

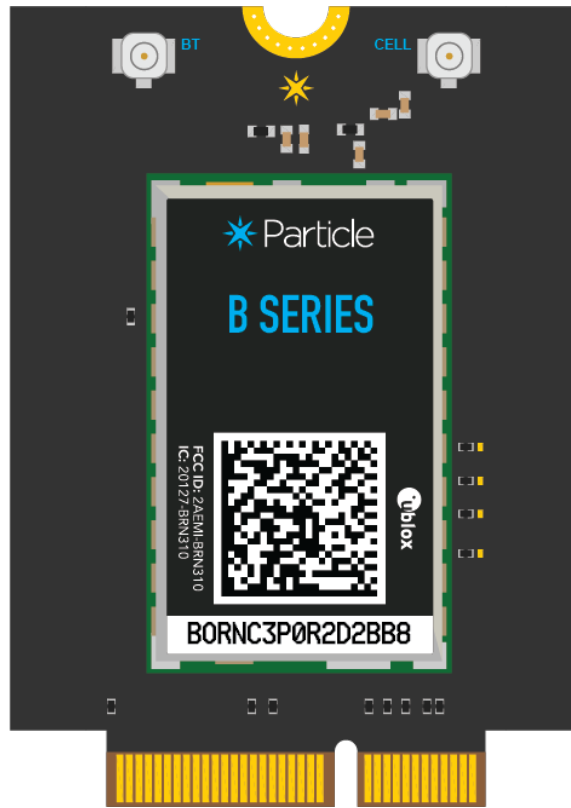
B404/B402 datasheet	3
Functional description	4
OVERVIEW	4
FEATURES	4
Features - B402, B404	4
Features - all models	4
MODEL COMPARISON	4
DEVICE OS SUPPORT	5
Interfaces	6
BLOCK DIAGRAM	6
POWER	6
VCC	6
3V3	6
ANTENNA	8
Certified cellular antenna	8
General antenna guidance	8
PERIPHERALS AND GPIO	8
JTAG AND SWD	9
Memory map	10
NRF52840 FLASH LAYOUT OVERVIEW	10
EXTERNAL SPI FLASH LAYOUT OVERVIEW (DFU OFFSET: 0X80000000)	10
Pins and button definitions	11
PINOUT DIAGRAM	11
COMMON SOM PINS	11
PIN DESCRIPTION	11
LED STATUS	13
System RGB LED	13
PMIC NOTES	14
Technical specifications	15
ABSOLUTE MAXIMUM RATINGS [1]	15
Supply voltages	15
RECOMMENDED OPERATING CONDITIONS	15
POWER CONSUMPTION	16
RADIO SPECIFICATIONS	17
nRF52840	17
u-blox SARA-R410M-02B-00 or R410M-02B-03	17
I/O CHARACTERISTICS	18
Mechanical specifications	19
DIMENSIONS AND WEIGHT	19
MECHANICAL DRAWING	19
3D MODELS	19
MATING CONNECTOR AND LAND PATTERN	20
SCREW ASSEMBLY	21
DESIGN CONSIDERATIONS	22
Product handling	24

ESD PRECAUTIONS	24
CONNECTORS	24
Schematics	25
MICROCONTROLLER	25
U-BLOX CELLULAR MODEM	25
M.2 CONNECTOR	26
SIM AND FLASH	26
BUFFERS	27
Assembly	28
CONFORMAL COATINGS	28
Default settings	29
Country compatibility	30
Ordering information	31
Revision history	32

# B404/B402 datasheet

The B404 and B402 have been deprecated. The recommended replacement is the [B404X](#).

See the [Supply Secure FAQ](#) for more information.



# Functional description

## OVERVIEW

The B-Series System-on-a-Module (SoM) is a cellular device with support for BLE (Bluetooth LE). It is based on the Nordic nRF52840 microcontroller.

The B-Series is designed to be integrated into your circuit board design, plugging into a M.2 NGFF connector on your board, allowing the module to be changed or upgraded easily.

## FEATURES

### Features - B402, B404

- u-blox SARA-R410M-02B-00 or R410M-02B-03 LTE modem (B402, B404)
- The B402 and B404 have been deprecated, replacement is the B404X. See the [Supply secure FAQ](#) for more information.
- LTE Cat M1 module
- Support for United States, Canada, and Mexico only
- 3GPP Release 13 LTE Cat M1
- LTE Cat M1 bands: 2, 4, 5, 12, 13
- Embedded Particle EtherSIM (B404)
- Embedded Particle SIM (B402)

<sup>1</sup> Not all bands enabled in software by default

### Features - all models

- Nordic Semiconductor nRF52840 SoC
- ARM Cortex-M4F 32-bit processor @ 64MHz
- 1MB flash, 256KB RAM
- Bluetooth 5: 2 Mbps, 1 Mbps, 500 Kbps, 125 Kbps
- Supports DSP instructions, HW accelerated Floating Point Unit (FPU) and encryption functions
- Up to +8 dBm TX power (down to -20 dBm in 4 dB steps)
- NFC-A tag
- On-module additional 4MB SPI flash
- 24 mixed signal GPIO (8 x Analog, 8 x PWM), UART, I2C, SPI
- USB 2.0 full speed (12 Mbps)
- JTAG (SWD) pins
- RGB status pins for LED
- Reset and Mode pins for buttons
- On-module MFF2 Particle SIM
- Two on-module U.FL connectors for external antennas
- M.2 interface
- FCC and PTCRB certified
- RoHS compliant (lead-free)

## MODEL COMPARISON

	B404X	B404	B402	B524	B523	B504
Region	NorAm	NorAm	NorAm	EMEA	Europe	Americas
EtherSIM	✓	✓		✓		✓
Supply Secure	✓			✓		✓

Lowest power (LTE Cat M1)	✓	✓	✓			
Fastest speed (LTE Cat 1)				✓	✓	✓
Lifecycle	GA	NRND	Deprecated	GA	Deprecated	In development

- EtherSIM devices generally have a larger number of carriers and more may be added in the future
- NorAm: North America (United States, Canada, and Mexico)
- Americas: North America, Central, and South America (not all countries supported)
- LTE Cat M1: Low-power cellular intended for IoT devices
- LTE Cat 1: Available in more countries and has higher data rates
- EMEAA: Europe, Middle East, Africa, and Asia (not all countries supported)
- NRND: Not recommended for new designs
- See the [Carrier list](#) for specific carrier and country compatibility
- See the [Supply secure FAQ](#) for more information
- See [Lifestyle stages](#) for more information

## DEVICE OS SUPPORT

It is recommended that you use the latest version in the 4.x LTS release line with the B404 and B402.

B404X devices requires a minimum of Device OS 4.0.0. If you have a mixed fleet of B404X, B404, and/or B402 devices, we recommend upgrading all device to the latest 4.x LTS release.

