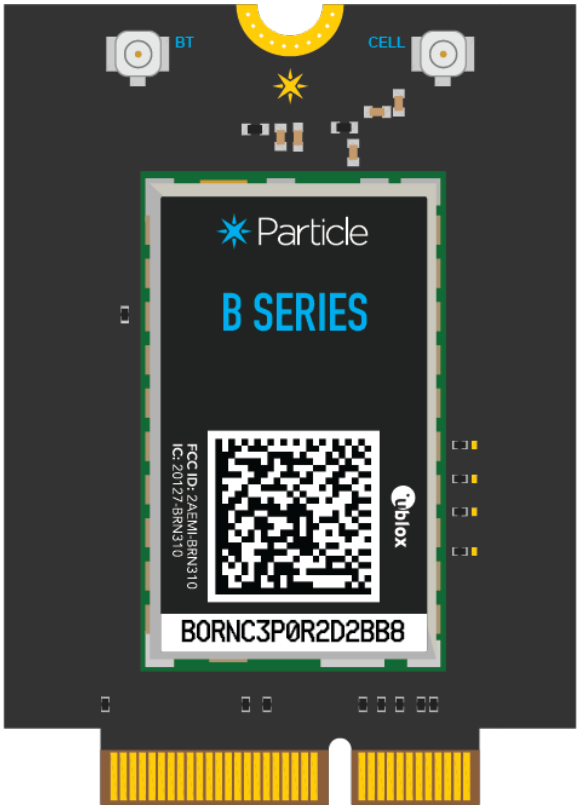
B404X Datasheet



This is a graphic of the B404. The B404X has the same exterior dimensions but the appearance may vary slightly from this graphic.

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 - B404X

- u-blox SARA-R510S-01B LTE modem (B404X)
- LTE Cat M1 module
- Support for United States, Canada, and Mexico only
- 3GPP Release 14 LTE Cat M1
- Cat M1 bands: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 71, 85[1]
- Embedded Particle EtherSIM (B404X)
- Requires Device OS 4.0.0 LTS (or later)

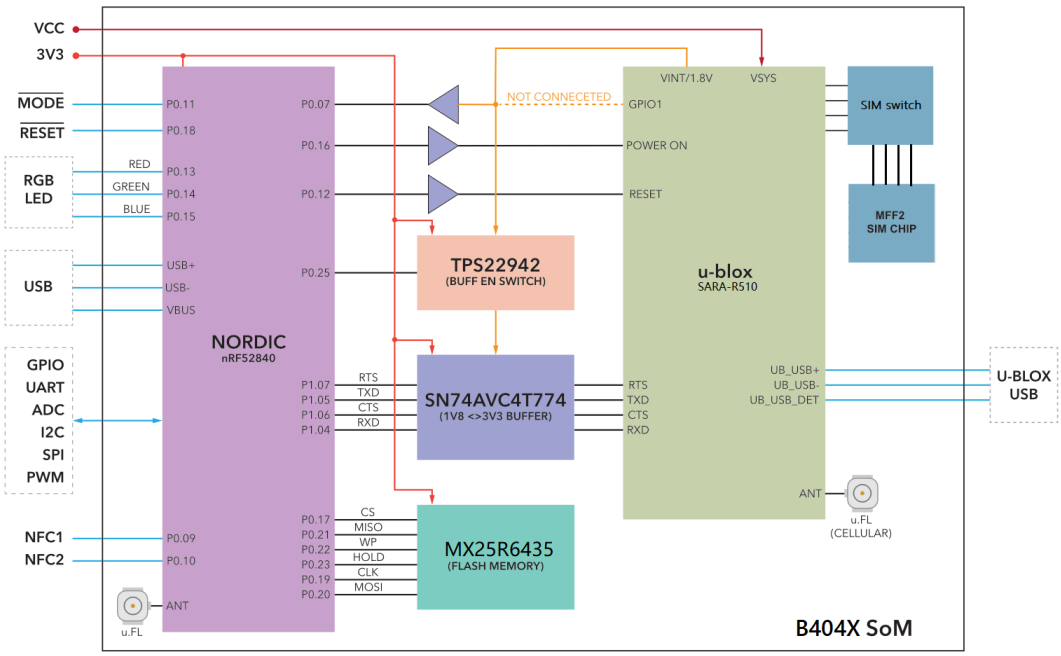
[1] Not all bands enabled in software by default

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)

Interfaces

BLOCK DIAGRAM



POWER

VCC

VCC is used to supply power to the u-blox SARA-R410M/R410S cellular module. The recommended input voltage range on this pin is between 3.6V to 4.2V DC. Make sure that the supply can handle currents of at least 2 A.

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 at least 150 mA, however it may need to be larger than that if you have additional 3.3V peripherals on your base board.

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.

VBus

VBus is connected to the USB detect pin of nRF52840 to enables the USB interface. The recommended input voltage range is between 4.35V to 5.5V DC.

