+1.5 V power supply for the SOM. An external power supply for the SOM can be applied to this pad (in this case the 1V5_EN signal must be connected to GND).
3	VBATT	74 of P4	SmartFusion RTC backup power. An external backup power supply of +2.7 V to +3.63 V can be applied to this pad.
4, 12	GND	2, 3, 5, 8, 9, 11, 14, 57, 75, 76 of P4	SOM ground.
5	1V5_EN	72 of P4	The on-module LDO regulator control signal. Must be left floating if the on-module LDO regulator is used. To disable the on-module LDO regulator, this signal must be connected to GND.

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
6	UART_1_TXD	28 of P4	SmartFusion MSS UART1 transmit data/ GPIO.
7	UART_1_RXD	31 of P4	SmartFusion MSS UART1 receive data/ GPIO.
8	I2C_0_SCL	33 of P4	SmartFusion MSS I2C0 bus serial clock output/ GPIO.
9	I2C_0_SDA	27 of P4	SmartFusion MSS I2C0 bus serial data input/output/ GPIO.
10	I2C_1_SDA	26 of P4	SmartFusion MSS I2C1 bus serial data input/output/ GPIO.
11	I2C_1_SCL	25 of P4	SmartFusion MSS I2C1 bus serial clock output/ GPIO.
13	SPI0_DO	63 of P4	SmartFusion MSS SPI0 data output/ GPIO.
14	SPI0_DI	65 of P4	SmartFusion MSS SPI0 data input/ GPIO.
15	SPI0_nSS	73 of P4	SmartFusion MSS SPI0 slave select/ GPIO.
16	SPI0_CLK	71 of P4	SmartFusion MSS SPI0 clock output/ GPIO.
17	SPI1_nSS	69 of P4	SmartFusion MSS SPI1 slave select/ GPIO.
18	SPI1_CLK	67 of P4	SmartFusion MSS SPI1 clock output/ GPIO.
19	SPI1_DI	61 of P4	SmartFusion MSS SPI1 data input/ GPIO.
20	SPI1_DO	59 of P4	SmartFusion MSS SPI1 data output/ GPIO.

Table 6: P9 Breadboard Area Connector

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
1	VCC3	77, 79 of P4	+3.3 V SOM power supply. Output voltage of the SOM-BSB U2 LDO regulator.
2	+5V_IN	Not available	External power supply for the U2 LDO regulator can be applied to this pad. For recommended settings of the JP3 pins, see section 4.
3	GND	2, 3, 5, 8, 9, 11, 14, 57, 75, 76 of P4	SOM ground.
4	nRESET_OUT	15 of P4	SOM reset output. Connected to the DS1 LED.
5	nRESET_IN	13 of P4	SOM reset input. An external open-drain active-low signal can be applied to this pad. Connected to the S1 push button.
6	VCC3_EN	Not available	SOM-BSB U2 LDO regulator active-high enable signal.

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
7	GPIO_90	37 of P4	SmartFusion FPGA I/O.
8	GPIO_88	23 of P4	SmartFusion MSS GPIO
9	GPIO_89	35 of P4	SmartFusion FPGA I/O
10	GPIO_87	21 of P4	SmartFusion MSS GPIO
11	GPIO_86	19 of P4	SmartFusion MSS GPIO
12	GPIO_85	17 of P4	SmartFusion MSS GPIO
13	GPIO_91	39 of P4	SmartFusion FPGA I/O
14	GPIO_83	32 of P4	SmartFusion FPGA I/O
15	GPIO_92	41 of P4	SmartFusion FPGA I/O
16	GPIO_84	34 of P4	SmartFusion FPGA I/O
17	GPIO_93	43 of P4	SmartFusion FPGA I/O
18	GPIO_82	18 of P4	SmartFusion FPGA I/O
19	GPIO_94	45 of P4	SmartFusion FPGA I/O
20	GPIO_81	16 of P4	SmartFusion FPGA I/O