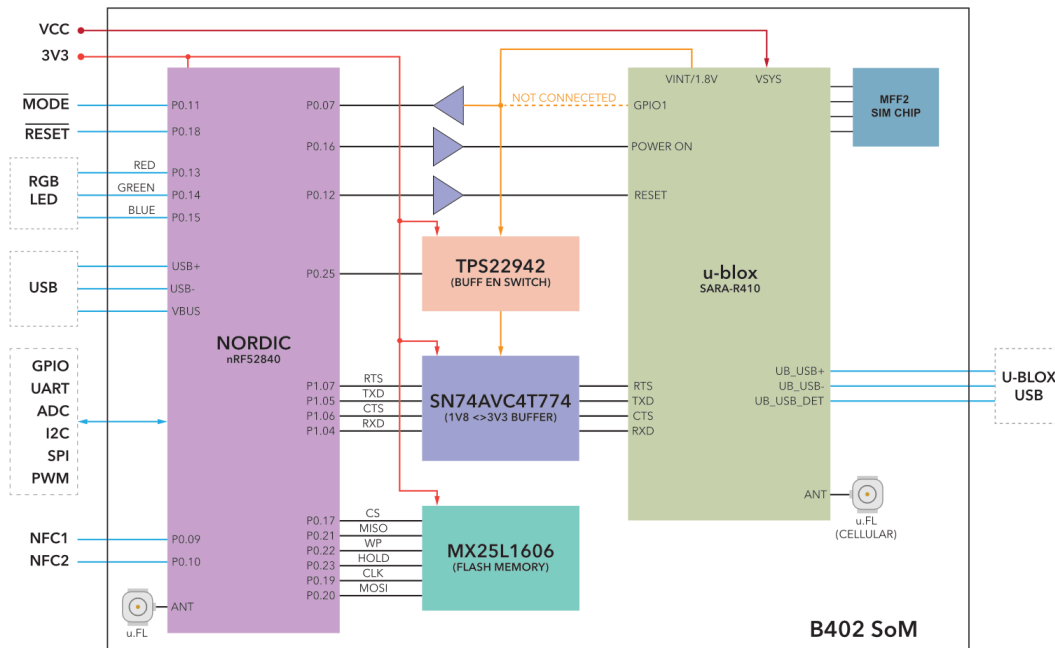
Recent B404 devices require Device OS 2.3.0 or later due to a required component change.

While older B404 devices and B402 devices can use earlier versions, we recommend that all B404 and B404 fleets use a minimum of 2.3.0 and recommend 4.x LTS. The 2.x LTS release line is in the Extended Support and Maintenance (ESM) window and will stop being supported in 2024.

For information on upgrading Device OS, see [Version information](#). For the latest version shipped from the factory, see [Manufacturing firmware versions](#) page. See also [Long Term Support \(LTS\) releases](#).

# Interfaces

## BLOCK DIAGRAM



## POWER

### VCC

VCC is used to supply power to the u-blox SARA-R410M cellular module. The recommended input voltage range on this pin is between 3.6V to 4.2V DC. This can be connected directly to a 3.7V LiPo battery.

If you are not using a battery, or using a battery of a different voltage, you should use a regulator to supply 3.7V to 4.2V. While you only need 600mA for the B402/B404/B404X, we recommend 2A for compatibility with future SoM modules.

### 3V3

3V3 is used to supply power to nRF52840, logic ICs, memory, etc.. The 3V3 input voltage range is between 3V to 3.6V DC, but 3.3V is recommended. Make sure that the supply can handle a minimum of 150 mA, however we recommend a minimum of 500 mA supplied from your base board to allow for compatibility with future modules.

These limits do not include any 3.3V peripherals on your base board, so that may increase the current requirements.

Power supply requirements:

- 3.3V output
- Maximum 5% voltage drop
- 100 mV peak-to-peak ripple maximum
- 500 mA minimum output current at 3.3V recommended for future compatibility
- Maintain these values at no-load as well as maximum load

We do not recommend using a single 3.6V supply for both VCC and 3V3 as the cellular modem

performance may be lower below 3.7V. Use two separate regulators for best results.

## ANTENNA

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There are two radios on the B402 module. A BLE radio (nRF52840) and a cellular radio (u-blox). We have provided two u.FL connectors to plug in the cellular and BLE antenna. These are required if you wish to use the cellular and BLE. If you do not need BLE, you do not need to connect the BLE antenna.

### Certified cellular antenna

SKU	Description
ANTCW2EA	Particle Cellular Flex Antenna 2G/3G/LTE [x1]
ANTCW2TY	Particle Cellular Flex Antenna 2G/3G/LTE Tray of 50 [x50]

- Type: LTE Ultra Wide Band Flex Antenna
- Frequency/band: 698 MHz-2690 MHz
- RoHS Compliant
- Mechanical Specs:
  - Dimensions: 97 x 21 x 0.2 mm
  - Mounting: 3M adhesive backed for application on non-metallic surfaces
  - Connector type: FPC + IPEX connector
  - Cable length: 210 mm
  - Gain: 4.71 dBi

Particle devices are certified for use only with the designated antenna specified above. The use of alternative antennas with our modules could necessitate a recertification process. To fully understand the potential consequences of using a non-certified antenna, Particle strongly advises seeking consultation with a qualified RF expert.

### General antenna guidance

- The antenna placement needs to follow some basic rules, as any antenna is sensitive to its environment. Mount the antenna at least 10mm from metal components or surfaces, ideally 20mm for best radiation efficiency, and try to maintain a minimum of three directions free from obstructions to be able to operate effectively.
- Needs tuning with actual product enclosure and all components.
- For the BLE antenna, it is recommended to use a 2.4 GHz single-frequency antenna and not a 2.4 GHz + 5 GHz antenna, so as to avoid large gain at the frequency twice of 2.4 GHz which can cause the second harmonic radiation of 2.4 GHz to exceed standards.

