

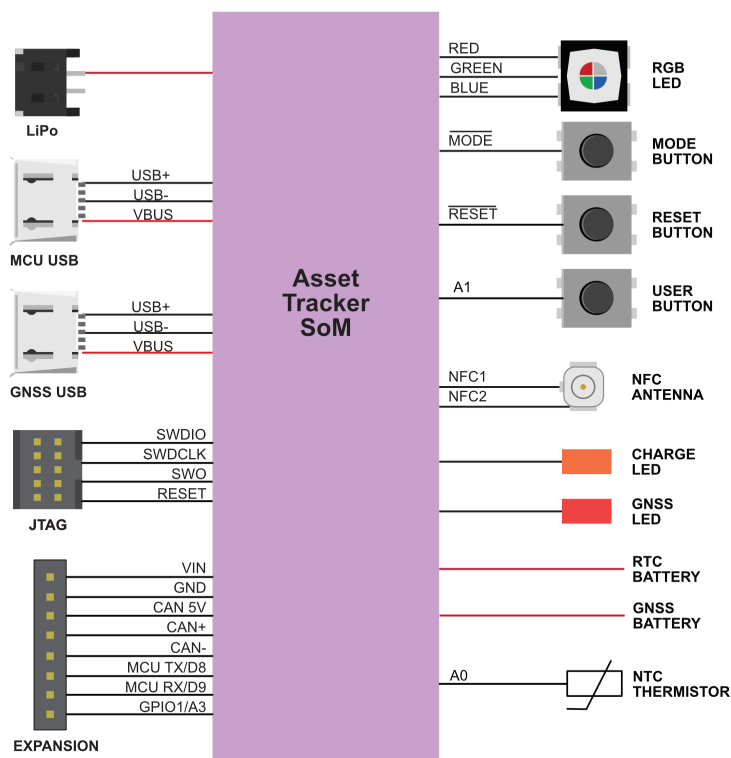
# Tracker One<sup>(015)</sup>

The Tracker One is a ready-to-go Tracker SoM carrier board with optional weatherproof enclosure.

- **Ready to go** with IP67-rated enclosure.
- **GNSS Antenna Onboard:** convenient high-gain GNSS antenna for easy access to GNSS signals.
- **Flexible Power Supply:** easily add asset tracking to most devices. A wide 6-30V power supply copes with most power delivery systems. Also accepts 5V supply via USB-C. LiPo battery connector with charge LED. Supports up to 90V when connecting directly to the carrier board.
- **High-precision Thermistor** with accuracy to 1%.
- **Extensible:** IP67-rated M8 connector includes CAN Bus, UART, GPIO, and power for simple expansion.
- **USB-C** for flashing, debugging and power with higher charging rates than Micro-USB.
- **RGB LED** for use as both a user-configurable device as well as Particle status information.



# Block Diagram



## Description



Num	ID	Description
1		GNSS Antenna
2		Wi-Fi Antenna (mounted on side of case)
3		NFC Antenna (mounted on lid) <sup>1</sup>
4		Power and I/O connector (B8B-PH)
5		BLE Antenna (mounted on side of case)
6		LiPo Connector
7		M8 8-pin male connector (mounted on side of case)
8		USB-C <sup>2</sup>
9		NFC connector (connects to NFC antenna on lid)
10		RGB Status LED
11	GNSS LED	GNSS Status LED
12	CHRG	LiPo charge status LED
13	USER	User Button
14	RESET	RESET Button
15	MODE	MODE button
16		Cellular Antenna (mounted on side of case)
17		USB-C switch <sup>3</sup>
18		Thermistor
19		JTAG connector (not populated) <sup>4</sup>

<sup>1</sup>When disassembling the Tracker One, be careful when removing the lid. The NFC antenna and LiPo battery are mounted on the lid, and the NFC antenna cable is short. Carefully remove the NFC U.FL connector before fully removing the lid of the case. Reconnect to (9).

<sup>2</sup>The USB-C connector is normally connected to the nRF52840 MCU. It can be connected to the GNSS module by using the USB-C switch (17).

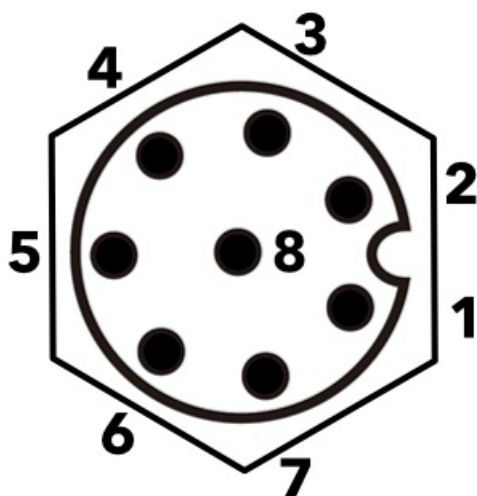
<sup>3</sup>The normal state is 1-4 OFF and 5-6 ON to connect the USB to the nRF52840. To connect the USB-C to the u-blox GNSS, turn 1-4 ON and 5-6 OFF. Disconnect the USB-C and the LiPo battery before changing the switch settings.

