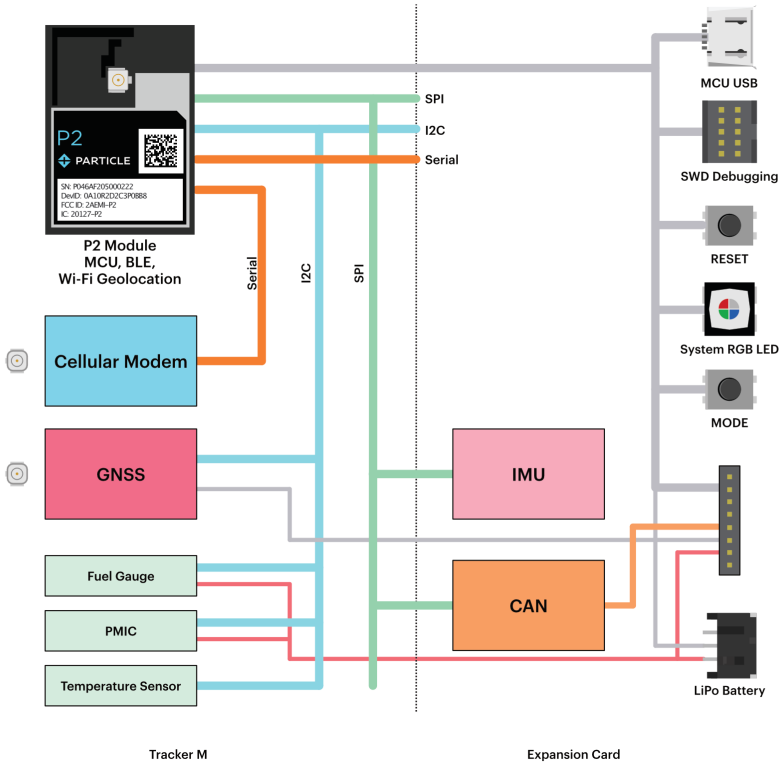
Tracker M Datasheet

Pre-release draft 2022-10-27 for review only. Do not distribute or share this URL!

This is an preliminary pre-release datasheet and the contents are subject to change. The Tracker M design has not been finalized so changes are likely.

The Tracker M will typically be used as a complete off-the-shelf design, like the Tracker One, particularly in micromobility and light electric vehicle applications. Unlike the Tracker One, it is a miniaturized set of circuit boards that are designed fit within your existing equipment enclosures.

Block diagram



The Tracker M module contains the following functional units:

- P2 module (MCU, BLE, and Wi-Fi geolocation)
- Cellular modem
- GNSS (GPS)
- Fuel gauge (battery level monitoring)
- PMIC (Power Management IC and charge controller)
- Temperature sensor

In most cases, you will use the standard expansion card which contains:

- IMU (accelerometer)
- CAN controller, transceiver, and protection circuity
- MCU USB connector, for development and debugging
- SWD debugging, for debugging and optionally for factory firmware flashing
- RESET and MODE buttons
- System RGB LED for troubleshooting
- LiPo battery connector with battery thermistor
- On-board GNSS antenna (optional)
- External connections (listed below)

The following antennas are available

- Cellular (LTE)
- GNSS (dual band, can be mounted on the expansion card, or external)
- Wi-Fi geolocation and BLE

MCU

The P2 is a SMD module with a microcontroller, 2.4 GHz and 5 GHz Wi-Fi, and BLE.

- 802.11a/b/g/n Wi-Fi, 2.4 GHz and 5 GHz
  - Integrated PCB antenna
  - Integrated U.FL connector for external antenna
  - Integrated RF switch
- BLE 5 using same antenna as Wi-Fi
- Realtek RTL8721DM MCU
  - ARM Cortex M23 CPU, 200 MHz
- 2048 KB (2 MB) user application maximum size
- 3072 KB (3 MB) of RAM available to user applications
- 2 MB flash file system
- FCC, IC, and CE certified

Interfaces

External connection

The Tracker M is intended to connect to your equipment using the 8-pin external connection:

Pin	Name	Description
1	GND	Ground
2	VIN	6 to 90 VDC
3	CAN+	CAN interface (+, P, or H)
4	CAN-	CAN interface (-, N, or L)
5	FET	Power control FET output
6	GNSS_WHEEL	
7	GNSS_DIR	
8	GND	Ground

Power is supplied by GND and VIN, from 6 to 90 VDC. It is acceptable to connect it directly to a vehicle power supply with no additional conditioning.