## PERIPHERALS AND GPIO

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Peripheral Type	Qty	Input(I) / Output(O)
Digital	24 (max)	I/O
Analog (ADC)	8 (max)	I
UART	1	I/O
SPI	2	I/O
I2C	2	I/O
USB	1	I/O
PWM	8 (max)	O
NFC	1	O

There are some optional B402 module specific I/O:



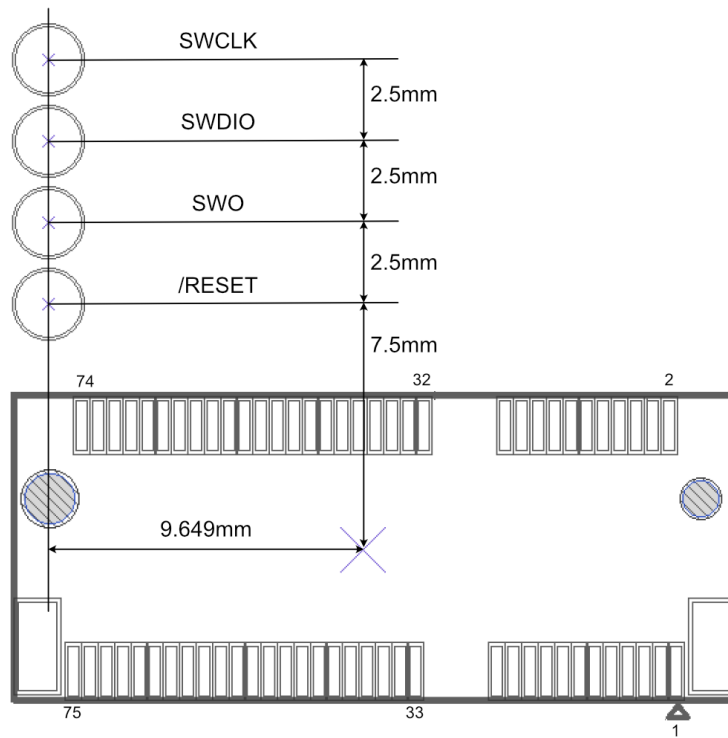
- u-blox USB and VBUS (for u-blox firmware upgrades)

**Note:** All GPIOs are only rated at 3.3VDC max.

## JTAG AND SWD

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The B402 module has 4 pads at the bottom exposing the SWD interface of the nRF52840. This interface can be used to debug your code or reprogram your B402 bootloader, device OS, or the user firmware. We use 4 pogo-pins connecting to these pads during production for firmware flashing.



# Memory map

## **NRF52840 FLASH LAYOUT OVERVIEW**

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- Bootloader (48KB, @0xF4000)
- User Application
- 256KB @ 0xB4000 (Device OS 3.1 and later)
- 128KB @ 0xD4000 (Device OS 3.0 and earlier)
- System (656KB, @0x30000)
- SoftDevice (192KB)

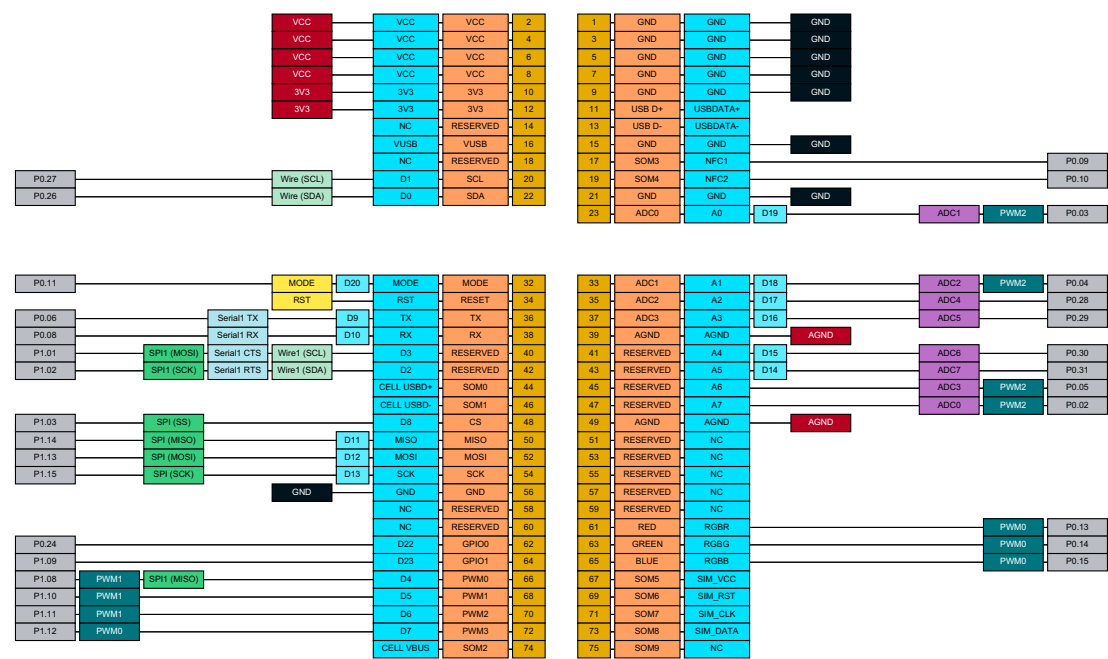
## **EXTERNAL SPI FLASH LAYOUT OVERVIEW (DFU OFFSET: 0X80000000)**

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- OTA (1500KB, @0x00289000)
- Reserved (420KB, @0x00220000)
- FAC (128KB, @0x00200000)
- LittleFS (2M, @0x00000000)

# Pins and button definitions

## PINOUT DIAGRAM



## COMMON SOM PINS

**RESERVED** and **SOM** pins may vary across different SoM models. If you are designing for this specific module, or similar modules, you can use the indicated functions even if the pin is marked RESERVED. Most nRF52840-based modules will have the same pin functions on the RESERVED pins

Future modules with a different MCU may have different pin functions. An effort will be made to assign all of the listed functions for ADC, PWM, SPI, etc. from the set of common SoM pin functions in future modules, but the functions on RESERVED and SOM pins will likely vary.

## PIN DESCRIPTION

#	Pin	Common	Function	nRF52	Description
1	GND	GND	POWER		System ground.
2	VCC	VCC	POWER		System power in, connect to the +LiPo or supply a fixed 3.6-4.2v power.
3	GND	GND	POWER		System ground.
4	VCC	VCC	POWER		System power in, connect to the +LiPo or supply a fixed 3.6-4.2v power.
5	GND	GND	POWER		System ground.
6	VCC	VCC	POWER		System power in, connect to the +LiPo or supply a fixed 3.6-4.2v power.
7	GND	GND	POWER		System ground.
8	VCC	VCC	POWER		System power in, connect to the +LiPo or supply a fixed 3.6-4.2v power.
9	GND	GND	POWER		System ground.
10	3V3	3V3	POWER		System power in, supply a fixed 3.0-3.6v power.
11	USB D+	USB D+	IO		Data+ pin of the NRF52840 USB port.