ANTENNA

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

Antenna	SKU	Details	Links
Wide band LTE-CAT M1 cell antenna, [x1]	PARANTC41EA	B404X, BRN404X, and E404X	Datasheet
Wide band LTE-CAT M1 cell antenna, [x50]	PARANTC41TY	B404X, BRN404X, and E404X	Datasheet

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

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

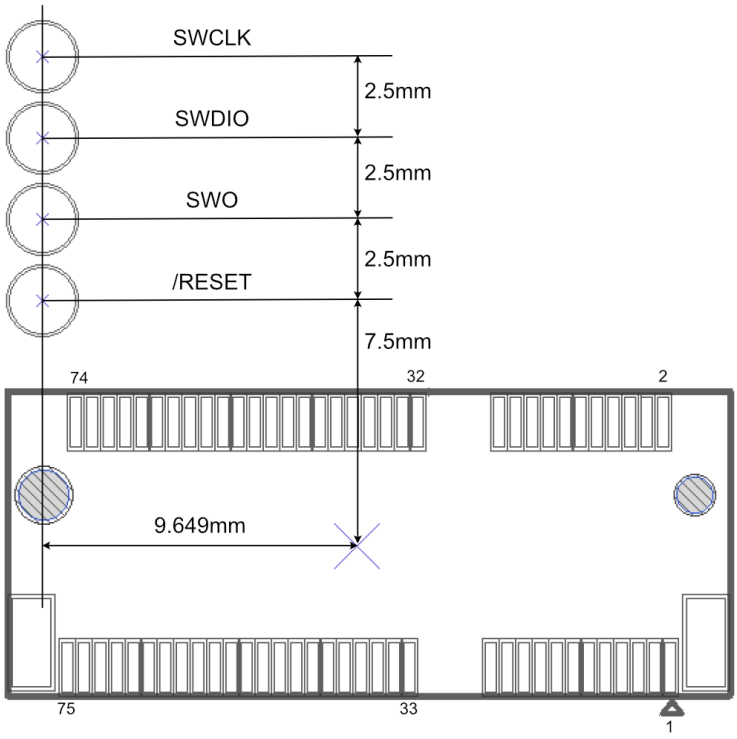
There are some optional B402 module specific I/O:

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

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

JTAG AND SWD

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.


SWCLK
2.5mm
SWDIO
2.5mm
SWO
2.5mm
/RESET
7.5mm
74
32
2
9.649mm
75
33
1

Memory map

NRF52840 FLASH LAYOUT OVERVIEW

- 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)

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

Pins and button definitions

PINOUT DIAGRAM

Pins SOM0 to SOM9 will vary across various SoM modules. For example, cellular-specific pins exists in this range.

Additionally there are RESERVED[3] pins, whose functions vary depending on the SoM. For example, nRF52 MCU-based modules use some of these pins for additional ADC and GPIO. They are able to be used as described on the B402, but their function may be be different on future modules.

For maximum cross-module flexibility, you should try to use only the common pins when possible.

GPIO AND PORT LISTING

Pin Name	Module Pin				MCU
A0 / D19	23	ADC1			P0.03
A1 / D18	33	ADC2			P0.04
A2 / D17	35	ADC4			P0.28
A3 / D16	37	ADC5			P0.29
A4 / D15	41	ADC6			P0.30
A5 / D14	43	ADC7			P0.31
A6	45	ADC3			P0.05
A7	47	ADC0			P0.02
CELL USBD-	46				
CELL USBD+	44				
CELL VBUS	74				
D0	22	Wire (SDA)			P0.26
D1	20	Wire (SCL)			P0.27
D2	42	Wire1 (SDA)	SPI1 (SCK)	Serial1 RTS	P1.02
D22	62				P0.24
D23	64				P1.09

D3	40	Wire1 (SCL)	SPI1 (MOSI)	Serial1 CTS	P1.01
D4	66		SPI1 (MISO)		P1.08
D5	68				P1.10
D6	70				P1.11
D7	72				P1.12
D8	48		SPI (SS)		P1.03
MISO / D11	50		SPI (MISO)		P1.14
MOSI / D12	52		SPI (MOSI)		P1.13
NC	14				
NC	75				
NFC1	17				P0.09
NFC2	19				P0.10
RGBB	65				P0.15
RGBG	63				P0.14
RGBR	61				P0.13
RX / D10	38			Serial1 RX	P0.08
SCK / D13	54		SPI (SCK)		P1.15
SIM_CLK	71				
SIM_DATA	73				
SIM_RST	69				
SIM_VCC	67				
TX / D9	36			Serial1 TX	P0.06
USBDATA-	13				
USBDATA+	11				
VUSB	16				

ADC (ANALOG TO DIGITAL CONVERTER)

The B404X supports 8 ADC inputs.

Pin	Pin Name	Description	Interface	MCU
23	A0 / D19	A0 Analog in, GPIO, PWM	ADC1	P0.03
33	A1 / D18	A1 Analog in, GPIO, PWM	ADC2	P0.04
35	A2 / D17	A2 Analog in, GPIO	ADC4	P0.28
37	A3 / D16	A3 Analog in, GPIO	ADC5	P0.29
41	A4 / D15	A4 Analog in, GPIO	ADC6	P0.30
43	A5 / D14	A5 Analog in, GPIO	ADC7	P0.31
45	A6	A6 Analog in, PWM, GPIO	ADC3	P0.05
47	A7	A7 Analog in, GPIO, Ethernet Reset	ADC0	P0.02

- ADC inputs are single-ended and limited to 0 to 3.3V
- Resolution is 12 bits

UART SERIAL

The B404X supports one UART serial interfaces.