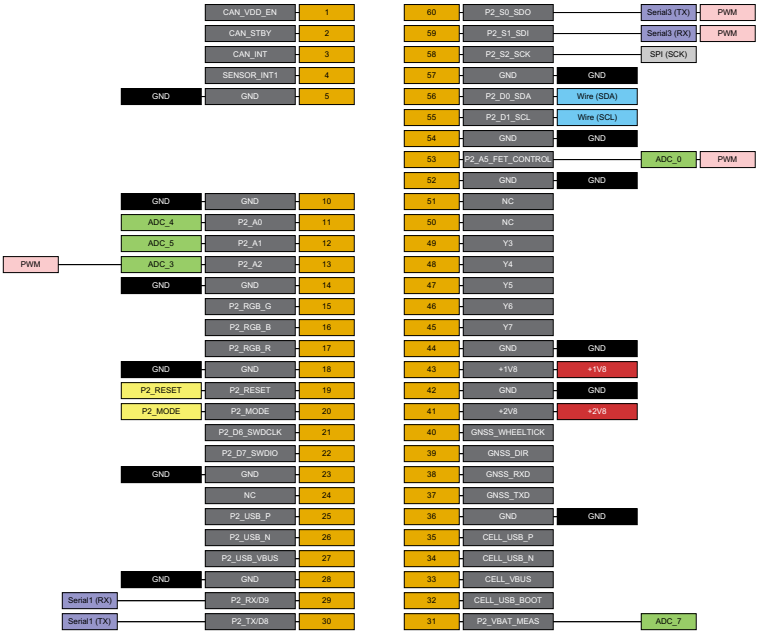
The CAN (controller access network) interface can interact with other equipment with a CAN interface, or an engine control unit (ECU).

The FET output allows control of an external device. In a micromobility device, it might disable the motor, for example, or engage a locking device.

The GNSS_WHEEL and GNSS_DIR are additional inputs to the dead reckoning support in the GNSS to allow for more accurate dead reckoning when there is no GNSS (GPS, etc.) or Wi-Fi geolocation signal. For example, in tunnels. While dead reckoning can be used only with the GNSS accelerometer, wheel motion sensors can improve accuracy.

Expansion card

In most cases, you will use the standard expansion card. It is also possible to develop your own expansion card.



The connectors on the Tracker M module are:

	Description
Manufacturer	Hirose Electric Co. Ltd.
Part Number	DF40C-60DP-0.4V(51)
Description	60 Position Connector Plug, Outer Shroud Contacts Surface Mount Gold

Note that the Tracker M is intended to be mounted on the bottom side of the expansion card, so the expansion card faces up and the Tracker M is on the bottom.

GPIO

Pin Name	Description	SoM Pin	MCU
CAN_VDD_EN	CAN_VDD_EN, CAN 5V supply enableIOEX GPB0		
CAN_STBY	CAN_STBY, IOEX GPB1		
P2_A0 / D11	A0 Analog in, GPIO		PB[1]
P2_A1 / D12	A1 Analog in, GPIO		PB[2]
P2_A2 / D13	A2 Analog in, PWM, GPIO		PB[7]
P2_D6_SWDCLK	D6 GPIO, SWCLK		PB[3]
P2_D7_SWDIO	D7 GPIO, SWDIO		PA[27]
P2_RX/D9 / D9	Serial1 RX (received data), GPIO		PA[8]
P2_TX/D8 / D8	Serial1 TX (transmitted data), GPIO		PA[7]
P2_A5_FET_CONTROL / D14	A5 Analog in, GPIO, PWM.		PB[4]
P2_S2_SCK / D17	S2 GPIO, SPI SCK		PA[14]
P2_S1_SDI / D16	S1 GPIO, PWM, SPI SDI/MISO, Serial3 RX.		PA[13]
P2_S0_SDO / D15	S0 GPIO, PWM, SPI SDO/MOSI, Serial3 TX.		PA[12]

- On the Tracker M, pins D0 and D1 are used in I2C mode by the temperature sensor. Pins D0 and D1 cannot be used as GPIO.