12	3V3	3V3	POWER		System power in, supply a fixed 3.0-3.6v power.
13	USB D-	USB D-	IO		Data- pin of the NRF52840 USB port.
14	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.
15	GND	GND	POWER		System ground.
16	VUSB	VUSB	POWER		System power in, USB detect pin for nRF52840. 5V on this pin enables the USB interface.
17	NFC1	SOM3 <sup>3</sup>	NFC input	P0.09	NFC antenna connection.
18	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.
19	NFC2	SOM4 <sup>3</sup>	NFC input	P0.10	NFC antenna connection.
20	D1	SCL	IO	P0.27	I2C SCL, and digital only GPIO.
21	GND	GND	POWER		System ground.
22	D0	SDA	IO	P0.26	I2C SDA, and digital only GPIO.
23	A0	ADC0	IO	P0.03	Analog input ADC0 <sup>2</sup> , and digital GPIO.
32	MODE	MODE	IO	P0.11	Connected to the MODE button input, and digital only GPIO.
33	A1	ADC1	IO	P0.04	Analog input ADC1 <sup>2</sup> , and digital GPIO.
34	RESET	RESET	I		Active-low reset input.
35	A2	ADC2	IO	P0.28	Analog input ADC2 <sup>2</sup> , and digital GPIO.
36	D9	TX	IO	P0.06	Primarily used as UART TX, but can also be used as a digital GPIO.
37	A3	ADC3	IO	P0.29	Analog input ADC3 <sup>2</sup> , and digital GPIO.
38	D10	RX	IO	P0.08	Primarily used as UART RX, but can also be used as a digital GPIO.
39	AGND	AGND	POWER		System analog ground.
40	D3	RESERVED <sup>3</sup>	IO	P1.01	UART flow control CTS, SCL1 (Wire1), SPI1 MOSI, digital only GPIO.
41	A4	RESERVED <sup>3</sup>	IO	P0.30	Analog input ADC4 <sup>2</sup> , and digital GPIO.
42	D2	RESERVED <sup>3</sup>	IO	P1.02	UART flow control RTS, SDA1 (Wire1), SPI1 SCK, digital only GPIO.
43	A5	RESERVED <sup>3</sup>	IO	P0.31	Analog input ADC5 <sup>2</sup> , and digital GPIO.
44	u-blox USB D+	SOM0	IO		Data+ pin of the cellular modem USB port.
45	A6	RESERVED <sup>3</sup>	IO	P0.05	Analog input ADC6 <sup>2</sup> , and digital GPIO.
46	u-blox USB D-	SOM1	IO		Data- pin of the cellular modem USB port.
47	A7	RESERVED <sup>3</sup>	IO	P0.02	Analog input ADC7 <sup>2</sup> , and digital GPIO.
48	D8	CS	IO	P1.03	SPI interface CS, and digital only GPIO.
49	AGND	AGND	POWER		System analog ground.
50	D11	MISO	IO	P1.14	SPI interface MISO, and digital only GPIO.
51	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.
52	D12	MOSI	IO	P1.13	SPI interface MOSI, and digital only GPIO.
53	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.
54	D13	SCK	IO	P1.15	SPI interface SCK, and digital only GPIO.
55	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.
56	GND	GND	POWER		System analog ground.
57	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.
58	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.

59	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.
60	NC	RESERVED <sup>3</sup>	NC		Leave unconnected.
61	RGBR	RED	IO	P0.13	Red pin of the RGB LED.
62	D22	GPIO0	IO	P0.24	GPIO0, digital only.
63	RGBG	GREEN	IO	P0.14	Green pin of the RGB LED.
64	D23	GPIO1	IO	P1.09	GPIO1, digital only.
65	RGBB	BLUE	IO	P0.15	Blue pin of the RGB LED.
66	D4	PWM0	IO	P1.08	SPI1 MISO, Digital only GPIO, and PWM0.
67	SIM_VCC <sup>1</sup>	SOM5 <sup>3</sup>	POWER		Leave unconnected, 1.8V/3V SIM Supply Output from cellular modem.
68	D5	PWM1	IO	P1.10	Digital only GPIO, and PWM1.
69	SIM_RST <sup>1</sup>	SOM6 <sup>3</sup>	IO		Leave unconnected, 1.8V/3V SIM Reset Output from cellular modem.
70	D6	PWM2	IO	P1.11	Digital only GPIO, and PWM2.
71	SIM_CLK <sup>1</sup>	SOM7 <sup>3</sup>	IO		Leave unconnected, 1.8V/3V SIM Clock Output from cellular modem.
72	D7	PWM3	IO	P1.12	Digital only GPIO, and PWM3.
73	SIM_DATA <sup>1</sup>	SOM8 <sup>3</sup>	IO		Leave unconnected, 1.8V/3V SIM Data I/O of cellular modem with internal 4.7 k pull-up.
74	u-blox VBUS	SOM2 <sup>3</sup>	IO		USB detect pin for cellular modem. 5V on this pin enables the u-blox USB interface.
75	NC	SOM9 <sup>3</sup>	NC		Leave unconnected.

<sup>1</sup>These pins are connected to the internal MFF2 SIM and should be left open.

<sup>2</sup>A0-A7 are 12-bit Analog-to-Digital (A/D) inputs (0-4095).

<sup>3</sup>SoM-specific and Reserved pins will vary depending on module. They are able to be used on the B402, but their function may be different on future modules.

By default, the Tinker application firmware enables the use of the bq24195 PMIC and MAX17043 fuel gauge. This in turn uses I2C (D0 and D1) and pin A6 (PM\_INT). If you are not using the PMIC and fuel gauge and wish to use these pins for other purposes, be sure to disable system power configuration. This setting is persistent, so you may want to disable it with your manufacturing firmware only.

```
System.setPowerConfiguration(SystemPowerConfiguration());
```

If you are using Ethernet with the B-Series SoM, the following pins are used by Ethernet:

Device	OS Pin	M.2 Pin	Ethernet Pin
MISO		50	SPI MISO
MOSI		52	SPI MOSI
SCK		54	SPI SCK
A7		47	nRESET
D22		62	nINTERRUPT
D8		48	nCHIP SELECT

## LED STATUS

### System RGB LED

Unlike the Boron, the B402 module does not have an on-module RGB system status LED. We have provided its individual control pins for you to connect an LED of your liking. This will allow greater flexibility in the end design of your products.

A detailed explanation of different color codes of the RGB system LED can be found [here](#).

## PMIC NOTES

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When using the B-Series SoM with a bq24195 PMIC, note the following:

By default, the bq24195 sets the input current limit, which affects powering by VIN and VUSB, to 100 mA. This affects the VSYS output of the PMIC, which powers both the cellular modem and 3V3 supply, and is not enough to power the B-Series SoM in normal operation.

If your device has the default firmware (Tinker), it will attempt to connect to the cloud, brown out due to insufficient current, then the device will reset. This may result in what appears to be the status LED blinking white, but is actually rolling reboot caused by brownout.

A factory new B-Series SoM does not enable the PMIC setup. To enable the use of the bq24195, you must enable the system power feature [PMIC\\_DETECTION](#) in your code. This defaults to off because the B-Series SoM can be used without a PMIC, or with a different PMIC, and also requires I2C on D0/D1, and some base boards may use those pins as GPIO.

Because the input current limit does not affect the battery input (Li+), for troubleshooting purposes it can be helpful to attach a battery to help rule out input current limit issues. It's also possible to supply 3.7V via a bench power supply to the battery input, instead of VIN.