<sup>4</sup>The JTAG connector is not populated at the factory. The connector is a [Samtec FTSB-105-01-F-DV-K](#) 10 position (2x5), 1.27mm pitch.

## POWER AND I/O CONNECTOR (M8)

M8 Pin	Function	Function	Function	I/O	Color
1	CAN_P			IO <sup>2</sup>	Yellow
2	VIN <sup>3</sup>			I	Red
3	Analog A3		GPIO D3	IO <sup>1</sup>	White
4	Serial1 RX	Wire3 SDA	GPIO D8	IO <sup>1</sup>	Green
5	Serial1 TX	Wire3 SCL	GPIO D9	IO <sup>1</sup>	Brown
6	CAN_5V <sup>4</sup>		CAN_PWR	O	Orange
7	CAN_N			IO <sup>2</sup>	Blue
8	GND				Black

The IP67 M8, 8-pin, male pins with threaded barrel connector is accessible from the outside of the enclosure.



View as looking into the M8 connector on the outside of the enclosure.

Note: Version 003 and earlier of this datasheet had a different pin numbering for M8 connector that didn't match the connector manufacturer's numbering. Only the numbering has changed; the function of the pin at a given location is unchanged and the change should not affect existing designs.

<sup>1</sup>MCU GPIO is limited to 3.3V maximum.

<sup>2</sup>CAN Bus specifications can be found in the [Tracker SoM datasheet](#).

<sup>3</sup>6.0 to 30 VDC at 2A when using the M8 connector. 6.0 - 90 VDC at 2A when connecting directly to the board.

<sup>4</sup>5V, 370 mA maximum. Controlled by the CAN\_PWR GPIO.

Additional information on M8 cables and connectors can be found in the [M8 Accessories Datasheet](#).

You must enable CAN\_5V in order to use GPIO on M8 pins 3, 4, and 5 (A3, D8/RX/SDA, D9/TX/SCL) on the Tracker One. If CAN\_5V is not powered, these pins are isolated from the MCU starting with version 1.1 of the Tracker One/Tracker Carrier Board (September 2020 and later). This is necessary to prevent an issue with shipping mode, see technical advisory note [TAN002](#).

CARRIER BOARD POWER AND I/O CONNECTOR

The connector on the carrier board itself is is a [JST B8B-PH-SM4-TB\(LF\)\(SN\)](#), 8-position, 2mm pitch, male pins, shrouded. The mating connector is the [JST PHR-8](#). The female sockets are available plain, with leads, and in pre-manufactured ribbon cable formats.

PHR-8 Pin	M8 Pin	Function	Color
1	2	VIN	Red
2	1	CAN_P	Yellow
3	7	CAN_N	Blue
4	6	CAN_5V	Orange
5	5	TX_SCL_D9	Brown
6	4	RX_SDA_D8	Green
7	3	A3	White
8	8	GND	Black

ADDITIONAL PERIPHERALS

Signal	Device OS	Description
THERM	A0	NTC Thermistor
USER	A1	USER button
GNSS_LOCK	A2	GNSS lock indicator
GPIO1	A3	GPIO on power and I/O connector
MCU TX	TX	MCU serial TX, GPIO D9, Wire3 SCL
MCU RX	RX	MCU serial RX, GPIO D8, Wire3 SDA

Note: While the USER button exists inside the Tracker One, the Tracker One is a sealed unit and opening it will void the warranty and may affect certifications, thus it is not practical to use. It can be used with the Tracker Carrier Board.

## POWERING THE TRACKER CARRIER BOARD

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There are several options for powering the carrier board:

The **MCU USB** connector (USB-C). If using a laptop with a USB-A to USB-C cable and a 500 mA USB port, you should also use the LiPo battery. With an true USB-C port and cable, or a 2A tablet charger, you can power only by USB.

The **VIN** connector (6 to 30 VDC at 2A on the M8 connector, or 6 to 90 VDC at 2A to the B8B-PH connector on the board). This is useful with an external power supply.

The **LiPo** connector. This is typically used with a LiPo battery.

## USB CONNECTOR

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There is a single USB C connector on the carrier board. On the Tracker One, this exits the enclosure and is IP67 rated.

A set of DIP switches on the carrier board allow this port to be connected to either the MCU (normal) or u-blox GNSS (for firmware updates). The normal state is 1-4 OFF and 5-6 ON to connect the USB to the nRF52840. To connect the USB-C to the u-blox GNSS, turn 1-4 ON and 5-6 OFF. Disconnect the USB-C and the LiPo battery before changing the switch settings.

## LED INDICATORS

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The **RGB LED** default behavior is:

- Red breathing: Attempting to connect to the cellular network
- Yellow breathing: Connecting to the cloud, weaker cellular signal
- Green breathing: Connecting to the cloud, good cellular signal
- Yellow solid: Connected to the cloud, weaker cellular signal
- Green solid: Connected to the cloud, good cellular signal

Alternatively the LED can be configured to the typical Particle color scheme (blinking green, blinking cyan, breathing cyan) via device or cloud configuration. Custom device firmware can provide other color schemes if desired.

