

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 micro-controller.

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

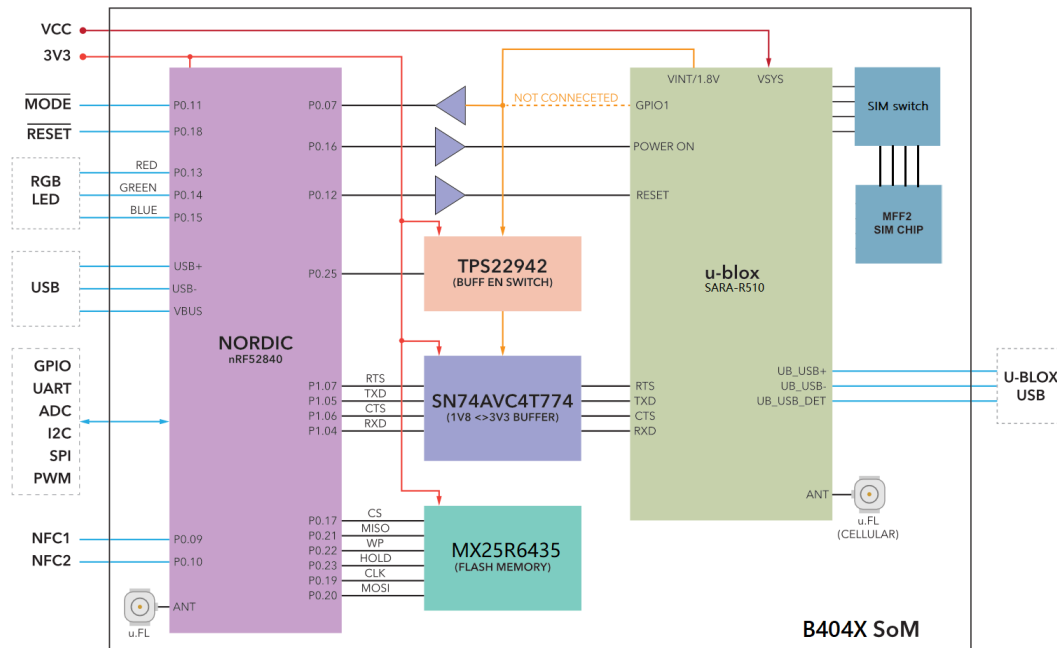
- u-blox SARA-R510S-01B LTE modem (B404X)
- LTE Cat M1 module
- Support for United States, Canada, and Mexico only
- 3GPP Release 14 LTE Cat M1
- Cat M1 bands: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 71, 85¹
- Embedded Particle EtherSIM (B404X)
- Requires Device OS 2.3.0 LTS (or later) or 3.2.0 (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) calculations
- ARM TrustZone CryptoCell-310 Cryptographic and security module
- 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)

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 enable 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 |

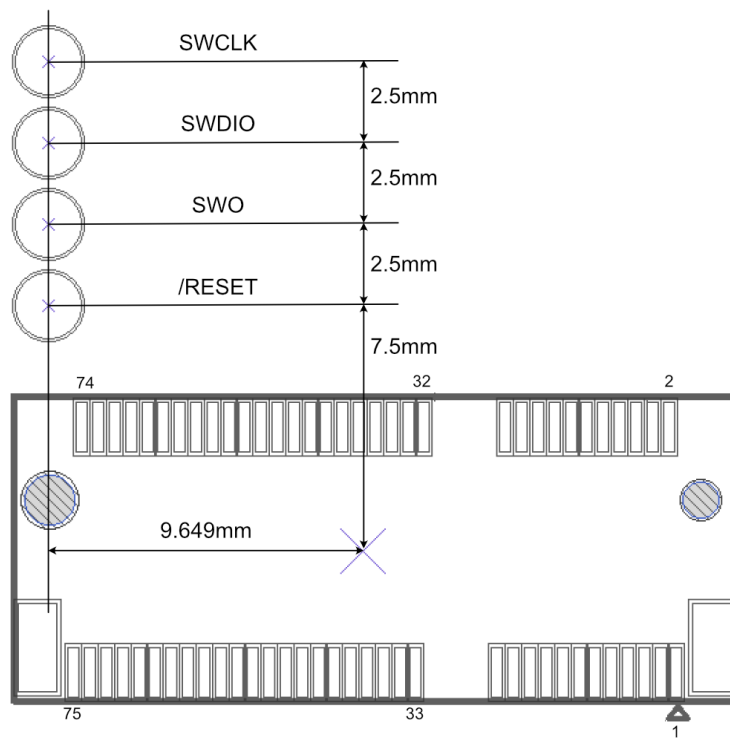
There are some optional B402 module specific I/O:

- 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.