Table 7: P10 Breadboard Area Connector

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
1	GPIO_20	20 of P6	SmartFusion FPGA I/O
2	GPIO_26	26 of P6	SmartFusion FPGA I/O
3	GPIO_18	18 of P6	SmartFusion FPGA I/O
4	GPIO_24	24 of P6	SmartFusion FPGA I/O
5	GPIO_16	16 of P6	SmartFusion FPGA I/O
6	GPIO_22	22 of P6	SmartFusion FPGA I/O
7	GPIO_14	14 of P6	SmartFusion FPGA I/O
8	GPIO_28	28 of P6	SmartFusion FPGA I/O
9	GPIO_6	6 of P6	SmartFusion FPGA I/O
10	GPIO_30	30 of P6	SmartFusion FPGA I/O
11	GPIO_10	10 of P6	SmartFusion FPGA I/O
12	GPIO_32	32 of P6	SmartFusion FPGA I/O
13	GPIO_8	8 of P6	SmartFusion FPGA I/O
14	GPIO_34	34 of P6	SmartFusion FPGA I/O
15	GPIO_12	12 of P6	SmartFusion FPGA I/O
16	GPIO_36	36 of P6	SmartFusion FPGA I/O
17	GPIO_4	4 of P6	SmartFusion FPGA I/O
18	GPIO_38	38 of P6	SmartFusion FPGA I/O

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
19	GPIO_2	2 of P6	SmartFusion FPGA I/O
20	GPIO_40	40 of P6	SmartFusion FPGA I/O

Table 8: P11 Breadboard Area Connector

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
1	GPIO_56	56 of P6	SmartFusion FPGA I/O
2	GPIO_62	62 of P6	SmartFusion FPGA I/O
3	GPIO_58	58 of P6	SmartFusion FPGA I/O
4	GPIO_64	64 of P6	SmartFusion FPGA I/O
5	GPIO_60	60 of P6	SmartFusion FPGA I/O
6	GPIO_66	66 of P6	SmartFusion FPGA I/O
7	GPIO_54	54 of P6	SmartFusion FPGA I/O
8	GPIO_68	68 of P6	SmartFusion FPGA I/O
9	GPIO_52	52 of P6	SmartFusion FPGA I/O
10	GPIO_70	70 of P6	SmartFusion FPGA I/O
11	GPIO_50	50 of P6	SmartFusion FPGA I/O
12	GPIO_72	72 of P6	SmartFusion FPGA I/O
13	GPIO_44	44 of P6	SmartFusion FPGA I/O
14	GPIO_74	74 of P6	SmartFusion FPGA I/O
15	GPIO_46	46 of P6	SmartFusion FPGA I/O
16	GPIO_76	76 of P6	SmartFusion FPGA I/O
17	GPIO_48	48 of P6	SmartFusion FPGA I/O
18	GPIO_78	78 of P6	SmartFusion FPGA I/O
19	GPIO_42	42 of P6	SmartFusion FPGA I/O
20	GPIO_80	80 of P6	SmartFusion FPGA I/O

Table 9: P12 Breadboard Area Connector

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
1	GPIO_61	61 of P6	SmartFusion FPGA I/O
2	GPIO_59	59 of P6	SmartFusion FPGA I/O
3	GPIO_63	63 of P6	SmartFusion FPGA I/O
4	GPIO_57	57 of P6	SmartFusion FPGA I/O
5	GPIO_65	65 of P6	SmartFusion FPGA I/O
6	GPIO_55	55 of P6	SmartFusion FPGA I/O
7	GPIO_67	67 of P6	SmartFusion FPGA I/O

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
8	GPIO_53	53 of P6	SmartFusion FPGA I/O
9	GPIO_69	69 of P6	SmartFusion FPGA I/O
10	GPIO_51	51 of P6	SmartFusion FPGA I/O
11	GPIO_71	71 of P6	SmartFusion FPGA I/O
12	GPIO_49	49 of P6	SmartFusion FPGA I/O
13	GPIO_73	73 of P6	SmartFusion FPGA I/O
14	GPIO_45	45 of P6	SmartFusion FPGA I/O
15	GPIO_79	79 of P6	SmartFusion FPGA I/O
16	GPIO_47	47 of P6	SmartFusion FPGA I/O
17	GPIO_77	77 of P6	SmartFusion FPGA I/O
18	GPIO_43	43 of P6	SmartFusion FPGA I/O
19	GPIO_75	75 of P6	SmartFusion FPGA I/O
20	GPIO_41	41 of P6	SmartFusion FPGA I/O