The **CHRG** LED indicates the charge status:

- Off: Not charging or no power
- On: Charging
- Blinking: Charge fault
- Flickering: No battery

The **GNSS** LED indicates the GNSS fix status:

- Off: GNSS is powered off.
- Blinking (1 Hz): Attempting to get a GNSS fix
- On: Has a GNSS fix.

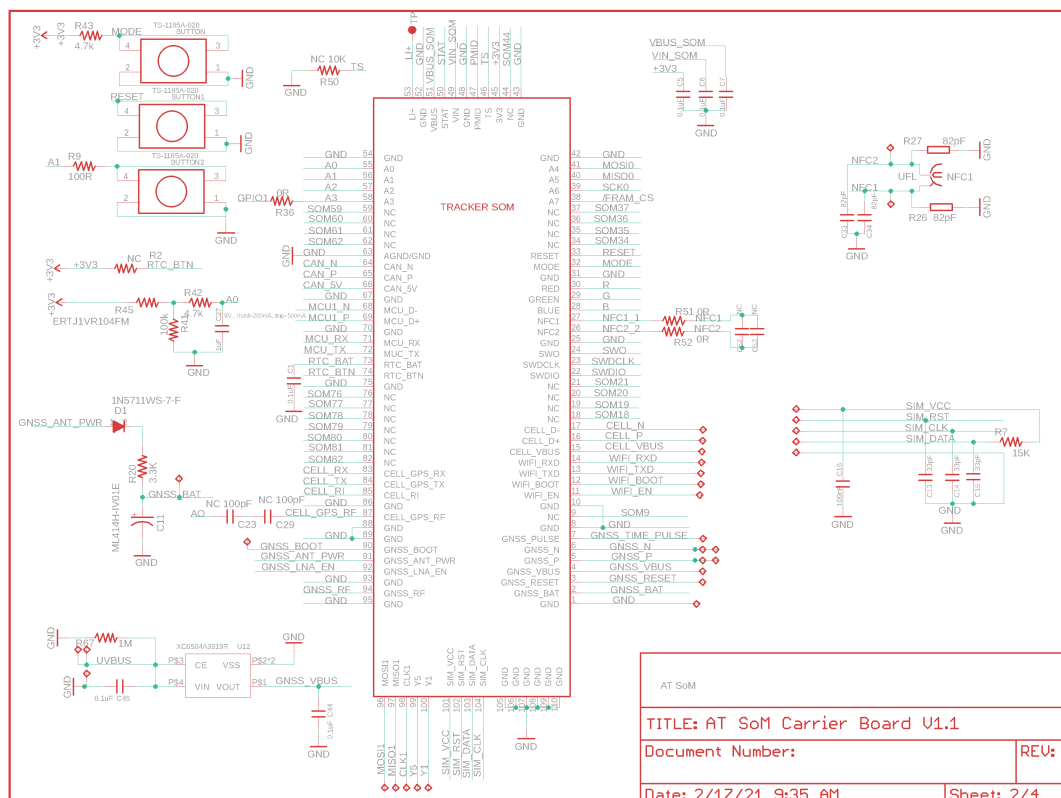
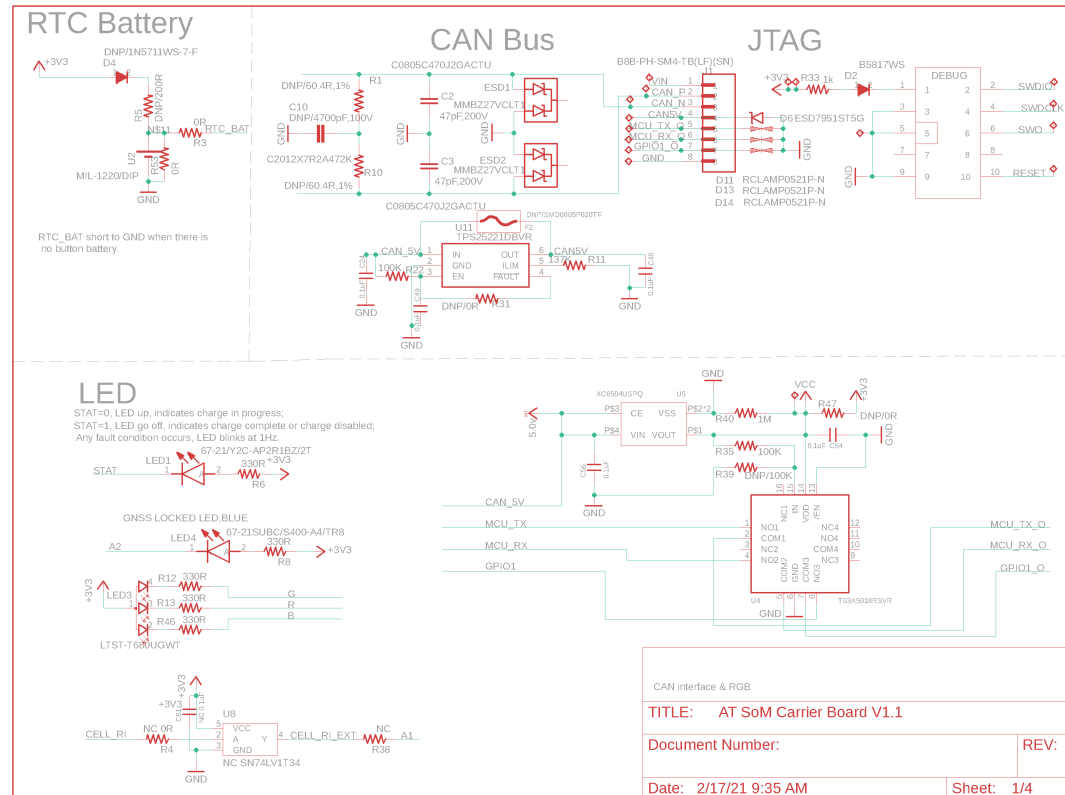
# Antennas