The input current limit can result in a situation where you can't bring up a B-Series SoM because it browns out continuously, but also cannot flash code to it to stop it from browning out. There are two general solutions:

- Attach a battery or supply by Li+ when bringing up a board.
- Use SWD/JTAG and reset halt the MCU. This will prevent it from connecting to the cloud, so you can flash Device OS and firmware to it by SWD.

The input current limit is actually controlled by three factors:

- The [power source max current setting](#) in the PMIC. The default is 900 mA. It can be set to 100, 150, 500, 900, 1200, 1500, 2000, or 3000 mA.
- It is also limited by the hardware ILIM resistor. On Particle devices with a built-in PMIC, this is set to 1590 mA, but if you are implementing your own PMIC hardware, you can adjust this higher.
- When connected by USB, it will use DPDM, current negotiation via the USB DP (D+) and DM (D-) lines.

Note that some 2A tablet chargers and multi-port USB power supplies supply 2A but do not implement DPDM; these will be treated as if VIN was used, and you must set the power source current, otherwise the input current will be limited to 900 mA, which is not enough to power a 2G/3G cellular modem without an attached battery.

# Technical specifications

## ABSOLUTE MAXIMUM RATINGS <sup>[1]</sup>

### Supply voltages

Parameter	Symbol	Min	Typ	Max	Unit
<b>Supply voltages</b>					
Supply Input Voltage	VCC	-0.3		+6.0	V
Supply Input Voltage	3V3	-0.3		+3.9	V
VBUS USB supply voltage	VUSB	-0.3		+5.8	V
<b>I/O pin voltage</b>					
VI/O, VDD ≤ 3.6 V	IO	-0.3		VDD + 0.3	V
VI/O, VDD > 3.6 V	IO	-0.3		+3.9	V
<b>NFC antenna pin current</b>					
I <sub>NFC1/2</sub>	NFC1/NFC2			80	mA
<b>Radio</b>					
BT RF input level (52840)				10	dBm
<b>Environmental</b>					
Storage temperature		-40		+85	°C

<sup>[1]</sup> Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
<b>Supply voltages</b>					
Supply Input Voltage	VCC	+3.6	+3.8	+4.2	V
Supply Input Voltage	3V3	+3.0	+3.3	+3.6	V
VBUS USB supply voltage	VUSB	+4.35	+5.0	+5.5	V
<b>Environmental</b>					
Normal operating temperature <sup>1</sup>		-20	+25	+65	°C
Extended operating temperature <sup>2</sup>		-40		+85	°C
Humidity Range Non condensing, relative humidity				95	%

### Notes:

<sup>1</sup> Normal operating temperature range (fully functional and meet 3GPP specifications).

<sup>2</sup> Extended operating temperature range (RF performance may be affected outside normal operating range, though module is fully functional)

## POWER CONSUMPTION

Parameter	Symbol	Min	Typ	Peak	Unit
Operating Current (uC on, peripherals and radio disabled)	$I_{idle}$	4.48	4.71	5.17	mA
Operating Current (uC on, cellular on but not connected)	$I_{cell\_idle}$	5.1	45.2	166	mA
Operating Current (uC on, cellular connecting to tower)	$I_{cell\_conn\_twr}$	13.7	56.0	192	mA
Operating Current (uC on, cellular connecting to cloud)	$I_{cell\_conn\_cloud}$		63.2	185	mA
Operating Current (uC on, cellular connected but idle)	$I_{cell\_cloud\_idle}$	13.4	15.5	98.3	mA
Operating Current (uC on, cellular connected and transmitting)	$I_{cell\_cloud\_tx}$	9.47	66.3	192	mA
STOP mode sleep, GPIO wake-up	$I_{stop\_gpio}$	552	555	559	uA
STOP mode sleep, analog wake-up	$I_{stop\_analog}$	554	557	559	uA
STOP mode sleep, RTC wake-up	$I_{stop\_intrtc}$	553	556	558	uA
STOP mode sleep, BLE wake-up, advertising	$I_{stop\_ble\_adv}$		631	2650	uA
STOP mode sleep, BLE wake-up, connected	$I_{stop\_ble\_conn}$	47.3	630	1540	uA
STOP mode sleep, serial wake-up	$I_{stop\_usart}$	553	556	558	uA
STOP mode sleep, cellular wake-up	$I_{stop\_cell}$	8.87	9.65	63.6	mA
ULP mode sleep, GPIO wake-up	$I_{ulp\_gpio}$	44.7	47.6	49.6	uA
ULP mode sleep, analog wake-up	$I_{ulp\_analog}$	45.0	47.8	49.5	uA
ULP mode sleep, RTC wake-up	$I_{ulp\_intrtc}$	43.4	46.4	47.9	uA
ULP mode sleep, BLE wake-up, advertising	$I_{ulp\_ble\_adv}$		130	2560	uA
ULP mode sleep, BLE wake-up, connected	$I_{ulp\_ble\_conn}$		121	1010	uA
ULP mode sleep, serial wake-up	$I_{ulp\_usart}$	554	557	559	uA
ULP mode sleep, cellular wake-up	$I_{ulp\_cell}$	0.37	9.47	53.7	mA
HIBERNATE mode sleep, GPIO wake-up	$I_{hib\_gpio}$	23.6	26.0	29.7	uA
HIBERNATE mode sleep, analog wake-up	$I_{hib\_analog}$	23.9	26.5	30.5	uA

<sup>1</sup>The min, and particularly peak, values may consist of very short transients. The typical (typ) values are the best indicator of overall power consumption over time. The peak values indicate the absolute minimum capacity of the power supply necessary, not overall consumption.



## RADIO SPECIFICATIONS

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The B-Series SoM has two radio modules.

### nRF52840

- Bluetooth® 5, 2.4 GHz
  - 95 dBm sensitivity in 1 Mbps Bluetooth® low energy mode
  - 103 dBm sensitivity in 125 kbps Bluetooth® low energy mode (long range)
  - 20 to +8 dBm TX power, configurable in 4 dB steps

### u-blox SARA-R410M-02B-00 or R410M-02B-03

Parameter	Value
Protocol stack	3GPP Release 13
RAT	LTE Cat M1 Half-Duplex
LTE FDD Bands	Band 12 (700 MHz)
	Band 28 (700 MHz)
	Band 13 (750 MHz)
	Band 20 (800 MHz)
	Band 5 (850 MHz)
	Band 8 (900 MHz)
	Band 4 (1700 MHz)
	Band 3 (1800 MHz)
	Band 2 (1900 MHz)
Power class	Class 3 (23 dBm)

- LTE Cat M1 for United States, Canada, and Mexico.
- Not all bands are enabled in software by default.
- Particle LTE Cat M1 devices are not certified for use in Europe or other countries that follow EU certification requirements.

## I/O CHARACTERISTICS

These specifications are based on the nRF52840 datasheet.

