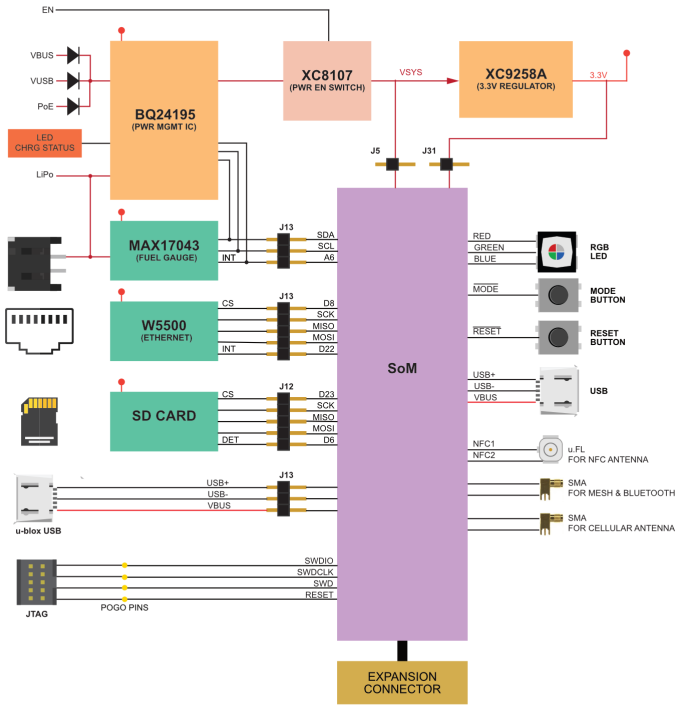
# B Series Evaluation Board

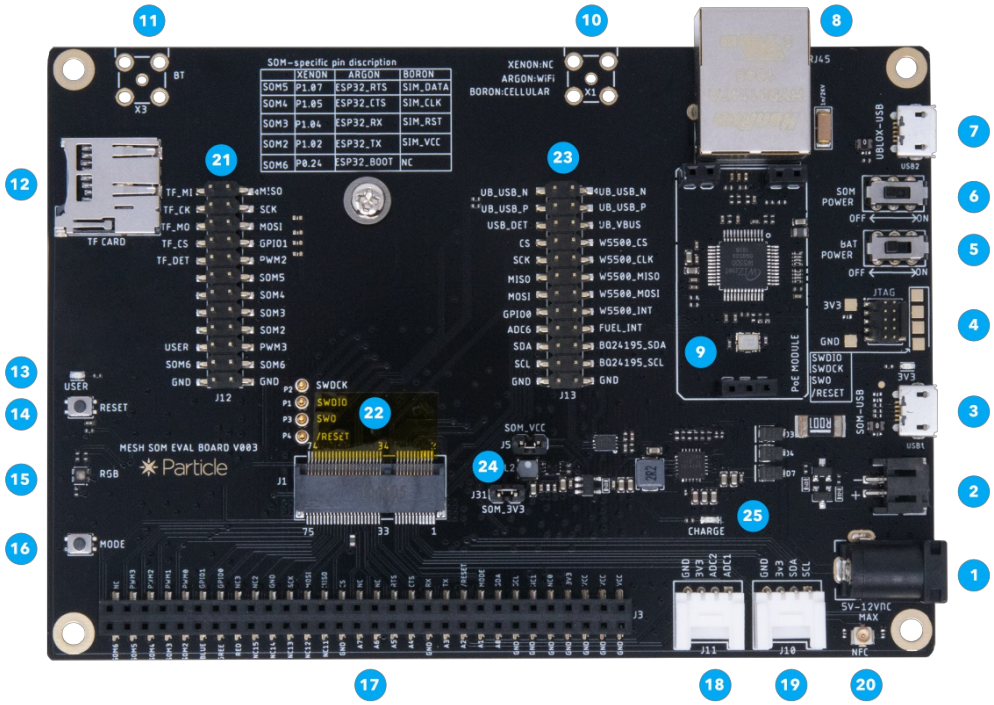
This is a simple breakout board for Particle's B series of cellular IoT modules. It breaks out all of its pins via easy to use headers. The board features a redundant USB port, connector for the LiPo battery, a barrel jack power connector, buttons, RGB LED, and charge status LED.

The Eagle CAD design files, Gerber files, and bill of materials can be found in the SoM eval board Github repository.