Antenna	Location
GNSS	Carrier Board (faces top of case)
Wi-Fi	Left Side
BLE	Left Side
NFC	Top
Cellular	Right Side

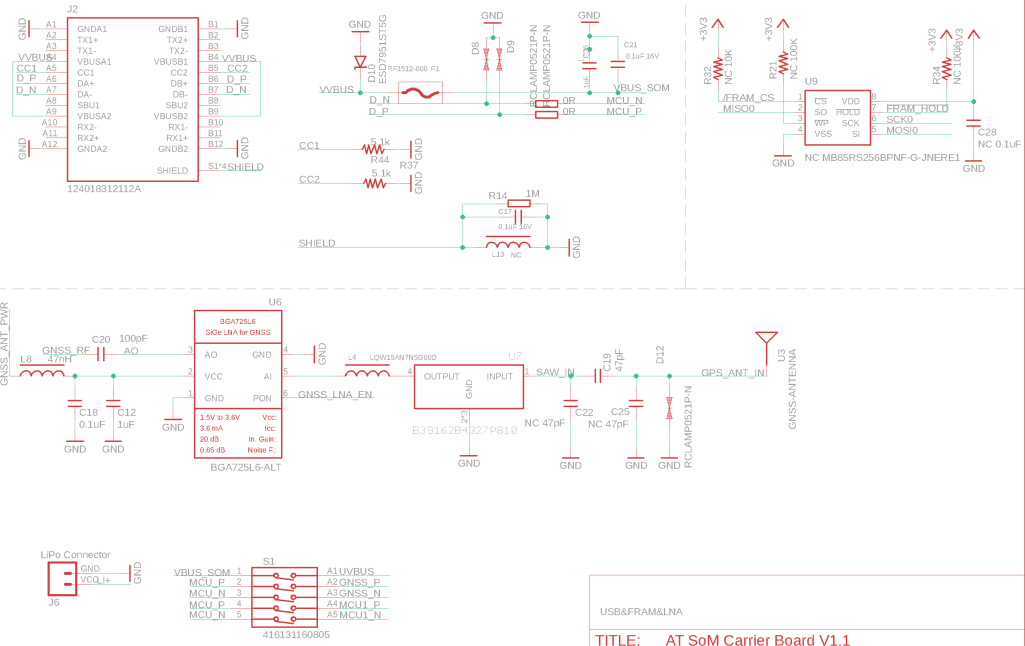


As the GNSS antenna faces the top of the case, you also want the top of the case facing the sky to the greatest extent possible. You will likely be unable to get a GNSS lock with the top facing down.

