

M635 datasheet



Overview

The Particle M-SoM contains the following functional units:

- M.2 SoM form-factor, like the B-Series SoM
- Can use cellular or Wi-Fi (2.4 GHz or 5 GHz) for the cloud connection
- Realtek RTL8722DM MCU (BLE and Wi-Fi)
- Cellular modem
 - M404: Quectel BG95-M5 LTE Cat M1 (NorAm)
 - M524: Quectel EG91-EX LTE Cat 1 with 2G/3G fallback (EMEA)
 - M635e: Quectel BG95-S5 LTE Cat M1/2G (Global with NTN satellite)

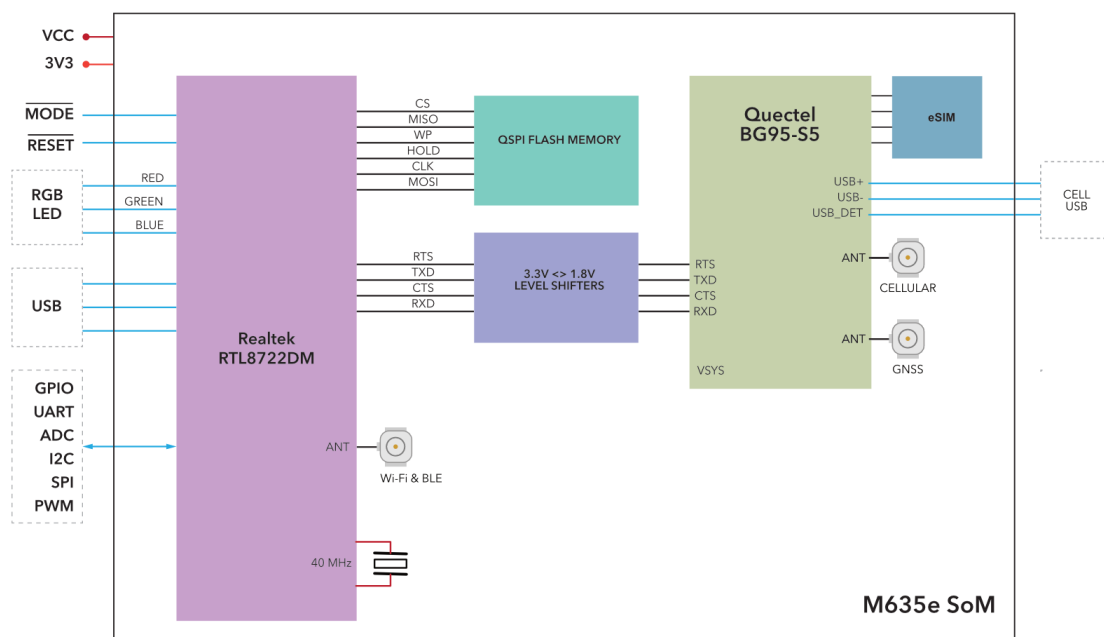
For the M404 and M524, see the [M-SoM datasheet](#).

MCU

The Realtek RTL8722DM is in the same family as the P2 and Photon 2 modules (RTL8721DM), but has additional GPIO.

- 802.11a/b/g/n Wi-Fi, 2.4 GHz and 5 GHz
 - U.FL connector for external antenna
- BLE 5 using same antenna as Wi-Fi
- Realtek RTL8722DM MCU
 - ARM Cortex M33 CPU, 200 MHz
- 2048 KB (2 MB) user application maximum size
- 3072 KB (3 MB) of RAM available to user applications
- 8 MB flash file system
- FCC (United States), ISED (Canada), and CE (European Union) certified

BLOCK DIAGRAM



DEVICE FAMILIES

	Cellular Only	Cellular & Wi-Fi	Wi-Fi Only
Developer devices	Boron		Photon 2
Production module	B-SoM	M-SoM	P2

MIGRATION GUIDES

If you are migrating to the M-SoM from another Particle device, see also the following migration guides:

- [M-SoM from B-SoM](#)
- [M-SoM from Boron or Argon](#)
- [M-SoM from E-Series](#)
- [M-SoM from P2](#)

POWER

VCC

VCC (sometimes referred to as 3V7) is used to supply power to the cellular module. The recommended input voltage range on this pin is between 3.6V to 4.2V DC. This can be connected directly to a 3.7V LiPo battery. Make sure that the supply can handle currents of at least 2 A.