# Block Diagram



# Description




| Num | ID | Description |
|---|---|---|
| 1 | **External Power** | 5-12 VDC. Minimum power requirements are 5VDC @500mA (when the LiPo battery) or 5VDC @2000mA (without LiPo battery). |
| 2 | **LiPo Battery connector** | Plug in the LiPo battery here. |
| 3 | **SoM USB port** | This is the module's main USB port that connects to the microcontroller. |
| 4 | **JTAG connector** | This can plug directly into the Particle debugger ribbon cable. |
| 5 | **Battery switch** | Controls power between the LiPo connector and the charge controller. |
| 6 | **SoM power switch** | Controls 3V3 power to the SoM |
| 7 | **u-blox USB port** | This USB port connects directly to the u-blox module for firmware updates. |
| 8 | **Ethernet connector** | RJ45 connector for twisted pair Ethernet, 10 or 100 Mbit/sec. |
| 9 | **PoE connector** | Connect for the Particle PoE adapter for power-over-Ethernet. |
| 10 | **Cellular antenna** | Connector for an external SMA connected cellular antenna. |
| 11 | **Bluetooth antenna** | Connector for an external SMA connected antenna for Bluetooth networking. |
| 12 | **TF/SD Card** | MicroSD card slot. |
| 13 | **User LED** | Blue LED connected to pin D7. |
| 14 | **Reset Button** | This is same as the RESET button on the Boron. |
| 15 | **RGB LED** | System status indicator RGB LED. |
| 16 | **Mode Button** | This is the same as the MODE button on the Boron. |
| 17 | **Expansion Connector** | Allows easy access to SoM IO pins. |
| 18 | **Grove Analog Port** | Connects to Seeed Studio Grove analog and digital boards. |

| | | |
|---|---|---|
| 19 | **Grove I2C Port** | Connects to Seeed Studio Grove I2C boards. |
| 20 | **NFC Antenna** | U.FL connector for an NFC antenna (optional). |
| 21 | **Jumpers J12** | Enable or disable various features on the evaluation board. |
| 22 | **SoM connector** | M.2 connector for the Boron SoM. |
| 23 | **Jumpers J13** | Enable or disable various features on the evaluation board. |
| 24 | **Power Jumpers** | Enable or disable power from the evaluation board. |
| 25 | **Charge LED** | Indicate LiPo is charging. |

#### JUMPERS J12

These pins are intended to be connected across using removable two-pin jumpers to connect features on the board to standard ports.

| Feature | Feature Pin | SoM Pin | B Series Pin |
|---|---|---|---|
| MicroSD | SD_MI | MISO | MISO |
| | SD_CK | SCK | SCK |
| | SD_MO | MOSI | MOSI |
| | SD_CS | GPIO1 | D23 |
| | SD_DET | PWM2 | D6 |
| D7 LED | USER | PWM3 | D7 |
| | GND | GND | GND |

#### JUMPERS J13

These pins are intended to be connected across using removable two-pin jumpers to connect features on the board to standard ports.

| B Series Pin | SoM Pin | Feature Pin | Feature |
|---|---|---|---|
| | UB_USB_N | UB_USB_N | u-blox USB |
| | UB_USB_P | UB_USB_N | |
| | USB_DET | UB_VBUS | |
| D8 | CS | ETH_CS | Ethernet |
| SCK | SCK | ETH_CLK | |
| MISO | MISO | ETH_MISO | |
| MOSI | MOSI | ETH_MOSI | |
| D22 | GPIO0 | ETH_INT | |
| A6 | ADC6 | PM_INT | Fuel Gauge & PMIC |
| D0 | SDA | PM_SDA | PMIC |
| D1 | SCL | PM_SCL | PMIC |