Pin	Pin Name	Description	Interface	MCU
36	TX / D9	Serial TX, GPIO	Serial1 TX	P0.06
38	RX / D10	Serial RX, GPIO	Serial1 RX	P0.08
40	D3	SPI1 MOSI, Serial1 CTS, GPIO, Wire1 SCL	Serial1 CTS	P1.01
42	D2	SPI1 SCK, Serial1 RTS, PWM, GPIO, Wire1 SDA	Serial1 RTS	P1.02

- The UART pins are 3.3V and must not be connected directly to a RS-232C port or to a 5V TTL serial port
- Hardware flow control is optional; if not used then the RTS and CTS pins can be used as regular GPIO
- You cannot use hardware flow control and Ethernet at the same time.

SPI

The B404X supports two SPI (serial peripheral interconnect) ports.

Pin	Pin Name	Description	Interface	MCU
40	D3	SPI1 MOSI, Serial1 CTS, GPIO, Wire1 SCL	SPI1 (MOSI)	P1.01
42	D2	SPI1 SCK, Serial1 RTS, PWM, GPIO, Wire1 SDA	SPI1 (SCK)	P1.02
48	D8	GPIO, SPI SS, Ethernet CS	SPI (SS)	P1.03
50	MISO / D11	SPI MISO, GPIO	SPI (MISO)	P1.14
52	MOSI / D12	SPI MOSI, GPIO	SPI (MOSI)	P1.13
54	SCK / D13	SPI SCK, GPIO	SPI (SCK)	P1.15
66	D4	SPI1 MISO, PWM, GPIO	SPI1 (MISO)	P1.08

- The SPI port is 3.3V and must not be connected directly to devices that drive MISO at 5V
- If not using a SPI port, its pins can be used as GPIO
- Any pins can be used as the SPI chip select
- Multiple devices can generally share a single SPI port
- You cannot use `SPI1` and Ethernet at the same time.

I2C

The B404X supports two I2C (two-wire serial interface) ports.

Pin	Pin Name	Description	Interface	MCU
20	D1	I2C SCL, GPIO	Wire (SCL)	P0.27
22	D0	I2C SDA, GPIO	Wire (SDA)	P0.26
40	D3	SPI1 MOSI, Serial1 CTS, GPIO, Wire1 SCL	Wire1 (SCL)	P1.01
42	D2	SPI1 SCK, Serial1 RTS, PWM, GPIO, Wire1 SDA	Wire1 (SDA)	P1.02

- The I2C port is 3.3V and must not be connected directly a 5V I2C bus
- Maximum bus speed is 400 kHz
- External pull-up resistors are recommended for I2C as the internal pull-up is 13K.
- If not using I2C, pins D0 and D1 can be used as GPIO or analog input.
- You cannot use `Wire1` and Ethernet at the same time.

PWM

The B404X supports PWM (pulse-width modulation) on the following pins:

Pin	Pin Name	Description	Timer	MCU
23	A0 / D19	A0 Analog in, GPIO, PWM	PWM2	P0.03
33	A1 / D18	A1 Analog in, GPIO, PWM	PWM2	P0.04
45	A6	A6 Analog in, PWM, GPIO	PWM2	P0.05
47	A7	A7 Analog in, GPIO, Ethernet Reset	PWM2	P0.02
66	D4	SPI1 MISO, PWM, GPIO	PWM1	P1.08
68	D5	PWM, GPIO	PWM1	P1.10
70	D6	PWM, GPIO	PWM1	P1.11
72	D7	PWM, GPIO	PWM0	P1.12

- PWM that share the same timer (`PMW2` for example) must share the same frequency but can have different duty cycles.
- Pin `D7` (PWM0) share a timer with the RGB LED and you should not change its frequency but it can have a different duty cycle.

USB

The B404X supports a USB interface for programming the device and for USB serial (CDC) communications. The module itself does not contain a USB connector; you typically add a micro USB or USB C connector on your base board. It is optional but recommended.

Pin	Pin Name	Description	MCU
11	USBDATA+	USB Data+	
13	USBDATA-	USB Data-	
16	VUSB	USB VUSB power pin	
44	CELL USBD+	Cellular Modem USB Data+	
46	CELL USBD-	Cellular Modem USB Data-	

- The Cellular Modem USB connector is optional, and can be used for firmware updates of the cellular module.

RGB LED

The B404X supports an external common anode RGB LED.

One common LED that meets the requirements is the Cree CLMVC-FKA-CL1D1L71BB7C3C3 which is inexpensive and easily procured. You need to add three current limiting resistors. With this LED, we typically use 1K ohm current limiting resistors. These are much larger than necessary. They make the LED less blinding but still provide sufficient current to light the LEDs. If you want maximum brightness you should use the calculated values - 33 ohm on red, and 66 ohm on green and blue.

A detailed explanation of different color codes of the RGB system LED can be found here.