If you are not using a battery, or using a battery of a different voltage, you should use a regulator to supply 3.7V to 4.2V at 2A. You may want to add additional bulk capacitors to handle the short, high current peak usage when the cellular modem is transmitting.

3V3

3V3 is used to supply power to RTL8722 MCU, logic ICs, memory, etc.. Make sure that the supply can handle a minimum of 500 mA.

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

Power supply requirements:

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

In some cases, it may be necessary to add a supervisory/reset IC, such as the Richtek RT9818C or SG Micro SGM809-RXN3L/TR:

- If your power supply has a slew rate from 1.5V to 3.0V slower than 15 ms, a reset IC is required.
- If your power supply at power off cannot be guaranteed to drop below 0.3V before powering back up, a reset IC required.

See [supervisory reset](#), below, for additional information.

RF

- The M-SoM includes three U.FL connectors for external antennas:

- Cellular (including NTN)
- Wi-Fi (2.4 GHz and 5 GHz) and BLE
- GNSS (GPS)
- Wi-Fi operation in the 5150-5250 MHz band is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems.

Approved Antennas

CERTIFIED CELLULAR ANTENNAS

The M-SoM is certified with the following cellular antenna:

Antenna	SKU	Details	Links
Wide band LTE cell antenna [x1]	PARANTCW1EA	B504e and M-SoM	Datasheet
Wide band LTE cell antenna [x50]	PARANTCW1TY	B504e and M-SoM	Datasheet

Single quantity units and developer kits include a PARANTCW1EA antenna. Tray quantities of the do not include antennas.

Dimension	Value	Unit
Length	116.0	mm
Width	27.0	mm
Thickness	0.2	mm
Cable Length	189.5	mm

Parameter	617-960	1156 - 1496	1520 - 1660.5	1710 - 2700	3330 - 4200	4200 - 5925
V.S.W.R.	≤ 3.5	≤ 3.0	≤ 2.0	≤ 2.0	≤ 1.5	≤ 2.0
Peak Gain	2.8 dBi	2.4 dBi	3.9 dBi	5.3 dBi	5.6 dBi	7.9 dBi
Eff % (max/avg)	71/62	55/53	68/62	85/70	76/71	69/62

CERTIFIED WI-FI/BLE ANTENNAS

The M-SoM is certified for use with the same antennas as the P2/Photon 2. The same antenna is shared for Wi-Fi and BLE. Unlike the P2/Photon 2, the external antenna is required for Wi-Fi and BLE and the M-SoM does not include a built-in trace antenna on the module.

Antenna	SKU	Links
Particle P2/Photon2 Wi-Fi Antenna 2.4/5GHz, [x1]	PARANTWM1EA	Datasheet Retail Store
Particle P2/Photon2 Wi-Fi Antenna 2.4/5GHz, [x50]	PARANTWM1TY	Datasheet

Single quantity M-SoM units and developer kits include a PARANTWM1EA antenna. Tray quantities of the M-SoM do not include antennas.

Do not use the Argon Wi-Fi/BLE antenna (ANT-FLXV2) on the P2, Photon 2, or M-SoM. The Argon antenna does not work with 5 GHz and this will result in poor Wi-Fi performance on the P2, Photon 2, and M-SoM.

CERTIFIED GNSS ANTENNAS

SKU	Description
PARANTGN1EA	Particle GNSS FPC Antenna, [x1] Datasheet
PARANTGN1TY	Particle GNSS FPC Antenna, [x50] Datasheet

Single quantity M-SoM units and developer kits include a PARANTGN1EA antenna. Tray quantities of the M-SoM do not include antennas. If not using the GNSS feature, the antenna can be omitted from your design.

- A [firmware library](#) is available now for the M404. A future update will add support for the M524.

- Another option is the [QuectelGnssRK](#) library that can be used with [LocationFusionRK](#) to provide Tracker-like location services on the M-SoM.
- Features such of high-precision, dead-reckoning, and high updates rates will require an external GNSS chip.
- On the M404 (BG95 cellular modem), radio hardware is shared between the cellular modem and built-in GNSS which limits concurrent use.

CERTIFIED NTN ANTENNA

Non-Terrestrial Network (NTN) is a 3GPP standard to allow devices to connect to satellites instead of earth-based cellular towers. A special antenna and a clear view of the sky outdoors is required to use NTN.