ADC

Pin Name	Description	Interface	SoM Pin	MCU
P2_A0 / D11	A0 Analog in, GPIO	ADC_4		PB[1]
P2_A1 / D12	A1 Analog in, GPIO	ADC_5		PB[2]
P2_A2 / D13	A2 Analog in, PWM, GPIO	ADC_3		PB[7]
P2_VBAT_MEAS	Battery voltage measurement (optional).	ADC_7		
P2_A5_FET_CONTROL / D14	A5 Analog in, GPIO, PWM.	ADC_0		PB[4]

SPI

Pin Name	Description	Interface	SoM Pin	MCU
P2_S2_SCK / D17	S2 GPIO, SPI SCK	SPI (SCK)		PA[14]
P2_S1_SDI / D16	S1 GPIO, PWM, SPI SDI/MISO, Serial3 RX.	SPI (MISO)		PA[13]
P2_S0_SDO / D15	S0 GPIO, PWM, SPI SDO/MOSI, Serial3 TX.	SPI (MOSI)		PA[12]

- Any available GPIO can be used as a SPI CS/SS pin.

I2C

Pin Name	Description	Interface	SoM Pin	MCU
P2_D1_SCL	I2C SCL	Wire (SCL)		PB[5]
P2_D0_SDA	I2C SDA	Wire (SDA)		PB[6]

- On the Tracker M, pins D0 and D1 are used in I2C mode by the temperature sensor. Pins D0 and D1 cannot be used as GPIO.

SERIAL (UART)

Pin Name	Description	Interface	SoM Pin	MCU
P2_RX/D9 / D9	Serial1 RX (received data), GPIO	Serial1 (RX)		PA[8]
P2_TX/D8 / D8	Serial1 TX (transmitted data), GPIO	Serial1 (TX)		PA[7]
P2_S1_SDI / D16	S1 GPIO, PWM, SPI SDI/MISO, Serial3 RX.	Serial3 (RX)		PA[13]
P2_S0_SDO / D15	S0 GPIO, PWM, SPI SDO/MOSI, Serial3 TX.	Serial3 (TX)		PA[12]

PWM

Pin Name	Description	SoM Pin	MCU
P2_A2 / D13	A2 Analog in, PWM, GPIO		PB[7]
P2_A5_FET_CONTROL / D14	A5 Analog in, GPIO, PWM.		PB[4]
P2_S1_SDI / D16	S1 GPIO, PWM, SPI SDI/MISO, Serial3 RX.		PA[13]
P2_S0_SDO / D15	S0 GPIO, PWM, SPI SDO/MOSI, Serial3 TX.		PA[12]

- If SPI is not used, the pins can be used for GPIO or Serial.

FULL EXPANSION PIN LISTING

Pin	Pin Name	Description	MCU
Top 1	CAN_VDD_EN	CAN_VDD_EN, CAN 5V supply enableIOEX GPB0	
Top 2	CAN_STBY	CAN_STBY, IOEX GPB1	
Top 3	CAN_INT	CAN_INT, interrupt from CAN controller, IOEX GPB2	
Top 4	SENSOR_INT1	SENSOR_INT1, IOEX GPB3	
Top 5	GND	Ground.	
Top 10	GND	Ground.	
Top 11	P2_A0 / D11	A0 Analog in, GPIO	PB[1]
Top 12	P2_A1 / D12	A1 Analog in, GPIO	PB[2]
Top 13	P2_A2 / D13	A2 Analog in, PWM, GPIO	PB[7]
Top 14	GND	Ground.	
Top 15	P2_RGB_G	RGB LED Green	PB[23]
Top 16	P2_RGB_B	RGB LED Blue	PB[22]
Top 17	P2_RGB_R	RGB LED Red	PA[30]
Top 18	GND	Ground.	
Top 19	P2_RESET	Hardware reset. Pull low to reset; can leave unconnected in normal operation.	CHIP_EN
Top 20	P2_MODE	MODE button. Pin number constant is BTN. Pull low when button is pressed.	PA[4]
Top 21	P2_D6_SWDCLK	D6 GPIO, SWCLK	PB[3]
Top 22	P2_D7_SWDIO	D7 GPIO, SWDIO	PA[27]