Symbol	Parameter	Min	Typ	Max	Unit
VIH	Input high voltage	0.7 xVDD		VDD	V
VIL	Input low voltage	VSS		0.3 xVDD	V
VOH,SD	Output high voltage, standard drive, 0.5 mA, VDD ≥1.7	VDD - 0.4		VDD	V
VOH,HDH	Output high voltage, high drive, 5 mA, VDD ≥ 2.7 V	VDD - 0.4		VDD	V
VOH,HDL	Output high voltage, high drive, 3 mA, VDD ≥ 1.7 V	VDD - 0.4		VDD	V
VOL,SD	Output low voltage, standard drive, 0.5 mA, VDD ≥1.7	VSS		VSS + 0.4	V
VOL,HDH	Output low voltage, high drive, 5 mA, VDD ≥ 2.7 V	VSS		VSS + 0.4	V
VOL,HDL	Output low voltage, high drive, 3 mA, VDD ≥ 1.7 V	VSS		VSS + 0.4	V
IOL,SD	Current at VSS+0.4 V, output set low, standard drive, VDD ≥1.7	1	2	4	mA
IOL,HDH	Current at VSS+0.4 V, output set low, high drive, VDD ≥ 2.7V	6	10	15	mA
IOL,HDL	Current at VSS+0.4 V, output set low, high drive, VDD ≥ 1.7V	3			mA
IOH,SD	Current at VDD-0.4 V, output set high, standard drive, VDD ≥1.7	1	2	4	mA
IOH,HDH	Current at VDD-0.4 V, output set high, high drive, VDD ≥ 2.7V	6	9	14	mA
IOH,HDL	Current at VDD-0.4 V, output set high, high drive, VDD ≥ 1.7V	3			mA
tRF,15pF	Rise/fall time, standard drivemode, 10-90%, 15 pF load <sup>1</sup>		9		ns
tRF,25pF	Rise/fall time, standard drive mode, 10-90%, 25 pF load <sup>1</sup>		13		ns
tRF,50pF	Rise/fall time, standard drive mode, 10-90%, 50 pF load <sup>1</sup>		25		ns
tHRF,15pF	Rise/Fall time, high drive mode, 10-90%, 15 pF load <sup>1</sup>		4		ns
tHRF,25pF	Rise/Fall time, high drive mode, 10-90%, 25 pF load <sup>1</sup>		5		ns
tHRF,50pF	Rise/Fall time, high drive mode, 10-90%, 50 pF load <sup>1</sup>		8		ns
RPU	Pull-up resistance	11	13	16	kΩ
RPD	Pull-down resistance	11	13	16	kΩ
CPAD	Pad capacitance		3		pF
CPAD_NFC	Pad capacitance on NFC pads		4		pF
INFC_LEAK	Leakage current between NFC pads when driven to different states		1	10	μA

- Rise and fall times based on simulations
- GPIO default to standard drive (2mA) but can be reconfigured to high drive (9mA) in Device OS 2.0.0 and later using the `pinSetDriveStrength()` function.

# Mechanical specifications

## DIMENSIONS AND WEIGHT

Parameters	Value	Unit
Width	30	mm
Height	42	mm
Thickness	5.5	mm
Weight	6.2	grams

## MECHANICAL DRAWING



Dimensions are in millimeters.

## 3D MODELS

3D models of the B-Series SoM module are available in the [hardware-libraries Github](#) in formats including step, iges, stl, and f3d.

The 3D models are the same for the B404 and B402, as the only changes are the SIM card, which is not visible.

MATING CONNECTOR AND LAND PATTERN

The mating connector is a an M.2 (NGFF) type 4. Note that there are several different key configurations for the M.2, and type 4 is different than is commonly used on SSDs.

One compatible connector is the [TE 2199230-4](#). It is widely available including at suppliers such as [DigiKey](#).





We recommend this screw assembly to securely affix the B series SoM to your circuit board. From top to bottom:

- M3 screw, 3mm long
- M3 washer
- M3 standoff, 2.45mm



- Mounting hole, 2.6 mm metal hole, 3.1mm metal ring diameter (picture is of the bottom side of the circuit board)



- An [alternative design](#) uses a [JAE SM3ZS067U410-NUTI-R1200](#) standoff. It's reflow soldered to your base board and has a threaded hole for a M2\*3 screw to hold down the SoM. This may be easier to obtain.
- Note that a hold-down screw is required because the M.2 connector does not have integrated locks and the SoM will pop up if not attached to the base board.
- The screw should be connected to the ground plane on your base board.

#### **DESIGN CONSIDERATIONS**

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We strongly recommend against placing components under the SOM board because there is not enough height.



# Product handling

## **ESD PRECAUTIONS**

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The B series contains highly sensitive electronic circuitry and is an Electrostatic Sensitive Device (ESD). Handling an B series without proper ESD protection may destroy or damage it permanently. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the B series module. ESD precautions should be implemented on the application board where the B series is mounted. Failure to observe these precautions can result in severe damage to the B series!

## **CONNECTORS**

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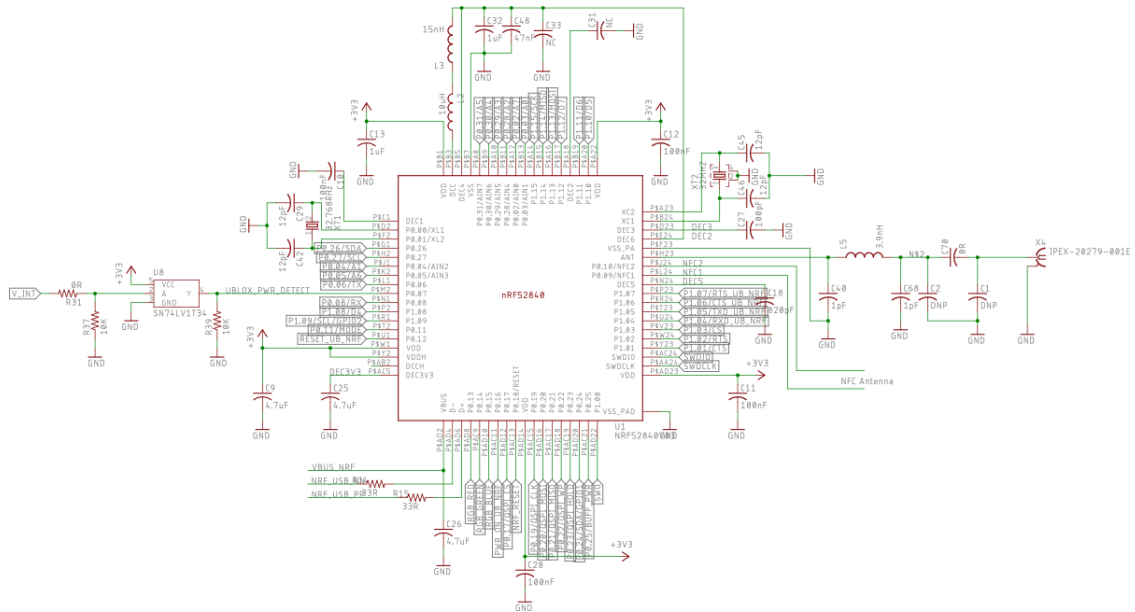
The U.FL antenna connector is not designed to be constantly plugged and unplugged. The antenna pin is static sensitive and you can destroy the radio with improper handling. A tiny dab of glue (epoxy, rubber cement, liquid tape or hot glue) on the connector can be used securely hold the plug in place.