The Particle NTN antenna can be used for both NTN and traditional cellular (2G, 3G, and 4G) with the M635e¹.

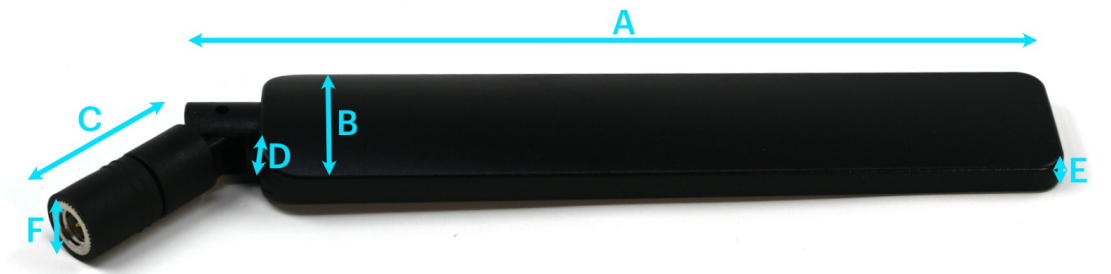
Antenna	SKU			Links	
NTN and LTE cell antenna, [x1]			PARANTCN1EA	Datasheet	
Parameter	617-960	1450 - 1605	1710 - 2690	3330 - 4900	5150 - 5925
V.S.W.R.	≤ 2.5	≤ 2.5	≤ 2.3	≤ 2.5	≤ 3.0
Peak Gain	2.5 dBi	1.5 dBi	3.9 dBi	3.7 dBi	4.2 dBi
Eff % (max/avg)	51/43	54/51	80/69	70/61	68/58

For additional NTN antenna information, see:

- [Antenna guide](#)
- [NTN troubleshooting](#)

¹From a certification standpoint, the flexible FPC antennas (PARANTCW1EA and PARANTCW1TY) can also be used with NTN. Because of the need for the antenna to have a clear view of the sky outside, it may be difficult to suitably mount the flexible antenna, so generally PARANTCN1EA and PARANTCN1TY are recommended for applications where the M-SoM will be used outdoors.

NTN antenna dimensions



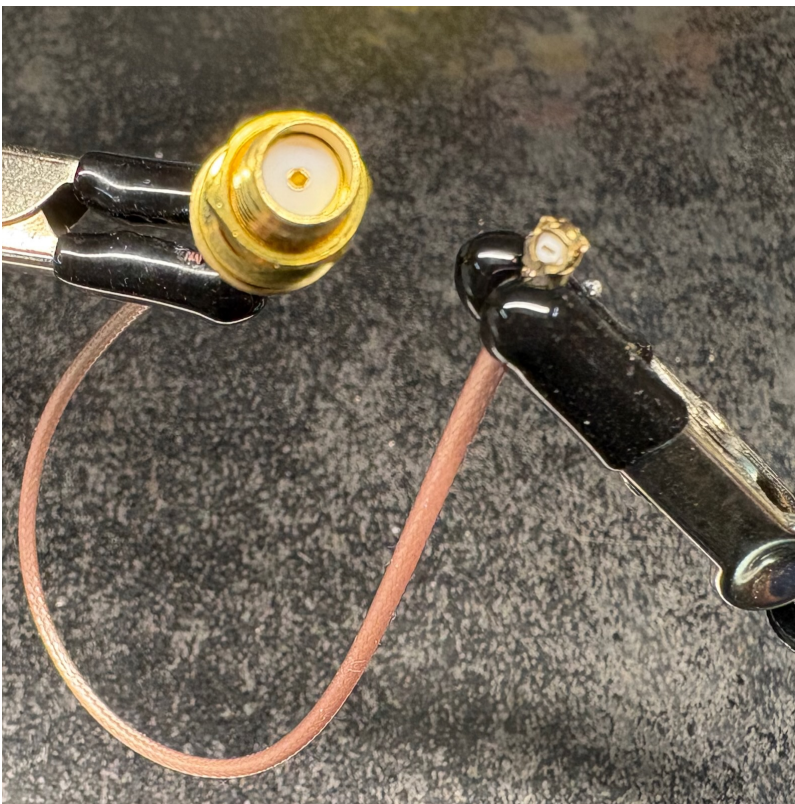
Label	Value	Description
A	145 mm	Length (antenna)
B	29 mm	Width
C	26 mm	Length (connector)
D	13.5 mm	Thickness (maximum)
E	6.5 mm	Thickness (minimum)
F	12.3 mm	Connector outside diameter