Top 23	GND	Ground.	
Top 24	NC	Leave unconnected	
Top 25	P2_USB_P	MCU USB Data+	PA[26]
Top 26	P2_USB_N	MCU USB Data-	PA[25]
Top 27	P2_USB_VBUS		
Top 28	GND	Ground.	
Top 29	P2_RX/D9 / D9	Serial1 RX (received data), GPIO	PA[8]
Top 30	P2_TX/D8 / D8	Serial1 TX (transmitted data), GPIO	PA[7]
Top 31	P2_VBAT_MEAS	Battery voltage measurement (optional).	
Top 32	CELL_USB_BOOT		
Top 33	CELL_VBUS		
Top 34	CELL_USB_N		
Top 35	CELL_USB_P		
Top 36	GND	Ground.	
Top 37	GNSS_TXD		
Top 38	GNSS_RXD		
Top 39	GNSS_DIR		
Top 40	GNSS_WHEELTICK		
Top 41	+2V8	2.8V power	
Top 42	GND	Ground.	
Top 43	+1V8	1.8V power	
Top 44	GND	Ground.	
Top 45	Y7	IMU Y7	
Top 46	Y6	IMU Y6	
Top 47	Y5	IMU Y5	
Top 48	Y4	IMU Y4	
Top 49	Y3	IMU Y3	

Top 50	NC	Leave unconnected	
Top 51	NC	Leave unconnected	
Top 52	GND	Ground.	
Top 53	P2_A5_FET_CONTROL / D14	A5 Analog in, GPIO, PWM.	PB[4]
Top 54	GND	Ground.	
Top 55	P2_D1_SCL	I2C SCL	PB[5]
Top 56	P2_D0_SDA	I2C SDA	PB[6]
Top 57	GND	Ground.	
Top 58	P2_S2_SCK / D17	S2 GPIO, SPI SCK	PA[14]
Top 59	P2_S1_SDI / D16	S1 GPIO, PWM, SPI SDI/MISO, Serial3 RX.	PA[13]
Top 60	P2_S0_SDO / D15	S0 GPIO, PWM, SPI SDO/MOSI, Serial3 TX.	PA[12]
Bot 1	VIN		
Bot 2	VIN		
Bot 3	VIN		
Bot 8	GND	Ground.	
Bot 9	GND	Ground.	
Bot 10	GND	Ground.	
Bot 11	LI+		
Bot 12	LI+		
Bot 13	LI+		
Bot 14	GND	Ground.	
Bot 15	GND	Ground.	
Bot 16	GND	Ground.	
Bot 17	TS	PMIC TS (temperature sensor) pin	
Bot 18	3V3		
Bot 19	3V3		
Bot 20	GND	Ground.	
Bot 21	GND	Ground.	
Bot 22	PMID	PMIC PMID power output	
Bot 23	PMID	PMIC PMID power output	
Bot 24	GND	Ground.	
Bot 25	GND	Ground.	

Bot 26	5V	
Bot 27	5V	
Bot 28	GND	Ground.
Bot 29	GND	Ground.
Bot 30	VCC	3.7V cellular modem supply
Bot 31	GND	Ground.
Bot 32	GND	Ground.
Bot 33	GND	Ground.
Bot 34	5V	
Bot 35	5V	
Bot 36	GND	Ground.
Bot 37	GND	Ground.
Bot 38	PMID	PMIC PMID power output
Bot 39	PMID	PMIC PMID power output
Bot 40	GND	Ground.
Bot 41	GND	Ground.
Bot 42	3V3	
Bot 43	3V3	
Bot 44	GND	Ground.
Bot 45	GND	Ground.
Bot 46	GND	Ground.
Bot 47	GND	Ground.
Bot 48	LI+	
Bot 49	LI+	
Bot 50	LI+	
Bot 51	GND	Ground.
Bot 52	GND	Ground.
Bot 53	GND	Ground.

Bot 58	VIN
Bot 59	VIN
Bot 60	VIN

I/O EXPANDER (IOEX)

The large number of peripheral chips on the Tracker M exceed the number of available GPIO on the P2. A MCP23S17 SPI I/O Expander is used to provide 16 additional GPIO pins. These can be accessed using the standard `digitalRead()` and `digitalWrite()` Device OS API calls.