The M.2 edge connector is static sensitive and should be handled carefully. The M.2 connector is not designed for repeated removal and insertion of the module.

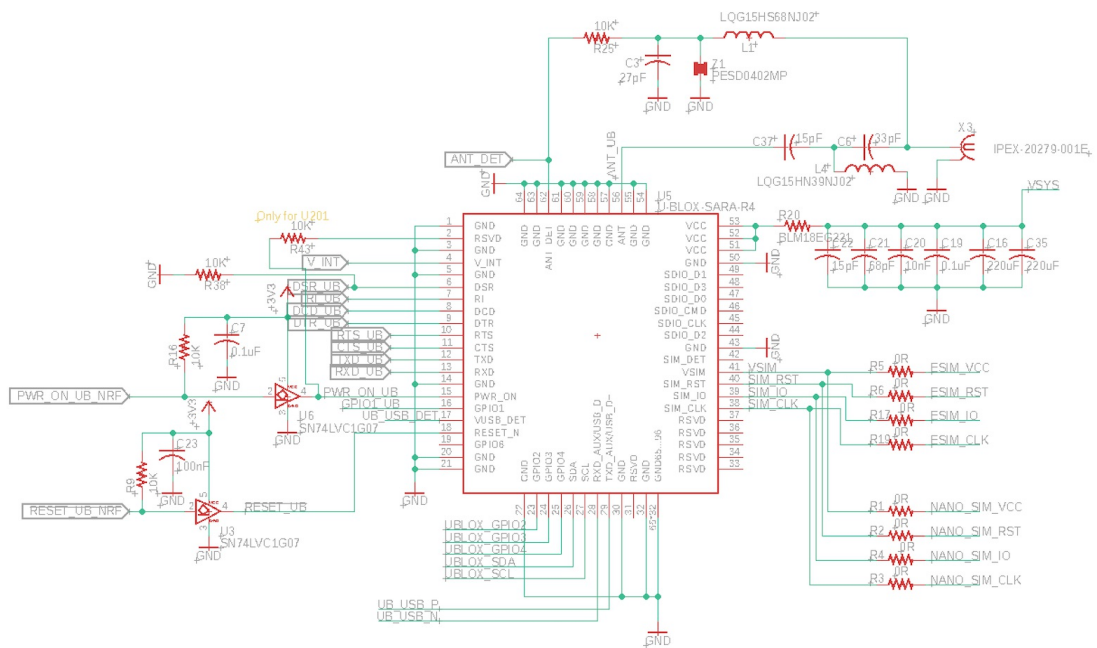


# Schematics

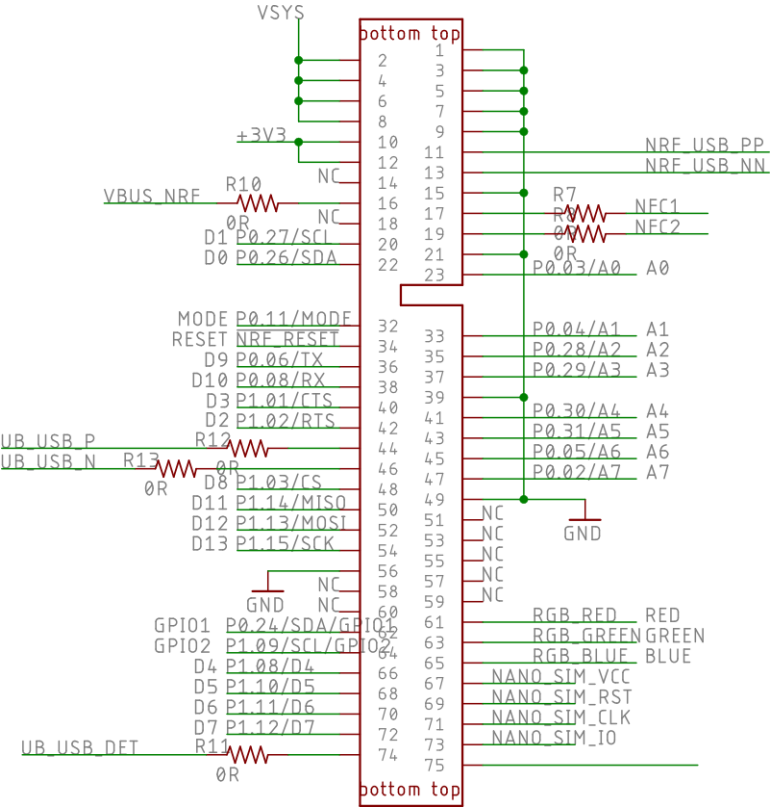
## MICROCONTROLLER



## U-BLOX CELLULAR MODEM



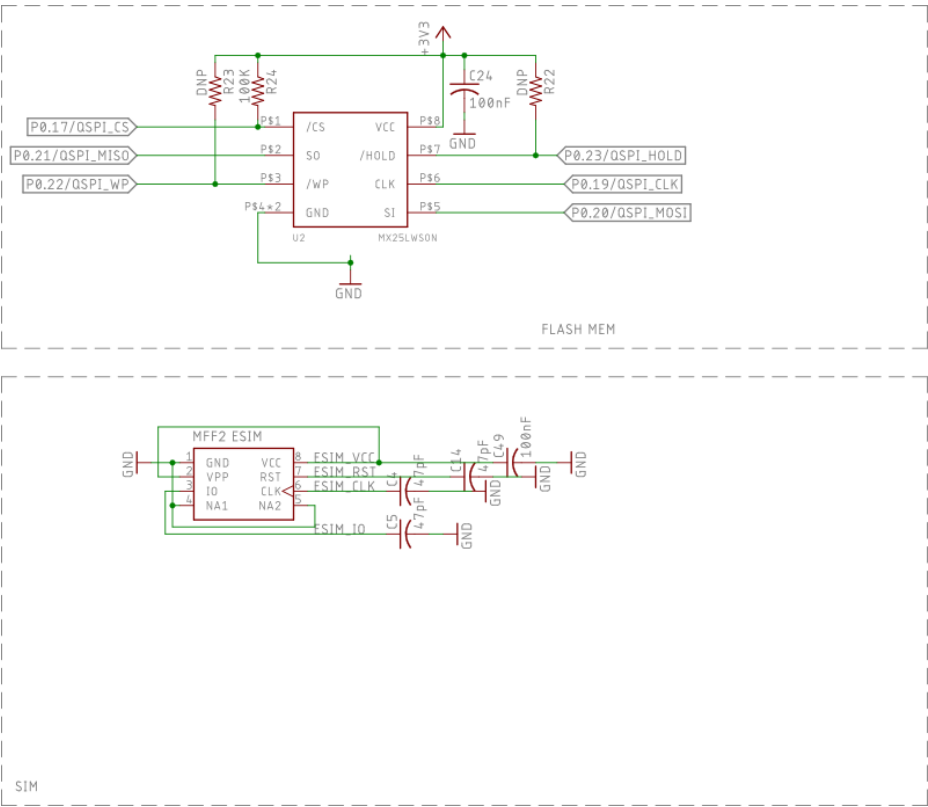
M.2 CONNECTOR

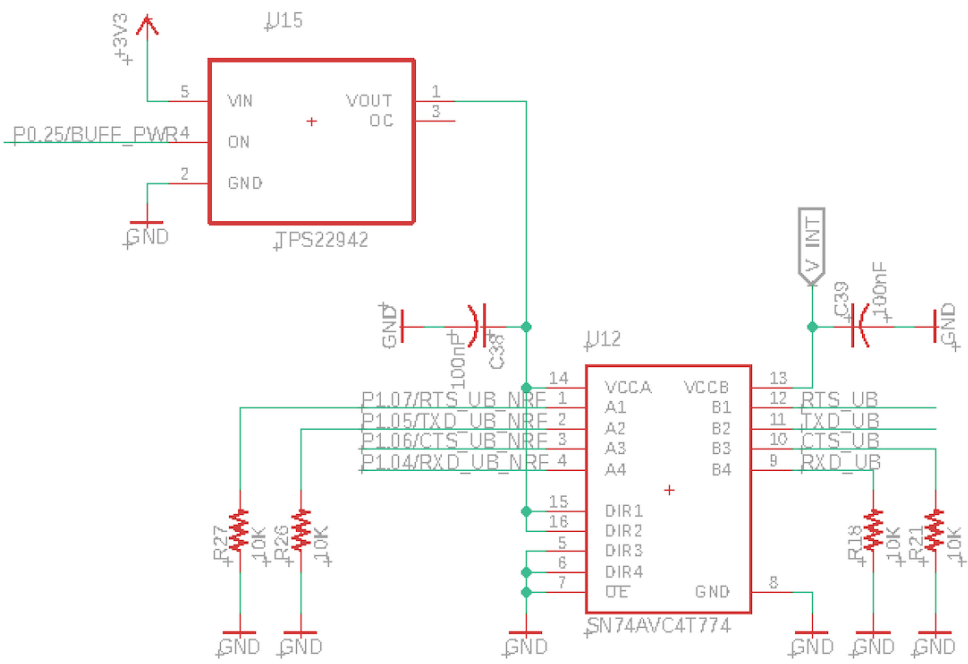


Note: An earlier version of this document had reversed the labels D2 and D3 in the diagram located here. The correct assignments are pictured above and are as follows:

SoM Pin	nRF52 Pin	Device OS Pin	Serial Flow Control
40	P1.01	D3	CTS
42	P1.02	D2	RTS

SIM AND FLASH





# Assembly

## **CONFORMAL COATINGS**

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B-Series SoM modules should not use a conformal coating to protect the module from water. Some components on the SoM cannot be coated and would need to be masked off during coating. This will make the coating process difficult to implement and test.

Furthermore, you cannot safely protect the the connection between the M.2 SoM and the M.2 NGFF connector by using a coating. Using an enclosure that protects both your base board and the B-Series SoM as a single waterproof assembly is recommended instead.

## Default settings

The B series comes pre-programmed with a bootloader and a user application called Tinker. This application works with an iOS and Android app also named Tinker that allows you to very easily toggle digital pins, take analog and digital readings and drive variable PWM outputs.

The bootloader allows you to easily update the user application via several different methods, USB, OTA, Serial Y-Modem, and also internally via the Factory Reset procedure. All of these methods have multiple tools associated with them as well.

# Country compatibility

Country	Model	Technologies	Carriers
Canada	B404	M1	Bell Mobility, Rogers Wireless, Telus