NTN antenna connections

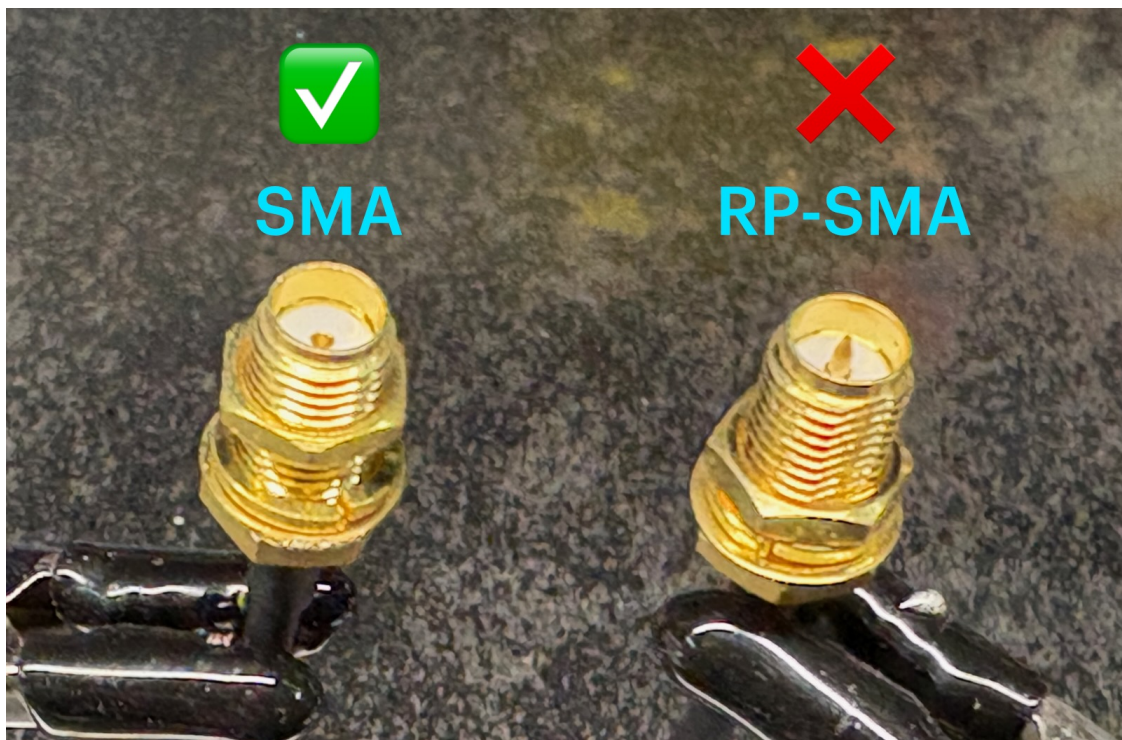
The Particle NTN antenna has a SMA connector as the antenna is typically mounted on the outside of an enclosure as a clear view of the sky is needed for proper operation.



You will typically use a U.FL to SMA bulkhead adapter. The U.FL connector connects to the CELL connector on the M636e M-SoM.



Note that there are two different styles of SMA bulkhead connectors. The PARANTCN1EA requires a standard SMA connector. Make sure you do not source a RP-SMA adapter!



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.