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

| | | | |
|-------------|----|----|----------|
| | H1 | H3 | |
| | H5 | | |
| VCC | 2 | 1 | GND |
| VCC | 4 | 3 | GND |
| VCC | 6 | 5 | GND |
| VCC | 8 | 7 | GND |
| 3V3 | 10 | 9 | GND |
| 3V3 | 12 | 11 | USB D+ |
| RESERVED | 14 | 13 | USB D- |
| VUSB | 16 | 15 | GND |
| RESERVED | 18 | 17 | NFC1 |
| SCL | 20 | 19 | NFC2 |
| SDA | 22 | 21 | GND |
| KEY | 23 | | ADC0 |
| MODE | 32 | 33 | ADC1 |
| RESET | 34 | 35 | ADC2 |
| TX | 36 | 37 | ADC3 |
| RX | 38 | 39 | AGND |
| CTS | 40 | 41 | ADC4 |
| RTS | 42 | 43 | ADC5 |
| u-blox USB+ | 44 | 45 | ADC6 |
| u-blox USB- | 46 | 47 | ADC7 |
| CS | 48 | 49 | AGND |
| MISO | 50 | 51 | RESERVED |
| MOSI | 52 | 53 | RESERVED |
| SCK | 54 | 55 | RESERVED |
| GND | 56 | 57 | RESERVED |
| RESERVED | 58 | 59 | RESERVED |
| RESERVED | 60 | 61 | RED |
| GPIO0 | 62 | 63 | GREEN |
| GPIO1 | 64 | 65 | BLUE |
| PWM0 | 66 | 67 | SIM_VCC |
| PWM1 | 68 | 69 | SIM_RST |
| PWM2 | 70 | 71 | SIM_CLK |
| PWM3 | 72 | 73 | SIM_DATA |
| u-blox VBUS | 74 | 75 | NC |
| | H2 | H4 | |

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

Additionally there are RESERVED³ 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 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 | P0.3 |
| A1 / D18 | 33 | ADC2 | P0.4 |
| 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 | P0.5 |
| A7 | 47 | ADC0 | P0.2 |
| Cellular Modem USB D- | 46 | | |
| Cellular Modem USB D+ | 44 | | |
| Cellular Modem 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 | | | P0.9 |
| 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 | P0.3 |
| 33 | A1 / D18 | A1 Analog in, GPIO, PWM | ADC2 | P0.4 |
| 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 | P0.5 |
| 47 | A7 | A7 Analog in, GPIO, Ethernet Reset | ADC0 | P0.2 |

- 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 | P0.3 |
| 33 | A1 / D18 | A1 Analog in, GPIO, PWM | PWM2 | P0.4 |
| 45 | A6 | A6 Analog in, PWM, GPIO | PWM2 | P0.5 |
| 47 | A7 | A7 Analog in, GPIO, Ethernet Reset | PWM2 | P0.2 |
| 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 (PWM2 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 | Cellular Modem USBD+ | Cellular Modem USB Data+ | |
| 46 | Cellular Modem 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 | P0.9 | 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 | P0.3 | 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 | P0.4 | 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 | P0.6 | 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 | P1.1 | 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 | P1.2 | 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 | P0.5 | 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 | P0.2 | Analog input ADC7 ² , and digital GPIO. |
| 48 | D8 | CS | IO | P1.3 | 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 | P1.9 | GPIO1, digital only. |
| 65 | RGBB | BLUE | IO | P0.15 | Blue pin of the RGB LED. |
| 66 | D4 | PWM0 | IO | P1.8 | 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. |

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

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

³SoM-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](#).

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)

POWER CONSUMPTION

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 |

¹The 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 |

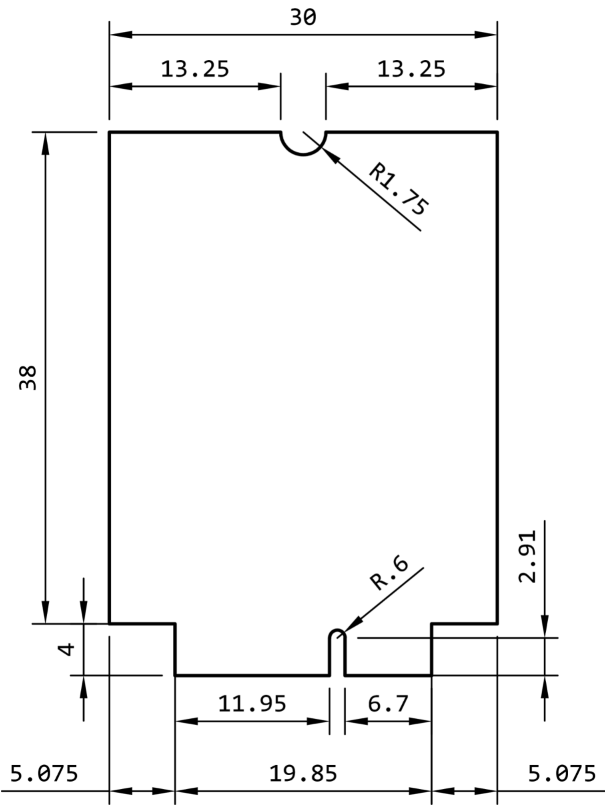
- Rise and fall times based on simulations
- GPIO default to standard drive (2mA) but can be reconfigured to high drive (9mA) in Device OS 2.0.0 and later using the `pinSetDriveStrength()` function.

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](#).



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.