The use of the RGB LED is optional, however it is highly recommended as troubleshooting the device without the LED is very difficult.

Pin	Pin Name	Description	MCU
61	RGBR	RGB LED Red	P0.13
63	RGBG	RGB LED Green	P0.14
65	RGBB	RGB LED Blue	P0.15

SETUP AND RESET BUTTON

It is highly recommended that you add MODE (SETUP) and RESET buttons to your base board using momentary switches that connect to GND. These are necessary to change the operating mode of the device, for example to enter listening or DFU mode.

Pin	Pin Name	Description	MCU
32	MODE / D20	MODE button, has internal pull-up	P0.11
34	RST	Hardware reset, active low. External pull-up required.	

The MODE button does not have a hardware pull-up on it, so you must add an external pull-up (2.2K to 10K) to 3V3, or connect it to 3V3 if not using a button.

The RST pin does have an internal weak pull-up, but you may want to add external pull-up on that as well, especially if you use an off-board reset button connected by long wires.

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[3]	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[3]	NFC input	P0.09	NFC antenna connection.
18	NC	RESERVED[3]	NC		Leave unconnected.
19	NFC2	SOM4[3]	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[2], 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[2], and digital GPIO.
34	RESET	RESET	I		Active-low reset input.
35	A2	ADC2	IO	P0.28	Analog input ADC2[2], 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[2], 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[3]	IO	P1.01	UART flow control CTS, SCL1 (Wire1), SPI1 MOSI, digital only GPIO.
41	A4	RESERVED[3]	IO	P0.30	Analog input ADC4[2], and digital GPIO.
42	D2	RESERVED[3]	IO	P1.02	UART flow control RTS, SDA1 (Wire1), SPI1 SCK, digital only GPIO.
43	A5	RESERVED[3]	IO	P0.31	Analog input ADC5[2], and digital GPIO.
44	u-blox USB D+	SOM0	IO		Data+ pin of the cellular modem USB port.
45	A6	RESERVED[3]	IO	P0.05	Analog input ADC6[2], and digital GPIO.
46	u-blox USB D-	SOM1	IO		Data- pin of the cellular modem USB port.
47	A7	RESERVED[3]	IO	P0.02	Analog input ADC7[2], 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[3]	NC		Leave unconnected.
52	D12	MOSI	IO	P1.13	SPI interface MOSI, and digital only GPIO.
53	NC	RESERVED[3]	NC		Leave unconnected.
54	D13	SCK	IO	P1.15	SPI interface SCK, and digital only GPIO.
55	NC	RESERVED[3]	NC		Leave unconnected.
56	GND	GND	POWER		System analog ground.
57	NC	RESERVED[3]	NC		Leave unconnected.
58	NC	RESERVED[3]	NC		Leave unconnected.
59	NC	RESERVED[3]	NC		Leave unconnected.
60	NC	RESERVED[3]	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[1]	SOM5[3]	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[1]	SOM6[3]	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[1]	SOM7[3]	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[1]	SOM8[3]	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[3]	IO		USB detect pin for cellular modem. 5V on this pin enables the u-blox USB interface.
75	NC	SOM9[3]	NC		Leave unconnected.

[1]These pins are connected to the internal MFF2 SIM and should be left open.

[2]A0-A7 are 12-bit Analog-to-Digital (A/D) inputs (0-4095).

[3]SoM-specific and Reserved pins will vary depending on module. They are able to be used on the B402, but their function may be 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 with 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.

Technical specifications

ABSOLUTE MAXIMUM RATINGS [1]

Supply voltages

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltages					
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
I/O pin voltage					
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
NFC antenna pin current					
$I_{NFC1/2}$	NFC1/NFC2			80	mA
Radio					
BT RF input level (52840)				10	dBm
Environmental					
Storage temperature		-40		+85	°C

[1] 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
Supply voltages					
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
Environmental					
Normal operating temperature[1]		-20	+25	+65	°C
Extended operating temperature[2]		-40		+85	°C
Humidity Range Non condensing, relative humidity				95	%

Notes:

[1] Normal operating temperature range (fully functional and meet 3GPP specifications).

[2] Extended operating temperature range (RF performance may be affected outside normal operating range, though module is fully functional)

Values are from B404/B402. Actual operating current with cellular using the R510 modem may vary but should be similar.

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

[1]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

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-R510S-01B

Parameter	Value	FCC Certified
Protocol stack	3GPP Release 14	
RAT	LTE Cat M1 Half-Duplex	
LTE FDD Bands	Band 71 (600 MHz)	
	Band 12 (700 MHz)	✓
	Band 28 (700 MHz)	✓
	Band 85 (700 MHz)	
	Band 13 (750 MHz)	✓
	Band 20 (800 MHz)	✓
	Band 5 (850 MHz)	✓
	Band 18 (850 MHz)	
	Band 19 (850 MHz)	
	Band 26 (850 MHz)	
	Band 8 (900 MHz)	✓
	Band 4 (1700 MHz)	✓
	Band 3 (1800 MHz)	✓
	Band 2 (1900 MHz)	✓
	Band 25 (1900 MHz)	
	Band 1 (2100 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.
- FCC Certification in the United States only tests bands in use in the United States.
- 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[1]		9		ns
tRF,25pF	Rise/fall time, standard drive mode, 10-90%, 25 pF load[1]		13		ns
tRF,50pF	Rise/fall time, standard drive mode, 10-90%, 50 pF load[1]		25		ns
tHRF,15pF	Rise/Fall time, high drive mode, 10-90%, 15 pF load[1]		4		ns
tHRF,25pF	Rise/Fall time, high drive mode, 10-90%, 25 pF load[1]		5		ns
tHRF,50pF	Rise/Fall time, high drive mode, 10-90%, 50 pF load[1]		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