Pin Name	Description	Interface
FUEL_INT	FUEL_INT, interrupt from battery fuel gauge, IOEX GPA0	GPA0
DCDC_EN	DCDC_EN, IOEX GPA1	GPA1
GNSS_PWR_EN	GNSS_PWR_EN, IOEX GPA2	GPA2
2V8_IO	2V8_IO_EN, IOEX GPA3	GPA3
SHT_ALERT	SHT_ALERT, alert signal from temperature sensor, IOEX GPA4	GPA4
GNSS_RST	GNSS_RST, IOEX GPA5	GPA5
PGOOD	PGOOD, DCDC power good, IOEX GPA6	GPA6
P2_CELL_DTR	P2_CELL_DTR, IOEX GPA7	GPA7
CAN_VDD_EN	CAN_VDD_EN, CAN 5V supply enableIOEX GPB0	GPB0
CAN_STBY	CAN_STBY, IOEX GPB1	GPB1
CAN_INT	CAN_INT, interrupt from CAN controller, IOEX GPB2	GPB2
SENSOR_INT1	SENSOR_INT1, IOEX GPB3	GPB3
CELL_RST	CELL_RST, IOEX GPB4	GPB4
CELL_PWR	CELL_PWR, IOEX GPB5	GPB5
CELL_STATUS	CELL_STATUS, IOEX GPB6	GPB6
GNSS_GEOFENCE	GNSS_GEOFENCE, IOEX GPB7	GPB7

CS DEMUX

The large number of SPI peripherals on the Tracker M and expansion card exceed the number of available GPIO on the P2.

Pin Name	Description	Interface
IOEX_RST	IOEX_RST, DEMUX Y1	Y1
IOEX_CS	IOEX_CS, DEMUX Y2	Y2
Y3	IMU Y3	Y3
Y4	IMU Y4	Y4
Y5	IMU Y5	Y5
Y6	IMU Y6	Y6
Y7	IMU Y7	Y7

MCU PIN LISTING

Pin Name	Description	P2 Pin	MCU

P2_A0 / D11	A0 Analog in, GPIO	50	PB[1]
P2_A1 / D12	A1 Analog in, GPIO	43	PB[2]
P2_A2 / D13	A2 Analog in, PWM, GPIO	49	PB[7]
P2_A5_FET_CONTROL / D14	A5 Analog in, GPIO, PWM.	23	PB[4]
P2_D0_SDA	I2C SDA	36	PB[6]
P2_D1_SCL	I2C SCL	35	PB[5]
P2_D2_RTS	Serial2 RTS for cellular modem	45	PA[16]
P2_D3_CTS	Serial2 CTS for cellular modem	51	PA[17]
P2_D4_TX	Serial2 TX for cellular modem	52	PA[18]
P2_D5_RX	Serial2 RX for cellular modem	53	PA[19]
P2_D6_SWDCLK	D6 GPIO, SWCLK	55	PB[3]
P2_D7_SWDIO	D7 GPIO, SWDIO	54	PA[27]
P2_MODE	MODE button. Pin number constant is BTN. Pull low when button is pressed.	46	PA[4]
P2_RESET	Hardware reset. Pull low to reset; can leave unconnected in normal operation.	34	CHIP_EN
P2_RGB_B	RGB LED Blue	31	PB[22]
P2_RGB_G	RGB LED Green	32	PB[23]
P2_RGB_R	RGB LED Red	29	PA[30]
P2_RX/D9 / D9	Serial1 RX (received data), GPIO	63	PA[8]
P2_S0_SDO / D15	S0 GPIO, PWM, SPI SDO/MOSI, Serial3 TX.	40	PA[12]
P2_S1_SDI / D16	S1 GPIO, PWM, SPI SDI/MISO, Serial3 RX.	41	PA[13]
P2_S2_SCK / D17	S2 GPIO, SPI SCK	42	PA[14]
P2_S3_CS0	CS Expander CS0	44	PB[26]
P2_S5_CS1	CS Expander CS1	48	PB[29]
P2_S6_CS2	CS Expander CS1	33	PB[31]
P2_TX/D8 / D8	Serial1 TX (transmitted data), GPIO	64	PA[7]
P2_USB_N	MCU USB Data-	62	PA[25]
P2_USB_P	MCU USB Data+	61	PA[26]
P2_VBAT_MEAS	Battery voltage measurement (optional).	12	