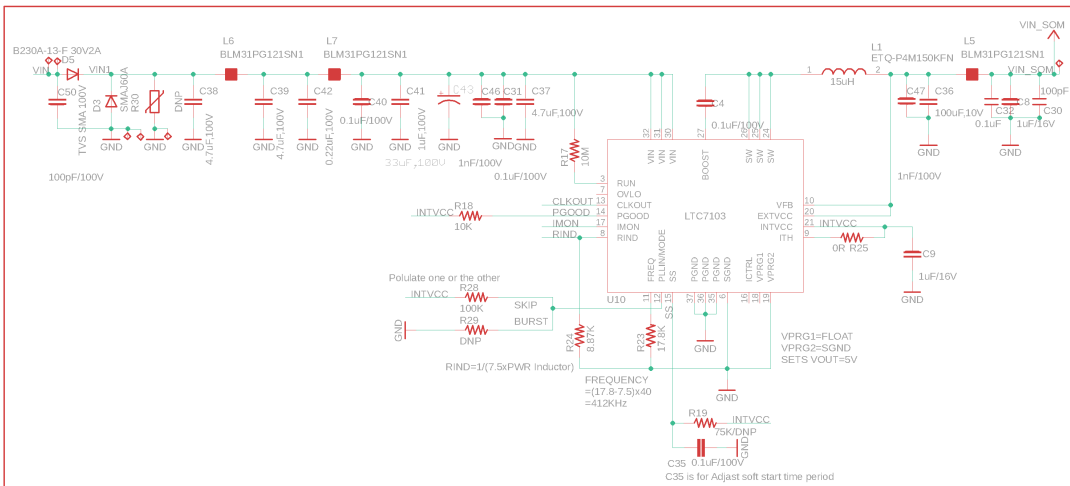




## MCU USB-C



USB&FRAM&LNA	
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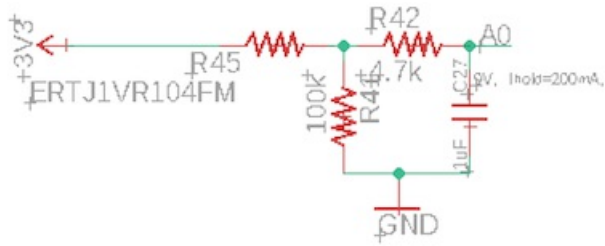
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# Peripheral Details

## THERMISTOR

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The Tracker Carrier Board contains a 100K NTC thermistor, connected to A0. It is a [Panasonic ERT-J1VR104FM](#) connected high-side.



It can be read using the [getTemperature\(\)](#) API. Note that this is the temperature on the board, within the enclosure, and will typically be several degrees warmer than the ambient temperature.

## Design Files

The Tracker Carrier Board in the Tracker One is open-source and the Eagle CAD design files are available in Github:

<https://github.com/particle-iot/tracker-hardware>

# Mechanical specifications

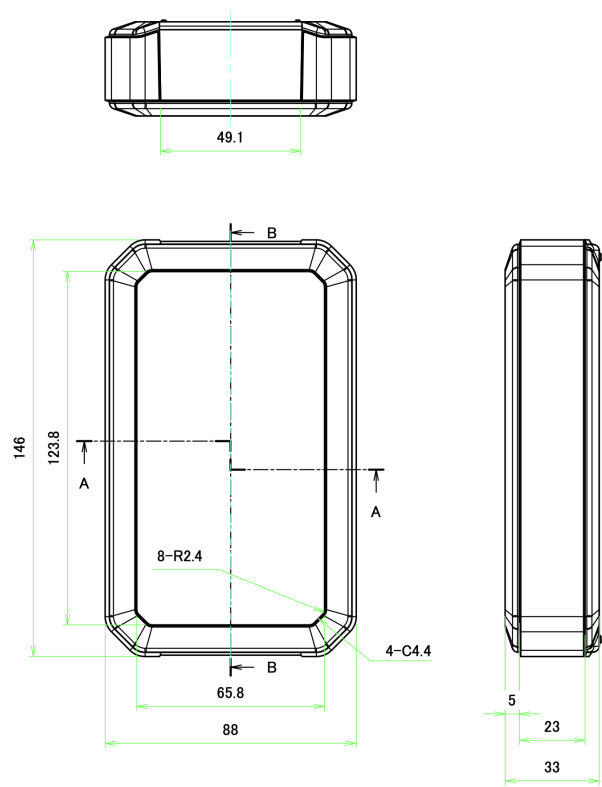
## OPERATING TEMPERATURE

Parameter	Minimum	Maximum	Units
Operating temperature	-10	60	°C
Battery charging enabled	0	50	°C

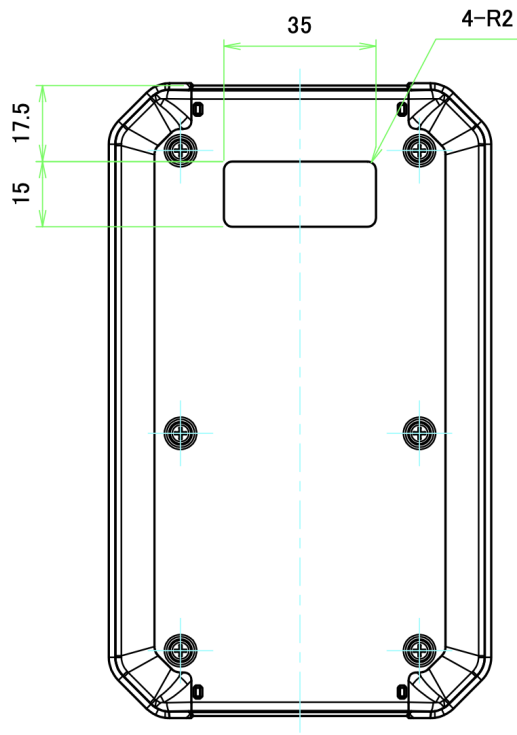
## DIMENSIONS AND WEIGHT

Parameter	Value	Units
Width	88	mm
Length (case only)	146	mm
Length (including M8 connector)	154	mm
Thickness	33	mm
Weight	290	g