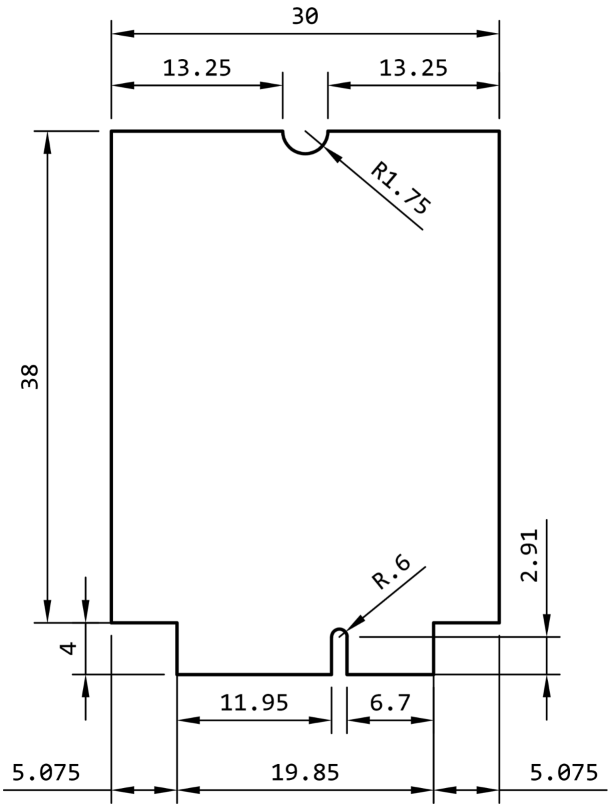
- Rise and fall times based on simulations
- GPIO default to standard drive (2mA) but can be reconfigured to high drive (9mA) in Device OS 2.0.0 and later using the `pinSetDriveStrength()` function.

Mechanical specifications

DIMENSIONS AND WEIGHT

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

MECHANICAL DRAWING

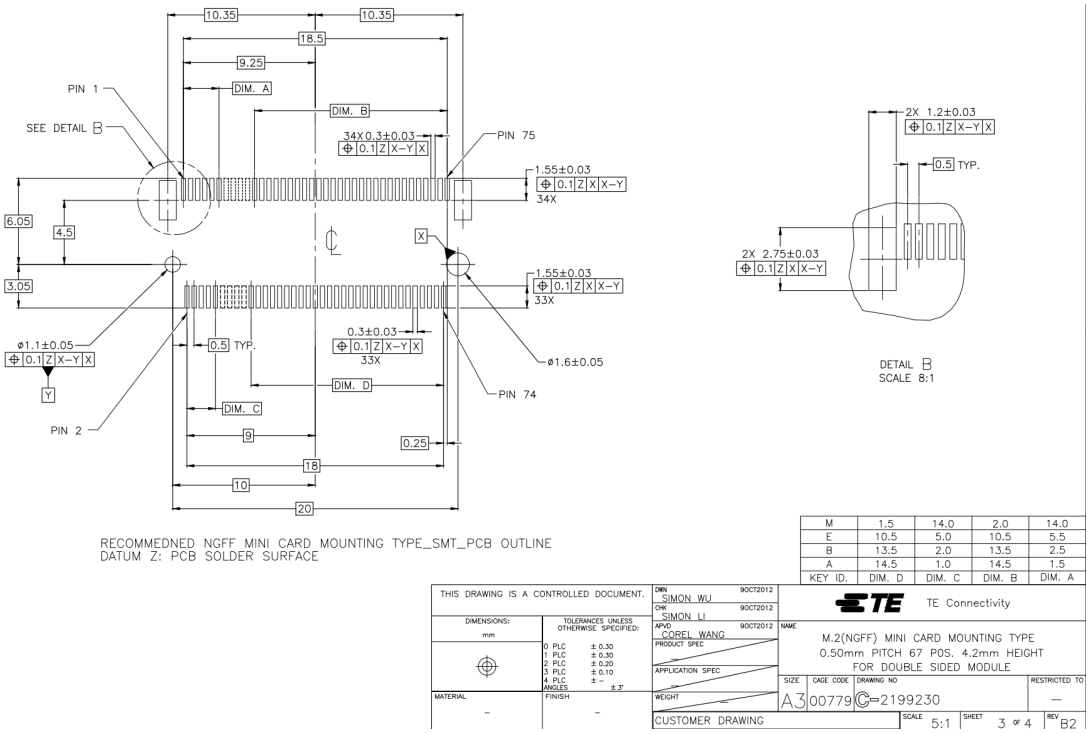


Dimensions are in millimeters.