Mexico	B404	M1	AT&T, Telcel
United States	B404	M1	AT&T, T-Mobile (USA), Verizon <sup>7</sup>

# Ordering information

SKU	Description	Region	Modem	EtherSIM	Lifecycle	Replacement
B404MTY	B-Series LTE-M (NorAm, EtherSIM), Tray [x50]	NORAM	R410	✓	NRND	B404XMTY
B402MEA	B-Series LTE CAT-M1 (NorAm), [x1]	NORAM	R410		Deprecated	B404XMEA
B402MTY	B-Series LTE CAT-M1 (NorAm), Tray [x50]	NORAM	R410		Deprecated	B404XMTY
B404MEA	B-Series LTE-M (NorAm, EtherSIM), [x1]	NORAM	R410	✓	Deprecated	B404XMEA

# Revision history

Revision	Date	Author	Comments
001	29 Apr 2019	RK	Initial Release
002	03 Feb 2020	RK	Fixed number of I2C, SPI, and PWM
003	18 Feb 2020	RK	Keep-out diagram M.2 connector was upside-down
004	16-Sep-2020	RK	Added power consumption information
005	16-Dec-2020	RK	Added missing TBD power consumption values
006	04-Jan-2021	RK	Fix incorrect pin number on pogo pin diagram
007	03-Feb-2021	RK	Split u-blox schematics into two images
008	15-Mar-2021	RK	Updated model, carrier, ordering information
009	23-Mar-2021	RK	Pins 40 and 42 functions were reversed
010	26-Apr-2021	RK	Added B404 model number
011	14-May-2021	RK	Pins 40 and 42 were not actually reversed
012	19-May-2021	RK	List Ethernet reserved pins
013	28-Jun-2021	RK	Added Device OS 3.1 memory map information
014	10-Sep-2021	RK	Changed wording of peak vs. max current
015	14-Mar-2022	RK	Added B404X, deprecation notice
016	05-May-2022	RK	Corrected number of PWM outputs (8)
017	11-Aug-2022	RK	Correct typo in 3V3 explanation
018	29-Aug-2022	RK	Split out B404X into separate datasheet
019	10-Dec-2022	RK	Added PMIC notes
020	06-Jan-2023	RK	Clarify power supply notes for VCC and 3V3
021	31-Jan-2023	RK	Add Device OS versions
022	28-Apr-2023	RK	Add conformal coating warning
023	07-Jun-2023	RK	Fixed diagram of M.2 connector in schematics
024	20-Feb-2024	RK	M.2 screw assembly should be connected to ground
025	19-Mar-2024	RK	Incorrect bands listed for the B402 and B404