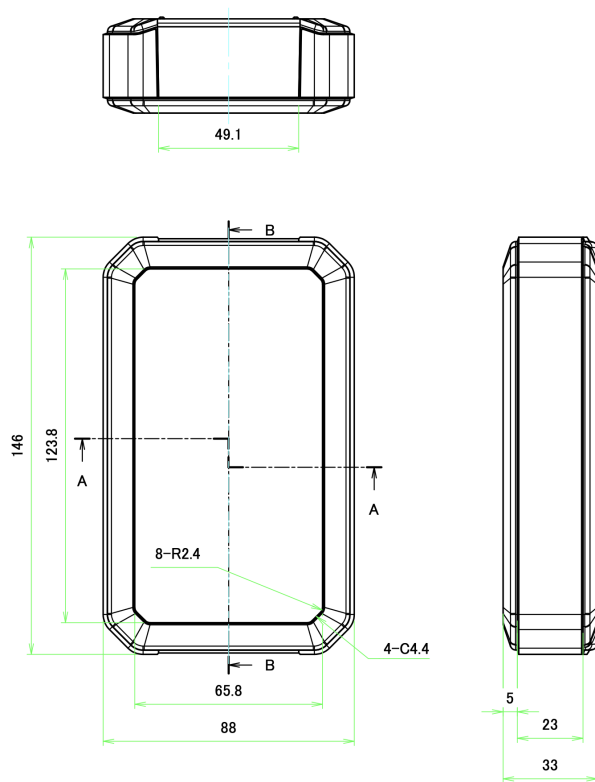
Case Dimensions (mm):



Bottom:



Maximum Carrier Board Dimensions (mm):



Note: The Tracker Carrier Board has a smaller bottom tab to provide space for the M8 connector.

**POWER CONSUMPTION (TRACKER ONE 402)**

Parameter	Symbol	Min	Typ	Max	Unit
Operating Current (uC on, peripherals and radio disabled)	I <sub>startup</sub>				mA
Operating Current (uC on, cellular connecting to cloud)	I <sub>cell_conn_cloud</sub>				mA
Operating Current (uC on, cellular connected but idle)	I <sub>cloud_idle</sub>				mA
Operating Current (uC on, cellular connected and transmitting)	I <sub>cloud_pub</sub>				mA
STOP mode sleep, GPIO wake-up	I <sub>stop_gpio</sub>	911	1140	1530	uA
STOP mode sleep, analog wake-up	I <sub>stop_analog</sub>	920	1120	1480	uA
STOP mode sleep, RTC wake-up	I <sub>stop_intrtc</sub>	919	1130	1500	uA
STOP mode sleep, BLE wake-up, advertising	I <sub>stop_ble_adv</sub>	136	1190	2880	uA
STOP mode sleep, BLE wake-up, connected	I <sub>stop_ble_conn</sub>	772	1180	1790	uA
STOP mode sleep, serial wake-up	I <sub>stop_usart</sub>	993	1120	1510	uA
STOP mode sleep, cellular wake-up	I <sub>stop_cell</sub>	11.2	17.3	116	mA
STOP mode sleep, IMU wake-up	I <sub>stop_imu</sub>	850	1150	1590	uA
STOP mode sleep, CAN wake-up	I <sub>stop_can</sub>	981	1200	1600	uA
STOP mode sleep, GPS wake-up	I <sub>stop_gps</sub>	29.3	36.1	50.2	mA
ULP mode sleep, GPIO wake-up	I <sub>ulp_gpio</sub>		201	552	uA
ULP mode sleep, analog wake-up	I <sub>ulp_analog</sub>		190	593	uA
ULP mode sleep, RTC wake-up	I <sub>ulp_intrtc</sub>		188	558	uA
ULP mode sleep, BLE wake-up, advertising	I <sub>ulp_ble_adv</sub>		270	2150	uA
ULP mode sleep, BLE wake-up, connected	I <sub>ulp_ble_conn</sub>		258	990	uA
ULP mode sleep, serial wake-up	I <sub>ulp_usart</sub>	638	842	1200	uA
ULP mode sleep, cellular wake-up	I <sub>ulp_cell</sub>	13.9	16.9	86.0	mA
ULP mode sleep, IMU wake-up	I <sub>imu_imu</sub>		225	642	uA
ULP mode sleep, CAN wake-up	I <sub>can_can</sub>	75.3	270	631	uA
ULP mode sleep, GPS wake-up	I <sub>ulp_gps</sub>	28.0	35.3	49.5	mA
HIBERNATE mode sleep, GPIO wake-up	I <sub>hib_gpio</sub>		161	564	uA
HIBERNATE mode sleep, analog wake-up	I <sub>hib_analog</sub>		151	557	uA
HIBERNATE mode sleep, external RTC wake-up	I <sub>hib_extrtc</sub>		151	562	uA
HIBERNATE mode sleep, IMU wake-up	I <sub>hib_imu</sub>		185	669	uA
HIBERNATE mode sleep, CAN wake-up	I <sub>hib_can</sub>		230	636	uA