## POWER JUMPERS

| Jumper | Name |
|---|---|
| J5 | SOM_VCC |
| J31 | SOM_3V3 |

## EXPANSION CONNECTOR

| B Series Pin | SoM Pin | SoM Pin | B Series Pin |
|---|---|---|---|
| | SOM9 | NC | |
| SIM_DATA | SOM8 | PWM3 | D7 |
| SIM_CLK | SOM7 | PWM2 | D6 |
| SIM_RST | SOM6 | PWM1 | D5 |
| SIM_VCC | SOM5 | PWM0 | D4 |
| | BLUE | GPIO1 | D23 |
| | GREEN | GPIO0 | D22 |
| | RED | NC | |
| | NC | NC | |
| | NC | GND | |
| | NC | SCK | D13 |
| | NC | MOSI | D12 |
| | NC | MISO | D11 |
| | GND | CS | D8 |
| A7/D20 | ADC7 | NC | |
| A6/D21 | ADC6 | NC | |
| A5/D14 | ADC5 | RTS | D2 |
| A4/D15 | ADC4 | CTS | D3 |
| | GND | RX | RX/D10 |
| A3/D16 | ADC3 | TX | TX/D9 |
| A2/D17 | ADC2 | RESET | |
| A1/D18 | ADC1 | MODE | |
| A0/D19 | ADC0 | SDA | D0 |
| | GND | SCL | D1 |
| | GND | NC | |
| | GND | NC | |
| | GND | VCC | |
| | GND | VCC | |
| | GND | VCC | |

### PWM DIFFERENCES

On the Boron SoM, pins D4, D5, D7, A0, A1, A6, and A7 can be used for PWM. Pins are assigned a PWM group. Each group must share the same frequency and resolution, but individual pins in the group can have a different duty cycle.

- Group 2: Pins A0, A1, A6, and A7.
- Group 1: Pins D4, D5, and D6.
- Group 0: Pin D7 and the RGB LED. This must use the default resolution of 8 bits (0-255) and frequency of 500 Hz.

On Gen 3 Feather devices (Argon, Boron, Xenon), pins A0, A1, A2, A3, D2, D3, D4, D5, D6, D7, and D8 can be used for PWM. Pins are assigned a PWM group. Each group must share the same frequency and resolution, but individual pins in the group can have a different duty cycle.

- Group 3: Pins D2, D3, A4, and A5.
- Group 2: Pins A0, A1, A2, and A3.
- Group 1: Pins D4, D5, D6, and D8.
- Group 0: Pin D7 and the RGB LED. This must use the default resolution of 8 bits (0-255) and frequency of 500 Hz.

These rules also apply to tone() (square wave with 50% duty cycle), however since each group must share the same frequency you can only generate two different simultaneous tones of different frequencies on the B Series SoM. You cannot generate tone on group 0.

# Basic Setup

The basic setup for the B series to be operational is shown below:

- Plug the cellular antenna into the U.FL connector labeled **CELL** on the SoM. Remember never to power up this board without the antenna being connected. There is potential to damage the transmitter of the u-blox module if no antenna is connected.
- If you are going to use mobile app setup or BLE, connect the 2.4 GHz antenna (the smaller one) to the **BT** U.FL connector on the SoM.
- Connect power the USB (3) or a LiPo battery (4).
- Turn on the appropriate power switches (5).

#### USING THE PMIC AND FUEL GAUGE (RECOMMENDED)

There is support for bq24195 PMIC and MAX17043 fuel gauge in Device OS so you don't need to add any additional configuration.

| PMIC | nRF52 Pin | SoM Pin | SoM Pin Number |
|---|---|---|---|
| PM_INT | P0.05 | A6 | 45 |
| PM_SDA | P1.13 | D0 | 22 |
| PM_SCL | P1.15 | D1 | 20 |

It requires these jumpers, which should be installed at the factory:

- ADC6 to PM_INT
- SDA to PM_SDA
- SCL to PM_SCL

#### USING THE MICROSD CARD

To use the MicroSD card, you must add the jumpers:

- SD_MISO to PWM0 (D4, SPI1 MISO)
- SD_SCK to RTS (D2, SPI1 SCK)
- SD_MOSI to CTS (D3, SPI1 MOSI)
- SD_CS to PWM1 (D5)
- SD_DECT to PWM2 (D6) (optional)

You will normally use this with the SdFat library.