宝贝实拍 PRODUCT PHOTOS



图纸参数 Drawing parameter

NGFF M.2 4.2H高配套铜柱



- 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.



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

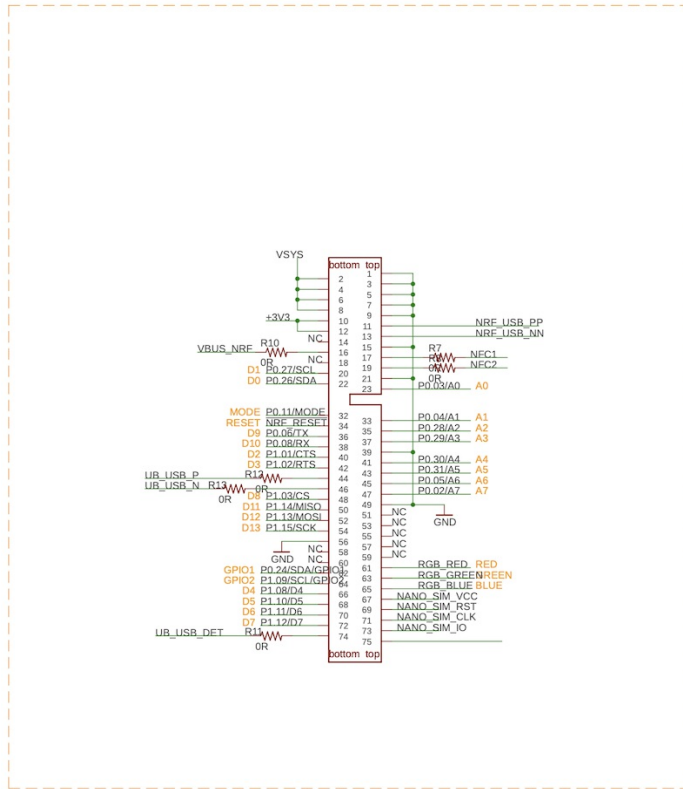
The U.FL antenna connector is not designed to be constantly plugged and unplugged. The antenna pin is static sensitive and you can destroy the radio with improper handling. A tiny dab of glue (epoxy, rubber cement, liquid tape or hot glue) on the connector can be used securely hold the plug in place.

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.

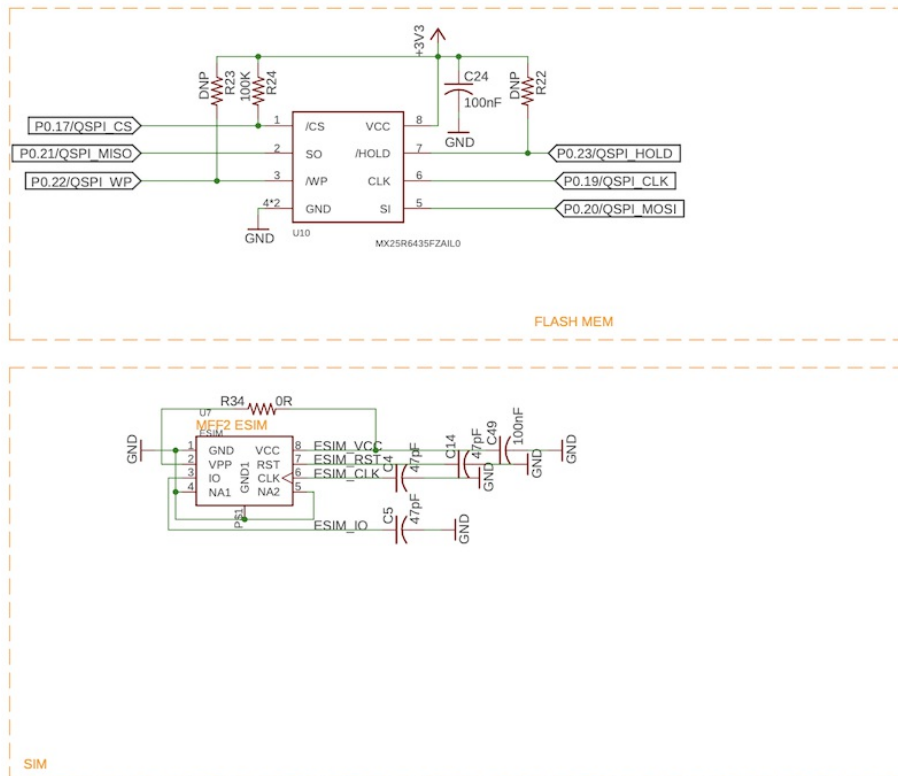
MICROCONTROLLER

The image shows a detailed PCB layout for the SARA-H1000 module. The layout includes various components such as the U15 IC (TP327842), U22 IC (SN74VHC4774), U16 IC (LQ115H-068N302), and various passive components like capacitors and resistors. The layout is labeled with component values and names, and includes a note about the U15 IC.

M.2 CONNECTOR



SIM AND FLASH



Certification

FCC (UNITED STATES)

FCC ID: 2AEMI-B404X

INDUSTRY CANADA (IC)

IC: 20127-B404X

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 |
| 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 |