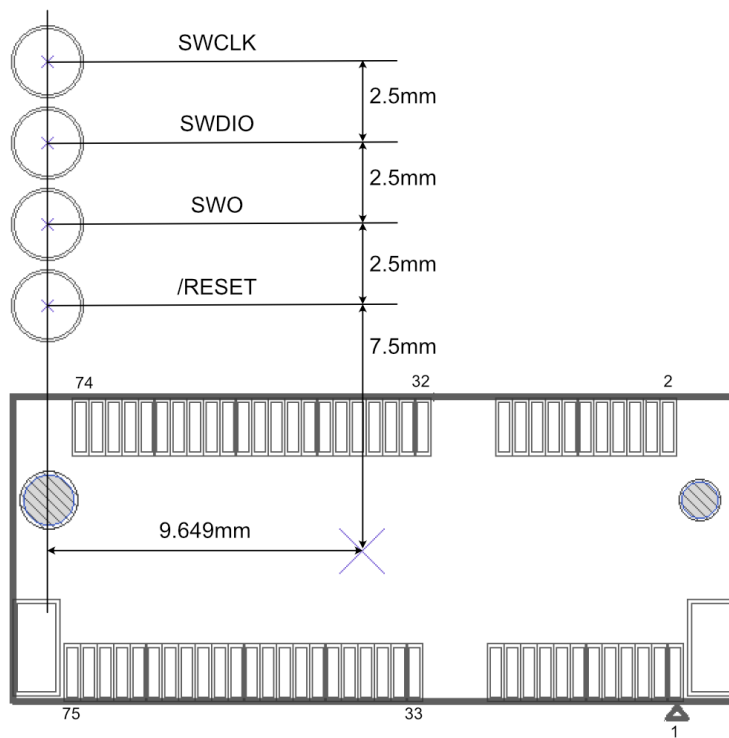
PERIPHERALS AND GPIO

Peripheral Type	Qty	Input(I) / Output(O)
Digital	30 (max)	I/O
Analog (ADC)	8 (max)	I
UART	2	I/O
SPI	2	I/O
I2C	1	I/O
USB	1	I/O
PWM	11 (max)	O

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

JTAG AND SWD

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



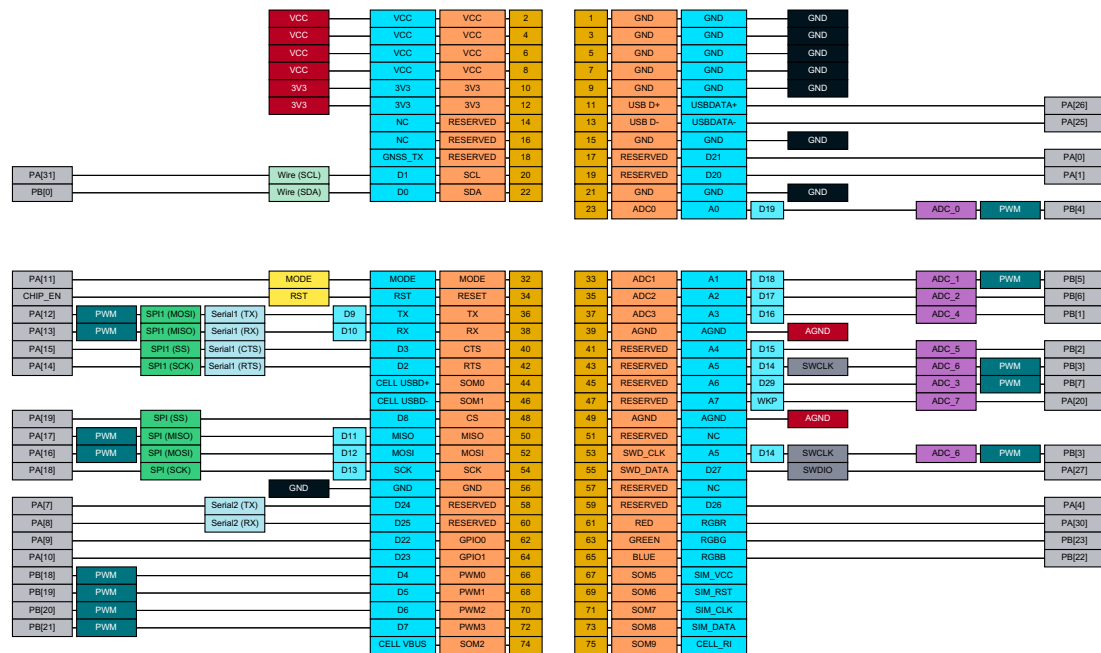
Additionally, SWD is supported on pins on the M.2 connector:

Pin	Pin Name	Description	Interface	MCU
43	A5 / D14	A5 Analog in, PWM, GPIO, shared with pin 53	SWCLK	PB[3]
53	A5 / D14	A5 Analog in, PWM, GPIO, SWCLK, shared with pin 43	SWCLK	PB[3]
55	D27	D27 GPIO, SWDIO (SWD_DATA), do not pull down at boot	SWDIO	PA[27]

- SWD is on the same pins as GPIO, so by default once user firmware boots, SWD is no longer available unless SWD is enabled at compile time. This is the same as Gen 2 (STM32) but different than Gen 3 (nRF52840).
- SWO (Serial Wire Output) is not supported on the RTL8722DM.
- Pins 43 and 53 are shared

Pin information

PINOUT DIAGRAM



COMMON SOM PINS

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

The nRF52840 B-SoM has some differences from the RTL8722 M-SoM. Future modules with a different MCU may have different pin functions. An effort will be made to assign all of the listed functions for ADC, PWM, SPI, etc. from the set of common SoM pin functions in future modules, but the functions on RESERVED and SOM pins will likely vary.