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.



RECOMMEDNED NGFF MINI CARD MOUNTING TYPE_SMT_PCB OUTLINE
DATUM Z: PCB SOLDER SURFACE

M	1.5	14.0	2.0	14.0
E	10.5	5.0	10.5	5.5
B	13.5	2.0	13.5	2.5
A	14.5	1.0	14.5	1.5
KEY ID.	DIM. D	DIM. C	DIM. B	DIM. A

THIS DRAWING IS A CONTROLLED DOCUMENT.

DIMENSIONS: mm

TOLERANCES UNLESS OTHERWISE SPECIFIED:
0 PLC ± 0.30
1 PLC ± 0.30
2 PLC ± 0.20
3 PLC ± 0.10
4 PLC ± –
ANGLES ± 3°

MATERIAL –
FINISH –

DWN SIMON WU 90CT2012
CHK SIMON LI 90CT2012
APVD COREL WANG 90CT2012
PRODUCT SPEC —
APPLICATION SPEC —
WEIGHT —

TE Connectivity

NAME
M.2(NGFF) MINI CARD MOUNTING TYPE
0.50mm PITCH 67 POS. 4.2mm HEIGHT
FOR DOUBLE SIDED MODULE

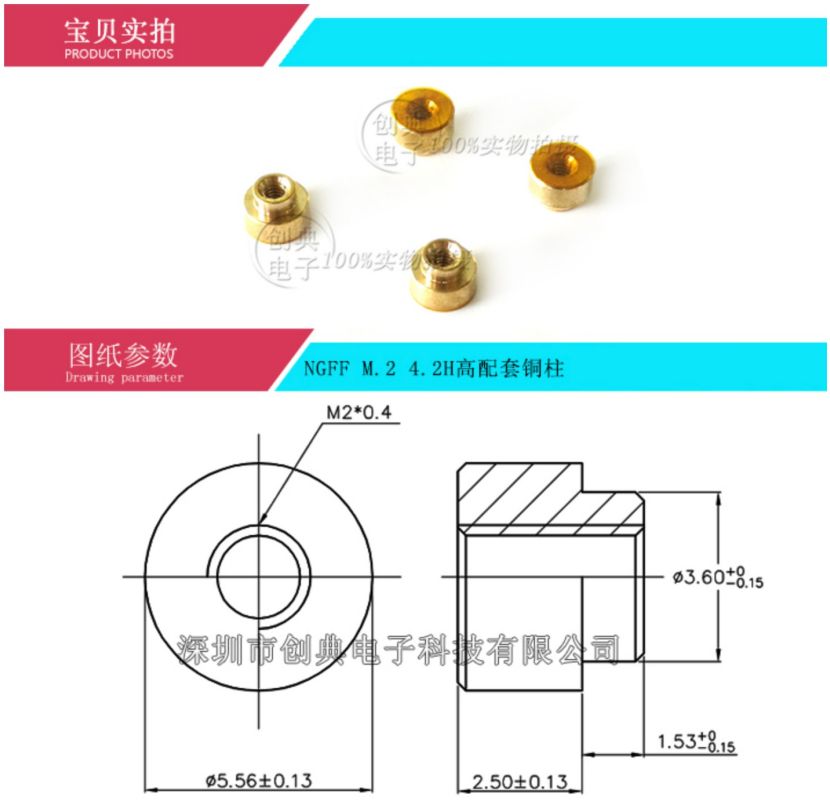
SIZE	CAGE CODE	DRAWING NO	RESTRICTED TO
A3	00779	C-2199230	—

CUSTOMER DRAWING | SCALE 5:1 | SHEET 3 OF 4 | REV B2

SCREW ASSEMBLY

The M.2 SoM requires a screw to hold the SoM in place 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 also provides better vibration resistance than locking clips.

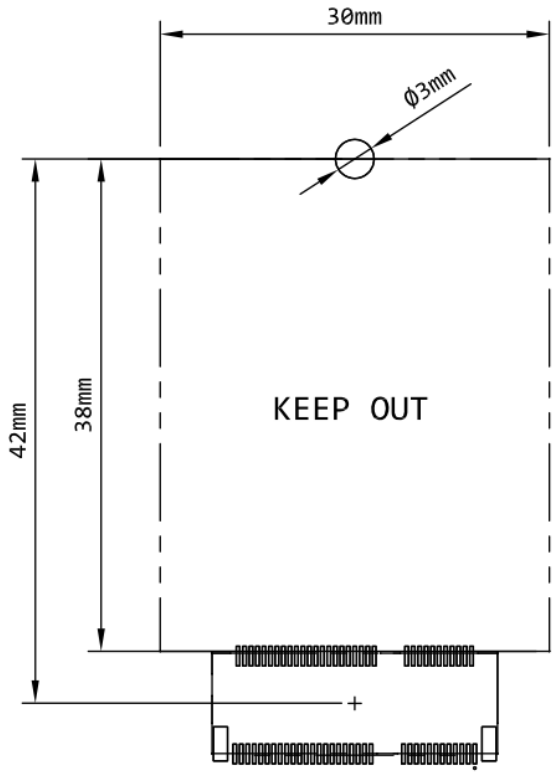
- This is one style of standoff.