**POWER CONSUMPTION (TRACKER ONE 523)**

Parameter	Symbol	Min	Typ	Max	Unit
Operating Current (uC on, peripherals and radio disabled)	I <sub>startup</sub>	24.2	132	689	mA
Operating Current (uC on, cellular connecting to cloud)	I <sub>cell_conn_cloud</sub>	51.2	112	594	mA
Operating Current (uC on, cellular connected but idle)	I <sub>cloud_idle</sub>	50.9	60.2	197	mA
Operating Current (uC on, cellular connected and transmitting)	I <sub>cloud_pub</sub>	57.2	173	702	mA
STOP mode sleep, GPIO wake-up	I <sub>stop_gpio</sub>	778	1010	1390	uA
STOP mode sleep, analog wake-up	I <sub>stop_analog</sub>	740	995	1390	uA
STOP mode sleep, RTC wake-up	I <sub>stop_intrtc</sub>	758	993	1420	uA
STOP mode sleep, BLE wake-up, advertising	I <sub>stop_ble_adv</sub>		1050	2500	uA
STOP mode sleep, BLE wake-up, connected	I <sub>stop_ble_conn</sub>	521	1050	1920	uA
STOP mode sleep, serial wake-up	I <sub>stop_usart</sub>	729	995	1390	uA
STOP mode sleep, cellular wake-up	I <sub>stop_cell</sub>	19.2	21.5	151	mA
STOP mode sleep, IMU wake-up	I <sub>stop_imu</sub>	741	1020	1460	uA
STOP mode sleep, CAN wake-up	I <sub>stop_can</sub>	884	1080	1490	uA
STOP mode sleep, GPS wake-up	I <sub>stop_gps</sub>	28.0	34.8	49.0	mA
ULP mode sleep, GPIO wake-up	I <sub>ulp_gpio</sub>		172	556	uA
ULP mode sleep, analog wake-up	I <sub>ulp_analog</sub>		165	526	uA
ULP mode sleep, RTC wake-up	I <sub>ulp_intrtc</sub>		164	561	uA
ULP mode sleep, BLE wake-up, advertising	I <sub>ulp_ble_adv</sub>		228	1810	uA
ULP mode sleep, BLE wake-up, connected	I <sub>ulp_ble_conn</sub>		231	1100	uA
ULP mode sleep, serial wake-up	I <sub>ulp_usart</sub>	503	731	1169	uA
ULP mode sleep, cellular wake-up	I <sub>ulp_cell</sub>	18.6	20.9	212	mA
ULP mode sleep, IMU wake-up	I <sub>imu_imu</sub>		194	534	uA
ULP mode sleep, CAN wake-up	I <sub>can_can</sub>	45.1	247	609	uA
ULP mode sleep, GPS wake-up	I <sub>ulp_gps</sub>	27.4	33.9	48.0	mA
HIBERNATE mode sleep, GPIO wake-up	I <sub>hib_gpio</sub>		148	519	uA
HIBERNATE mode sleep, analog wake-up	I <sub>hib_analog</sub>		141	515	uA
HIBERNATE mode sleep, external RTC wake-up	I <sub>hib_extrtc</sub>		140	525	uA
HIBERNATE mode sleep, IMU wake-up	I <sub>hib_imu</sub>		178	544	uA
HIBERNATE mode sleep, CAN wake-up	I <sub>hib_can</sub>		222	608	uA