PIN FUNCTION BY PIN NAME

Pin Name	Module Pin		PWM	MCU
A0 / D19	23	ADC_0	✓	PB[4]
A1 / D18	33	ADC_1	✓	PB[5]
A2 / D17	35	ADC_2		PB[6]
A3 / D16	37	ADC_4		PB[1]
A4 / D15	41	ADC_5		PB[2]
A5 / D14	43	ADC_6 SWCLK	✓	PB[3]
A5 / D14	53	ADC_6 SWCLK	✓	PB[3]
A6 / D29	45	ADC_3	✓	PB[7]
A7 / WKP	47	ADC_7		PA[20]
CELL USBD-	46			
CELL USBD+	44			
CELL VBUS	74			
CELL_RI	75			
D0	22	Wire (SDA)		PB[0]

D1	20	Wire (SCL)			PA[31]
D2	42	SPI1 (SCK)	Serial1 (RTS)		PA[14]
D3	40	SPI1 (SS)	Serial1 (CTS)		PA[15]
D4	66			✓	PB[18]
D5	68			✓	PB[19]
D6	70			✓	PB[20]
D7	72			✓	PB[21]
D8	48	SPI (SS)			PA[19]
D20	19				PA[1]
D21	17				PA[0]
D22	62				PA[9]
D23	64				PA[10]
D24	58		Serial2 (TX)		PA[7]
D25	60		Serial2 (RX)		PA[8]
D26	59				PA[4]
D27	55	SWDIO			PA[27]
GNSS_TX	18				
MISO / D11	50	SPI (MISO)		✓	PA[17]
MOSI / D12	52	SPI (MOSI)		✓	PA[16]
NC	14				
RGBB	65				PB[22]
RGBG	63				PB[23]
RGBR	61				PA[30]
RX / D10	38	SPI1 (MISO)	Serial1 (RX)	✓	PA[13]
SCK / D13	54	SPI (SCK)			PA[18]
SIM_CLK	71				
SIM_DATA	73				
SIM_RST	69				
SIM_VCC	67				
TX / D9	36	SPI1 (MOSI)	Serial1 (TX)	✓	PA[12]
USBDATA-	13				PA[25]
USBDATA+	11				PA[26]

PIN FUNCTION BY M.2 PIN

Module Pin	Pin Name		PWM	MCU
11	USBDATA+			PA[26]
13	USBDATA-			PA[25]
14	NC			
17	D21			PA[0]
18	GNSS_TX			
19	D20			PA[1]
20	D1	Wire (SCL)		PA[31]
22	D0	Wire (SDA)		PB[0]
23	A0 / D19	ADC_0	✓	PB[4]
33	A1 / D18	ADC_1	✓	PB[5]

35	A2 / D17	ADC_2				PB[6]
36	TX / D9		SPI1 (MOSI)	Serial1 (TX)	✓	PA[12]
37	A3 / D16	ADC_4				PB[1]
38	RX / D10		SPI1 (MISO)	Serial1 (RX)	✓	PA[13]
40	D3		SPI1 (SS)	Serial1 (CTS)		PA[15]
41	A4 / D15	ADC_5				PB[2]
42	D2		SPI1 (SCK)	Serial1 (RTS)		PA[14]
43	A5 / D14	ADC_6	SWCLK		✓	PB[3]
44	CELL USBD+					
45	A6 / D29	ADC_3			✓	PB[7]
46	CELL USBD-					
47	A7 / WKP	ADC_7				PA[20]
48	D8		SPI (SS)			PA[19]
50	MISO / D11		SPI (MISO)		✓	PA[17]
52	MOSI / D12		SPI (MOSI)		✓	PA[16]
53	A5 / D14	ADC_6	SWCLK		✓	PB[3]
54	SCK / D13		SPI (SCK)			PA[18]
55	D27	SWDIO				PA[27]
58	D24			Serial2 (TX)		PA[7]
59	D26					PA[4]
60	D25			Serial2 (RX)		PA[8]
61	RGBR					PA[30]
62	D22					PA[9]
63	RGBG					PB[23]
64	D23					PA[10]
65	RGBB					PB[22]
66	D4				✓	PB[18]
67	SIM_VCC					
68	D5				✓	PB[19]
69	SIM_RST					
70	D6				✓	PB[20]
71	SIM_CLK					
72	D7				✓	PB[21]
73	SIM_DATA					
74	CELL VBUS					
75	CELL_RI					