With the jumpers installed, it will use the secondary SPI (SPI1) and pin D5 as the chip select.

| Micro SD | nRF52 Pin | SoM Pin | SoM Pin Number |
|---|---|---|---|
| SD_MISO | P1.8 | D4 / PWM0 / SPI1 MISO | 66 |
| SD_SCK | P1.12 | D2 / RTS / SPI1 SCK | 42 |
| SD_MOSI | P1.1 | D3 / CTS / SPI1 MOSI | 40 |
| SD_CS | P1.10 | D5 / PWM1 | 68 |
| SD_DET | P1.11 | D6 / PWM2 | 70 |

## USING ETHERNET

To use Ethernet, you must add the jumpers:

- CS to ETH_CS
- SCK to ETH_SCK
- MISO to ETH_MISO
- MOSI to ETH_MOSI
- GPIO0 to ETH_INT

With the jumpers installed, it will use the primary SPI and pins D8 as the chip select and D22 as the interrupt pin.

| W5500 | nRF52 Pin | SoM Pin | SoM Pin Number |
|---|---|---|---|
| ETH_CS | P1.03 | D8 | 48 |
| ETH_SCK | P1.15 | D13 | 13 |
| ETH_MISO | P1.14 | D11 | 11 |
| ETH_MOSI | P1.13 | D12 | 12 |
| RST_N | P0.02 | A7 (D20) | 47 |
| ETH_INT | P0.24 | D22 | 62 |

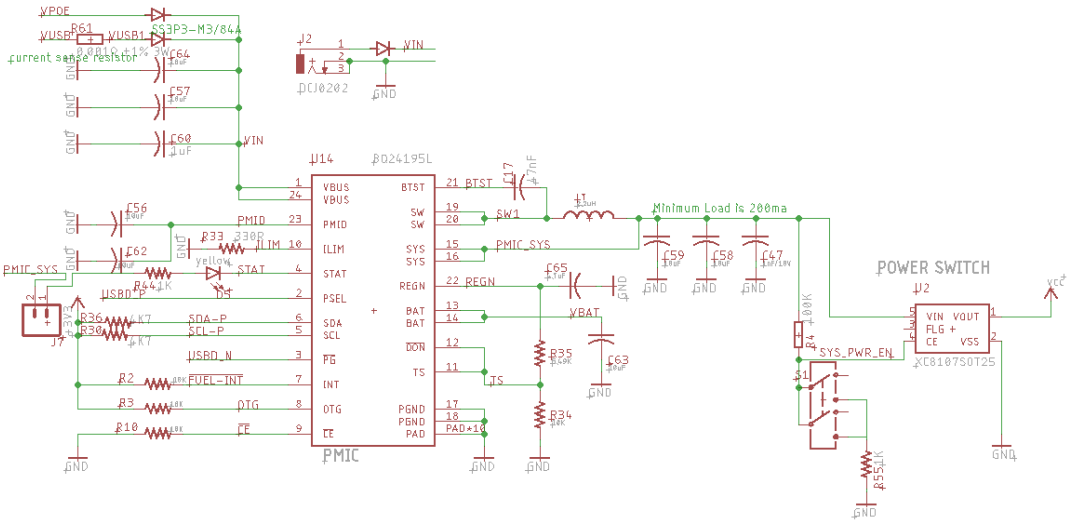
## USING THE GROVE CONNECTORS

| J11 | nRF52 Pin | SoM Pin | SoM Pin Number |
|---|---|---|---|
| GND | | | |
| 3V3 | | | |
| ADC2 | P0.28 | A2 | 35 |
| ADC1 | P0.04 | A1 | 33 |

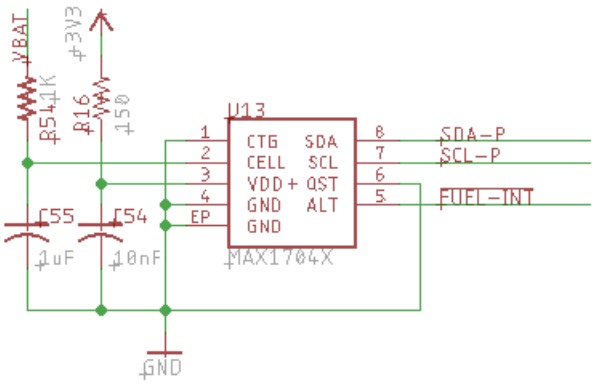
| J10 | nRF52 Pin | SoM Pin | SoM Pin Number |
|---|---|---|---|
| GND | | | |
| 3V3 | | | |
| SDA | P1.13 | D0 | 22 |
| SCL | P1.15 | D1 | 20 |