- An alternative design uses a JAE SM3ZS067U410-NUT1-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.

DESIGN CONSIDERATIONS

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


30mm
Ø3mm
42mm
38mm
KEEP OUT
+

Product Handling

ESD PRECAUTIONS

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!

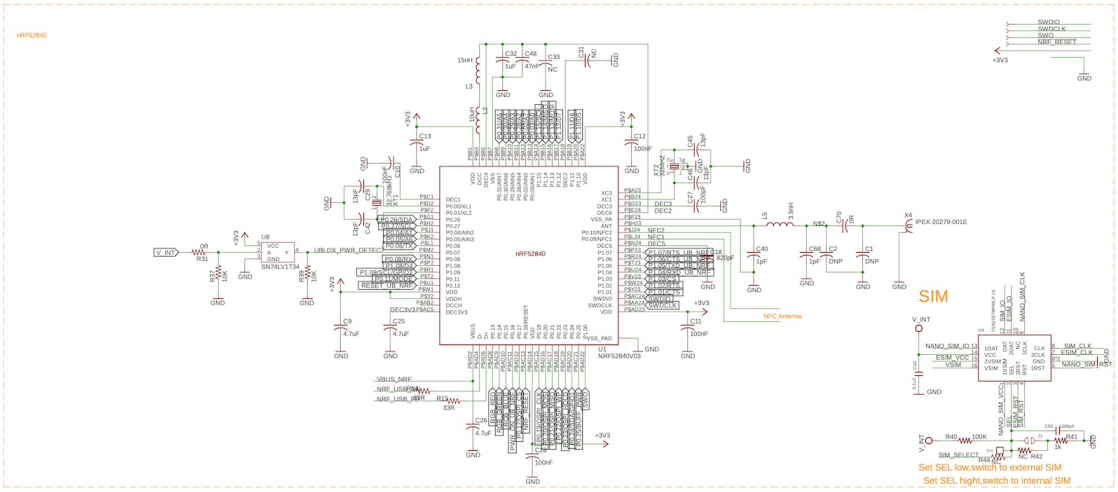
CONNECTORS

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.

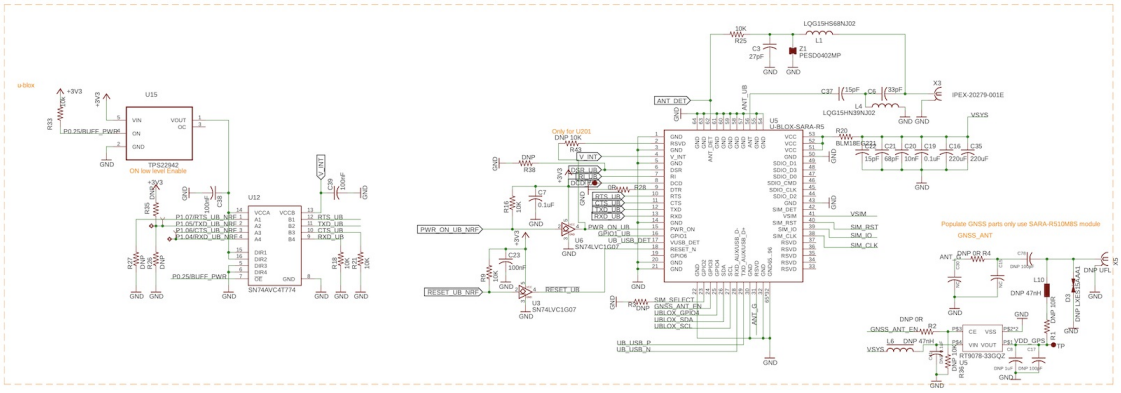
The M.2 edge connector is static sensitive and should be handled carefully. The M.2 connector is not designed for repeated removal and insertion of the module.