# Country compatibility

Country	Model	Technologies	Carriers
Albania	ONE524	2G, 3G, Cat1	ALBtelecom, Telekom, Vodafone
Austria	ONE524	2G, 3G, Cat1	3 (Drei), A1, T-Mobile
Belarus	ONE524	2G, 3G, Cat1	A1, MTS
Belgium	ONE524	2G, 3G, Cat1	Base, Orange, Proximus
Bosnia and Herzegovina	ONE524	2G, 3G, Cat1	BH Telecom
Bulgaria	ONE524	2G, 3G, Cat1	A1, Telenor, Vivacom
Canada	ONE404	M1	Bell Mobility, Rogers Wireless, Telus
Croatia	ONE524	2G, 3G, Cat1	Hrvatski Telekom, Tele2
Czechia	ONE524	2G, 3G, Cat1	O2, T-Mobile, Vodafone
Denmark	ONE524	2G, 3G, Cat1	3 (Tre), TDC, Telenor, Telia
Estonia	ONE524	2G, 3G, Cat1	Elisa, Tele2, Telia
Faroe Islands	ONE524	2G, 3G, Cat1	Vodafone
Finland	ONE524	2G, 3G, Cat1	DNA, Elisa, Telia
France	ONE524	2G, 3G, Cat1	Bouygues, Free Mobile, Orange, SFR
Germany	ONE524	2G, 3G, Cat1	O2, Telekom, Vodafone
Gibraltar	ONE524	2G, 3G, Cat1	Gibtel
Greece	ONE524	2G, 3G, Cat1	Cosmote, Vodafone, Wind
Hungary	ONE524	2G, 3G, Cat1	Magyar Telekom, Telenor, Vodafone
Iceland	ONE524	2G, 3G, Cat1	Nova, Siminn, Vodafone
Ireland	ONE524	2G, 3G, Cat1	3 (Tre), Meteor, Vodafone
Italy	ONE524	2G, 3G, Cat1	TIM, Vodafone, Wind
Kosovo	ONE524	2G, 3G, Cat1	Monaco Telecom
Latvia	ONE524	2G, 3G, Cat1	Bite, LMT, Tele2
Liechtenstein	ONE524	2G, 3G, Cat1	Orange
Lithuania	ONE524	2G, 3G, Cat1	Bite, Omnitel, Tele2
Luxembourg	ONE524	2G, 3G, Cat1	Orange, POST, Tango
Malta	ONE524	2G, 3G, Cat1	Go Mobile, Vodafone
Mexico	ONE404	M1	AT&T
Moldova	ONE524	2G, 3G, Cat1	Moldcell
Monaco	ONE524	2G, 3G, Cat1	Monaco Telecom
Montenegro	ONE524	2G, 3G, Cat1	Telenor
Netherlands	ONE524	2G, 3G, Cat1	KPN, T-Mobile, Vodafone
Norway	ONE524	2G, 3G, Cat1	TDC, Telenor, Telia
Poland	ONE524	2G, 3G, Cat1	Orange, Play, Plus, T-Mobile
Portugal	ONE524	2G, 3G, Cat1	NOS, TMN, Vodafone
Romania	ONE524	2G, 3G, Cat1	DigiMobil, Orange, Telekom Romania, Vodafone
Serbia	ONE524	2G, 3G, Cat1	Telenor
Slovakia	ONE524	2G, 3G, Cat1	O2, Orange, Telekom
Slovenia	ONE524	2G, 3G, Cat1	A1, Mobitel
Spain	ONE524	2G, 3G, Cat1	Orange, Telefonica, Vodafone, Yoigo

Sweden	ONE524	2G, 3G, Cat1	3 (Tre), Tele2, Telenor, Telia
Switzerland	ONE524	2G, 3G, Cat1	Salt, Swisscom
United Kingdom	ONE524	2G, 3G, Cat1	3, EE, Manx, O2, Vodafone
United States	ONE404	M1	AT&T

## Ordering Information

SKU	Description	Region	Modem	Lifecycle	Replacement
ONE404MEA	Tracker One LTE M1 (NorAm), [x1]	NORAM	BG96-MC	GA	
ONE404MTY	Tracker One LTE M1 (NorAm), Bulk [x40]	NORAM	BG96-MC	GA	
ONE404MTY-NB	Tracker One LTE M1 (NorAm), no battery, Bulk [x40]	NORAM	BG96-MC	GA	
ONE524MEA	Tracker One LTE CAT1/3G/2G (Europe), [x1]	EMEAA	EG91-EX	GA	
ONE524MTY	Tracker One CAT1/3G/2G (Europe), Bulk [x40]	EMEAA	EG91-EX	GA	
ONE524MTY-NB	Tracker One CAT1/3G/2G (Europe), no battery, Bulk [x40]	EMEAA	EG91-EX	GA	
ONE402MEA	Tracker One LTE M1 (NorAm), [x1]	NORAM	BG96-MC	NRND	ONE404MEA
ONE402MTY	Tracker One LTE M1 (NorAm), Bulk [x40]	NORAM	BG96-MC	NRND	ONE404MTY
ONE523MEA	Tracker One LTE CAT1/3G/2G (Europe), [x1]	EMEAA	EG91-EX	NRND	ONE524MEA
ONE523MTY	Tracker One CAT1/3G/2G (Europe), Bulk [x40]	EMEAA	EG91-EX	NRND	ONE524MTY

# Product Handling

## ESD PRECAUTIONS

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The Tracker SoM 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

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### CAUTION

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

## DISPOSAL

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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

Revision	Date	Author	Comments
pre1	2020 Apr 20	RK	Preview Release1
pre2	2020 May 12	RK	Added partial dimensions
001	2020 Jun 29	RK	First release
002	2020 Jun 30	RK	CAN 5V is limited to 400 mA, not 500 mA
003	2020 Jul 16	RK	Corrected M8 pinouts
004	2020 Aug 06	RK	Corrected M8 pin numbering
005	2020 Aug 09	RK	Updated VIN voltages
006	2020 Aug 10	RK	Updated carrier board diagram
007	2020 Sep 01	RK	Added antenna diagram
008	2020 Sep 08	RK	Corrected USB connector description
009	2020 Sep 25	RK	Add battery warning
010	2020 Oct 14	RK	Add temperature range
011	2020 Nov 05	RK	Add power usage
012	2020 Dec 09	RK	CAN termination resistor is not present
013	2021 Feb 03	RK	Change M8 CAN output current to 370 mA
014	2021 Feb 17	RK	Tracker One v1.1 GPIO note, update schematics
015	2021 Mar 15	RK	Updated model, carrier, ordering information