GPIO (DIGITAL I/O)

Pin	M-SoM Pin Name	M-SoM GPIO	MCU	Special boot function
17	D21	✓	PA[0]	
19	D20	✓	PA[1]	
20	D1	✓	PA[31]	
22	D0	✓	PB[0]	
23	A0 / D19	✓	PB[4]	
33	A1 / D18	✓	PB[5]	

35	A2 / D17	✓	PB[6]	
36	TX / D9	✓	PA[12]	
37	A3 / D16	✓	PB[1]	
38	RX / D10	✓	PA[13]	
40	D3	✓	PA[15]	
41	A4 / D15	✓	PB[2]	
42	D2	✓	PA[14]	
43	A5 / D14	✓	PB[3]	SWCLK. 40K pull-down at boot.
45	A6 / D29	✓	PB[7]	
47	A7 / WKP	✓	PA[20]	
48	D8	✓	PA[19]	
50	MISO / D11	✓	PA[17]	
52	MOSI / D12	✓	PA[16]	
53	A5 / D14	✓	PB[3]	SWCLK. 40K pull-down at boot.
54	SCK / D13	✓	PA[18]	
55	D27	✓	PA[27]	SWDIO. 40K pull-up at boot. Low at boot triggers MCU test mode.
58	D24	✓	PA[7]	Low at boot triggers ISP flash download
59	D26	✓	PA[4]	
60	D25	✓	PA[8]	Goes high at boot
62	D22	✓	PA[9]	
64	D23	✓	PA[10]	
66	D4	✓	PB[18]	
68	D5	✓	PB[19]	
70	D6	✓	PB[20]	
72	D7	✓	PB[21]	

- All GPIO are 3.3V only and are not 5V tolerant
- The drive strength is 4 mA per pin in normal drive and 12 mA per pin in high drive mode on the M-SoM.
- There is a maximum of 200 mA across all pins. The total maximum could be further limited by your 3.3V regulator.
- Drive strength selection using [pinSetDriveStrength](#) is only available in Device OS 5.5.0 and later on the M-SoM.

Certain GPIO will change state at boot, or cause the MCU to enter a special mode. See the [boot mode pins](#) section, below, for more information.

ADC (ANALOG TO DIGITAL CONVERTER)

Pin	Pin Name	Description	Interface	MCU
23	A0 / D19	A0 Analog in, GPIO, PWM	ADC_0	PB[4]
33	A1 / D18	A1 Analog in, GPIO, PWM	ADC_1	PB[5]
35	A2 / D17	A2 Analog in, GPIO	ADC_2	PB[6]
37	A3 / D16	A3 Analog in, PDM CLK, GPIO	ADC_4	PB[1]
41	A4 / D15	A4 Analog in, PDM DAT, GPIO	ADC_5	PB[2]
43	A5 / D14	A5 Analog in, PWM, GPIO, shared with pin 53	ADC_6	PB[3]
45	A6 / D29	A6 Analog in, GPIO, PWM, M.2 eval PMIC INT	ADC_3	PB[7]

47	A7 / WKP	A7 Analog In, WKP, GPIO D28	ADC_7	PA[20]
53	A5 / D14	A5 Analog in, PWM, GPIO, SWCLK, shared with pin 43	ADC_6	PB[3]

- ADC inputs are single-ended and limited to 0 to 3.3V
- Resolution is 12 bits
- SoM pin 43 (A5) on the M-SoM is shared with SoM pin 53 (SWD_CLK). You cannot use A5 and SWD at the same time. If you implement SWD on your base board, driving pin A6 will prevent SWD from functioning. The SWD_CLK will be driven at boot by the MCU.

The ADCs on the M-SoM (RTL872x) have a lower impedance than other Particle device MCUs (nRF52, STM32F2xx). They require a stronger drive and this may cause issues when used with a voltage divider. This is particularly true for A7, which has an even lower impedance than other ADC inputs.