Table 10: P13 Breadboard Area Connector

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
1	GPIO_25	25 of P6	SmartFusion MSS GPIO
2	GPIO_19	19 of P6	SmartFusion MSS GPIO
3	GPIO_23	23 of P6	SmartFusion MSS GPIO
4	GPIO_17	17 of P6	SmartFusion MSS GPIO
5	GPIO_21	21 of P6	SmartFusion MSS GPIO
6	GPIO_15	15 of P6	SmartFusion MSS GPIO
7	GPIO_27	27 of P6	SmartFusion MSS GPIO
8	GPIO_13	13 of P6	SmartFusion MSS GPIO
9	GPIO_29	29 of P6	SmartFusion MSS GPIO
10	GPIO_11	11 of P6	SmartFusion MSS GPIO
11	GPIO_31	31 of P6	SmartFusion FPGA I/O
12	GPIO_9	9 of P6	SmartFusion MSS GPIO
13	GPIO_33	33 of P6	SmartFusion FPGA I/O
14	GPIO_7	7 of P6	SmartFusion MSS GPIO
15	GPIO_35	35 of P6	SmartFusion FPGA I/O
16	GPIO_5	5 of P6	SmartFusion FPGA I/O
17	GPIO_37	37 of P6	SmartFusion FPGA I/O
18	GPIO_3	3 of P6	SmartFusion FPGA I/O
19	GPIO_39	39 of P6	SmartFusion FPGA I/O

Breadboard Pin #	Signal Name	SOM Connector Pin #	Notes
20	GPIO_1	1 of P6	SmartFusion FPGA I/O

Table 11: P14 Breadboard Area Connector

3.7. Battery Retainer

The BT1 battery retainer on the bottom side of the SOM-BSB is designated for the CR2016 compatible coin cell batteries. The cover of the retainer is connected to the positive contact of the battery. Caution should be exercised to avoid contact of the retainer with a ground potential.

4. Jumpers

The SOM-BSB provides the configurable jumpers listed in the table below. The default settings are marked in bold:

Designation	Name	Settings	Description
JP1	VCC3	1-2 closed	The +3.3 V voltage from the output of the U2 LDO regulator is applied to the SOM and to the SOM-BSB.
		1-2 open	The +3.3 V voltage from the output of the U2 LDO regulator is disconnected from the SOM and from the SOM-BSB. To measure the current consumption of the SOM, connect an ammeter between these pins of the jumper.
		3-4 closed	The +3.3 V voltage from the output of the U2 LDO regulator is applied to the D1 double diode oring scheme. This voltage and the lithium battery voltage are used to provide the V_{BATT} power supply for the SOM RTC. Use this setting to save the charge of the lithium battery.
		3-4 open	The +3.3 V voltage from the output of the U2 LDO regulator is not applied to the D1 double diode oring scheme. Only the lithium battery voltage is used to provide the V_{BATT} power supply for the SOM RTC.
JP2	JTAG Mode Selection	1-2 closed	The SmartFusion JTAG controller is in the Cortex-M3 debug mode.
		1-2 open	The SmartFusion JTAG controller is in the FPGA programming mode.
		3-4 closed	The SmartFusion programming and JTAG controller power supply pins are connected to the +3.3 V LDO regulator output.
		3-4 open	The SmartFusion programming and JTAG controller power supply pins are left floating to reduce the power consumption of the SmartFusion.

Designation	Name	Settings	Description
JP3	VCC5	1-3 closed 2-4 open	The +3.3 V LDO regulator is powered from the external +5 V voltage through the P10.2 pad of the breadboard area.
		1-3 open 2-4 closed	The +3.3 V LDO regulator is powered from the +5 V USB power through the P1 mini USB connector.

Table 12: Jumpers

5. LEDs

The SOM-BSB provides the following LEDs:

Designation	Color	Description
DS1	Green	Indicates the status of <code>nRESET_OUT</code> signal of the SOM. The LED is lit when <code>nRESET_OUT</code> is 0.
DS2	Green	Power Good LED. The LED is lit when the output on the U2 LDO regulator is +3.3 V.
DS3	Green	User-controlled LED connected to the pin 75 on the P6 SOM connector (<code>GPIO_75</code> signal).
DS4	Green	User-controlled LED connected to the pin 77 on the P6 SOM connector (<code>GPIO_77</code> signal).
Integrated in the P2 RJ45 Ethernet connector	Green	Ethernet Link/Activity status.
Integrated in the P2 RJ45 Ethernet connector	Yellow	Ethernet 10/100Mbit link status.

Table 13: LEDs

6. Switches

The SOM-BSB provides the following switches:

Switch	Type	Signal	Function
S1	Push button	<code>nRESET_IN</code>	SOM hardware reset.
S2	Push button	<code>GPIO_79</code>	User button connected to the pin 79 on the P6 SOM connector.

Table 14: Switches