# Evaluation Board Schematics

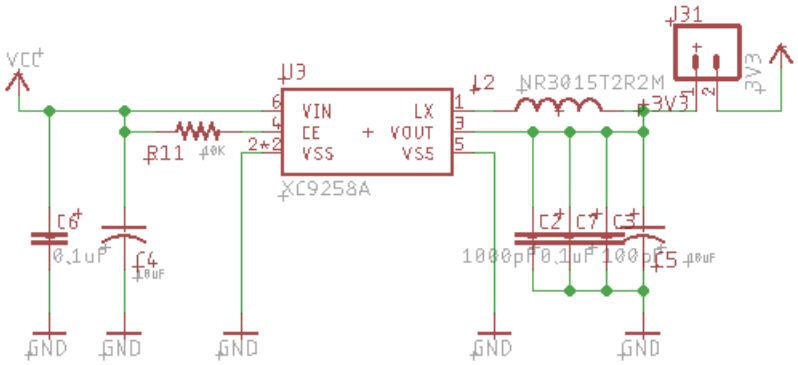
**PMIC**



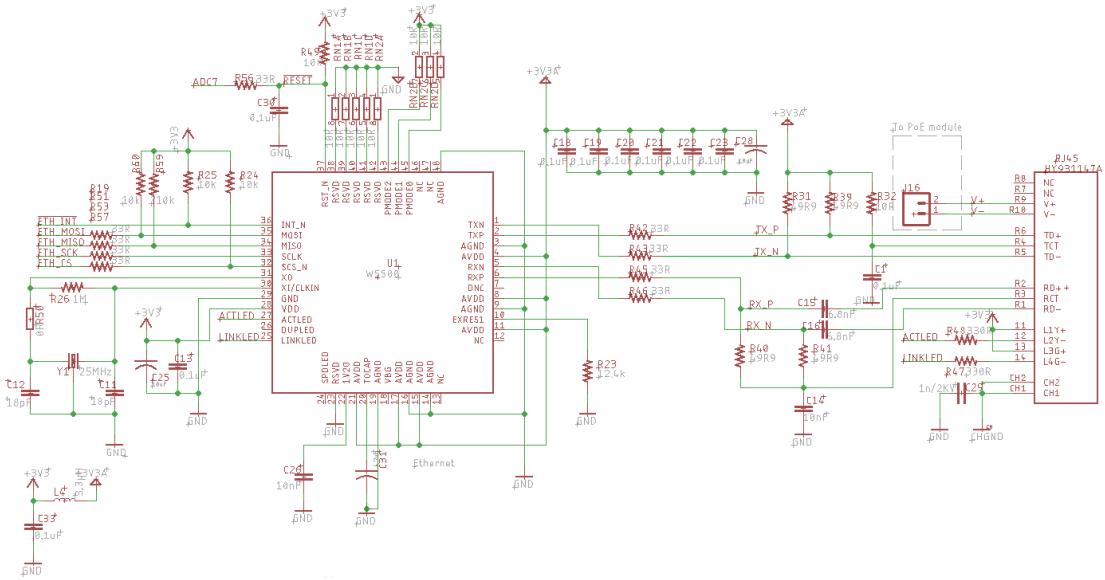

**FUEL GAUGE**



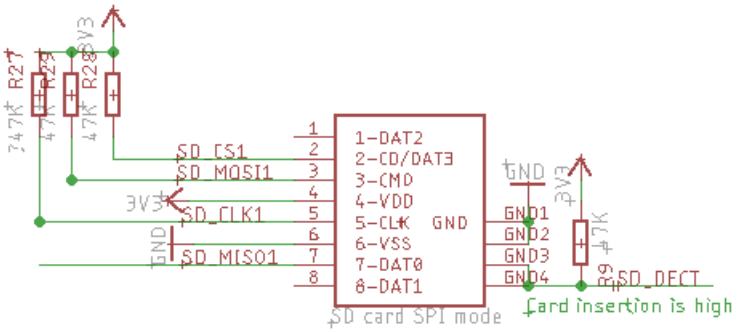
## 3.3V REGULATOR




## ETHERNET




## SD CARD



# Mechanical specifications

**DIMENSIONS AND WEIGHT**

| Parameter | Value |
|---|---|
| Width | 91 mm |
| Length | 1425 mm |
| Thickness | 15.5 mm |
| Weight | 71.8 grams (including PoE module) |

# Revision history

| Revision | Date | Author | Comments |
|---|---|---|---|
| 001 | 29 Apr 2019 | RK | Initial Release |
| 002 | 21 Jan 2020 | RK | Remove mesh |
| 003 | 3 Feb 2020 | RK | Correct pins for SD card |