Tracker feature comparison

	Tracker SoM	Tracker M	Tracker One	Monitor One
Style	SMD Module	Module	All-in-one	All-in-one
Enclosure	Your design	Your design	Included	Included
MCU	nRF52840	RTL8721DM	nRF52840	nRF52840
CPU Speed	60 MHz	200 MHz	64 MHz	64 MHz
Maximum user binary	256 KB	2 MB	256 KB	256 KB
Flash file system[6]	4 MB	2 MB	4 MB	4 MB
Base board	Your design	Included	Included	Included
Expansion connector	Your design	8-pin	M8 8-pin	Multiple options
GNSS Antenna	Your design	Int/Ext[2]	Internal	Int/Ext[2]
Cellular Antenna	Your design	Int/Ext[2]	Internal	Int/Ext[2]
Wi-Fi geolocation antenna	Your design	Int/Ext[5]	Internal	Internal
BLE Antenna	Your design	Int/Ext[5]	Internal	Internal[4]
NFC Tag	Your design	n/a	Included	n/a
USB Connector	Your design	Micro B	USB C	Micro B (Int)[3]
System RGB LED	Your design	Included	Included	Included
External user button	n/a	n/a		✓
User RGB LEDs				2
SETUP and MODE buttons	Your design	On board	Inside Enclosure	Inside Enclosure
External power	3.9 - 17 VDC	6 - 90 VDC	6 - 30 VDC	6 - 90 VDC
SPI	✓	Expansion card	n/a	Expansion card
I2C	✓	Expansion card	M8	Expansion card
Serial	✓	Expansion card	M8	Expansion card
Internal temperature sensor	Your design	✓	✓	✓
Battery temperature sensor	n/a	✓	n/a	✓
Controlling charging by temperature	Your design	In hardware	In software	In software

[1]On the Tracker One, the M8 can be configured for GPIO, I2C (SDA and SCL), or Serial (RX and TX) on two pins.

[2]Both internal and external GNSS and cellular are supported by physically changing the antenna connector inside the enclosure.

[3]There is no external MCU USB connector on the Monitor One.

[4]The Monitor One uses the Tracker SoM BLE chip antenna on the board and does not include a separate BLE antenna, but one could be added using the BLE U.FL connector.

[5]The Tracker M uses a shared antenna for BLE and Wi-Fi geolocation. You can use the built-in trace antenna or an external 2.4 GHz/5 GHz dual-band antenna, selectable in software.

[6]A small portion of the flash file system is used by the system, and a configurable portion can be used for store and forward, to optionally allow location publishes to be saved when the device is offline to be uploaded later. The remainder of the flash file system can be used by user applications.

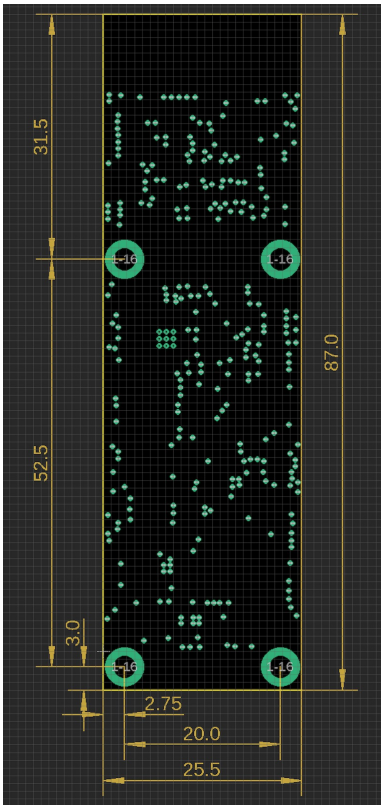
Mechanical specifications

OPERATING TEMPERATURE

To be provided at a later date.

DIMENSIONS AND WEIGHT

Dimensions	Metric	SAE
Width	25.5 mm	7/8 "
Length	87.0 mm	3 5/16"



Thickness and weight to be provided at a later date.

POWER CONSUMPTION

To be provided at a later date.

Country compatibility

To be provided at a later date.

Ordering Information

To be provided at a later date.

Certification

To be provided at a later date.

Product Handling

ESD PRECAUTIONS

The Monitor One contains highly sensitive electronic circuitry and is an Electrostatic Sensitive Device (ESD). Handling an module 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 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 module!

BATTERY WARNING

CAUTION

RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.

DISPOSAL

This device must be treated as Waste Electrical & Electronic Equipment (WEEE) when disposed of.

Any WEEE marked waste products must not be mixed with general household waste, but kept separate for the treatment, recovery and recycling of the materials used. For proper treatment, recovery and recycling; please take all WEEE marked waste to your Local Authority Civic waste site, where it will be accepted free of charge. If all consumers dispose of Waste Electrical & Electronic Equipment correctly, they will be helping to save valuable resources and preventing any potential negative effects upon human health and the environment of any hazardous materials that the waste may contain.

Revision history

Date	Author	Comments
2022-10-24	RK	For internal review only