Schematics

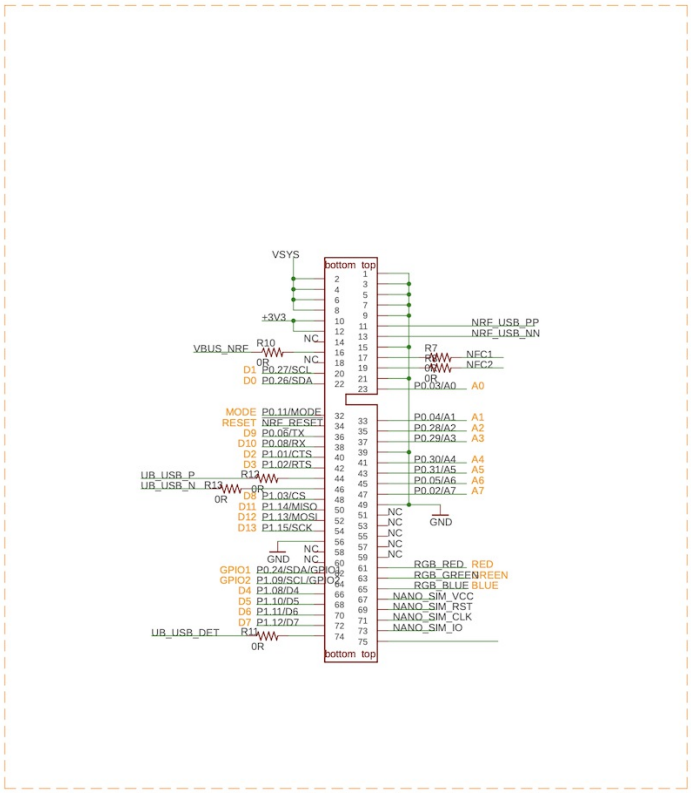
MICROCONTROLLER



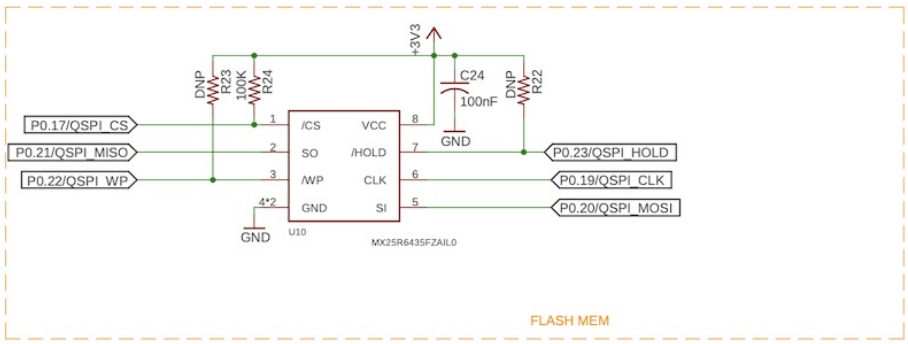
U-BLOX CELLULAR MODEM

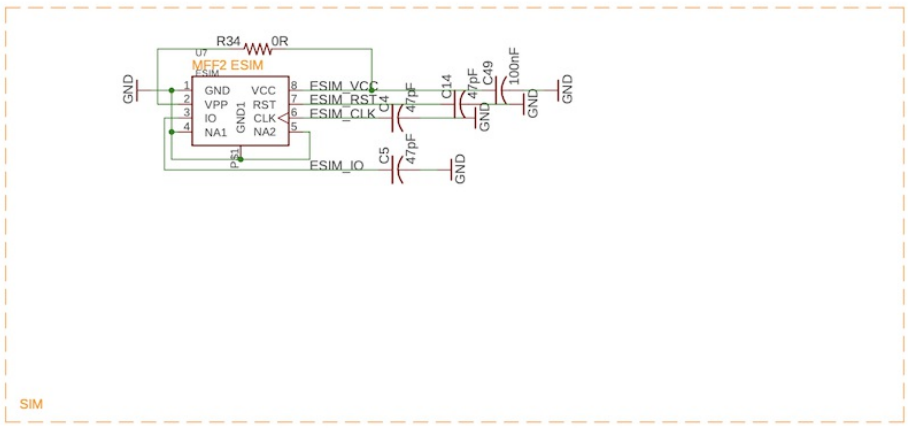


M.2 CONNECTOR



SIM AND FLASH





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.

FCC IC CE Warnings and End Product Labeling Requirements

Federal Communication Commission Interference Statement This equipment has been tested and found to comply with the limits for a Class B 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 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/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. 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.

FCC Radiation Exposure Statement: This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter. This End equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling The final end product must be labeled in a visible area with the following:

- Contains FCC ID: 2AEMI-B404X

Manual Information to the End User The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module.

Canada Statement This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

1. This device may not cause interference; and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage;
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Caution Exposure: This device meets the exemption from the routine evaluation limits in section 2.5 of RSS102 and users can obtain Canadian information on RF exposure and compliance. Le dispositif répond à l'exemption des limites d'évaluation de routine dans la section 2.5 de RSS102 et les utilisateurs peuvent obtenir des renseignements canadiens sur l'exposition aux RF et le respect.

The final end product must be labelled in a visible area with the following: The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the Industry Canada certification number of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

- Contains transmitter module IC: 20127-B404X

This End equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body. Cet équipement devrait être installé et actionné avec une distance minimum de 20 centimètres entre le radiateur et votre corps.

The end user manual shall include all required regulatory information/warning as shown in this manual.

Country compatibility

Country	Model	Technologies	Carriers
Canada	B404	M1	Bell Mobility, Rogers Wireless, Telus
Mexico	B404	M1	AT&T
United States	B404	M1	AT&T

Ordering information

SKU	Description	Region	Modem	EtherSIM	Lifecycle	Replacement
B404XMEA	B Series LTE CAT-M1 (NorAm), [x1]	NORAM	R510	✓	In development	
B404XMTY	B Series LTE CAT-M1 (NorAm), Tray [x50]	NORAM	R510	✓	In development	

Revision history

Revision	Date	Author	Comments
018	2022-08-29	RK	Split out from B404 and B402
019	2022-09-06	RK	Update certified cellular antenna
020	2022-09-07	RK	Add additional port and pin information
021	2022-09-16	RK	Added FCC and IC ID
022	2022-09-16	RK	Fix minimum Device OS version, is 4.0.0
023	2022-09-26	RK	Added FCC and IC labeling requirements