For signals that change slowly, such as NTC thermocouple resistance, you can add a 2.2 uF capacitor to the signal. For rapidly changing signals, a voltage follower IC can be used.

UART SERIAL

Pin	Pin Name	Description	Interface	MCU
36	TX / D9	Serial TX, PWM, GPIO, SPI1 MOSI, I2S MCLK	Serial1 (TX)	PA[12]
38	RX / D10	Serial RX, PWM, GPIO, SPI1 MISO	Serial1 (RX)	PA[13]
40	D3	D3 GPIO, Serial1 CTS flow control (optional), SPI1 SS	Serial1 (CTS)	PA[15]
42	D2	D2 GPIO, Serial RTS flow control (optional), SPI1 SCK	Serial1 (RTS)	PA[14]
58	D24	D24 GPIO, Serial2 TX, do not pull down at boot	Serial2 (TX)	PA[7]
60	D25	GPIO25, Serial2 RX	Serial2 (RX)	PA[8]

- 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
- Serial1 uses the RTL872x UART_LOG peripheral
- Serial2 uses the RTL872x HS_UART0 peripheral
- Supported baud rates: 110, 300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200, 128000, 153600, 230400, 380400, 460800, 500000, 921600, 1000000, 1382400, 1444400, 1500000, 1843200, 2000000, 2100000, 2764800, 3000000, 3250000, 3692300, 3750000, 4000000, 6000000

SPI

Pin	Pin Name	Description	Interface	MCU
36	TX / D9	Serial TX, PWM, GPIO, SPI1 MOSI, I2S MCLK	SPI1 (MOSI)	PA[12]
38	RX / D10	Serial RX, PWM, GPIO, SPI1 MISO	SPI1 (MISO)	PA[13]
40	D3	D3 GPIO, Serial1 CTS flow control (optional), SPI1 SS	SPI1 (SS)	PA[15]
42	D2	D2 GPIO, Serial RTS flow control (optional), SPI1 SCK	SPI1 (SCK)	PA[14]
48	D8	D8 GPIO, SPI SS	SPI (SS)	PA[19]
50	MISO / D11	D11 GPIO, PWM, SPI MISO	SPI (MISO)	PA[17]
52	MOSI / D12	D12 GPIO, PWM, SPI MOSI	SPI (MOSI)	PA[16]
54	SCK / D13	D13 GPIO, SPI SCK	SPI (SCK)	PA[18]

- 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
- SPI uses the RTL872x SPI0 peripheral (50 MHz maximum speed)
- SPI1 uses the RTL872x SPI1 peripheral (25 MHz maximum speed)
- Note: The P2/Photon 2 maximum speeds for SPI and SPI1 are reversed from the M-SoM

Even though the B-SoM and M-SoM both have two SPI interfaces, note that the M-SoM SPI1 is on different pins.

Pin	B-SoM Pin Name	B-SoM SPI	M-SoM Pin Name	M-SoM SPI
36	TX / D9		TX / D9	SPI1 (MOSI)
38	RX / D10		RX / D10	SPI1 (MISO)
40	D3	SPI1 (MOSI)	D3	SPI1 (SS)
42	D2	SPI1 (SCK)	D2	SPI1 (SCK)
48	D8	SPI (SS)	D8	SPI (SS)
50	MISO / D11	SPI (MISO)	MISO / D11	SPI (MISO)
52	MOSI / D12	SPI (MOSI)	MOSI / D12	SPI (MOSI)
54	SCK / D13	SPI (SCK)	SCK / D13	SPI (SCK)
66	D4	SPI1 (MISO)	D4	

I2C

Pin	Pin Name	Description	Interface	MCU
20	D1	D1 GPIO, I2C SCL	Wire (SCL)	PA[31]
22	D0	D0 GPIO, I2C SDA	Wire (SDA)	PB[0]

- 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 required for I2C

PWM

Pin	Pin Name	Description	MCU
23	A0 / D19	A0 Analog in, GPIO, PWM	PB[4]
33	A1 / D18	A1 Analog in, GPIO, PWM	PB[5]
36	TX / D9	Serial TX, PWM, GPIO, SPI1 MOSI, I2S MCLK	PA[12]
38	RX / D10	Serial RX, PWM, GPIO, SPI1 MISO	PA[13]
43	A5 / D14	A5 Analog in, PWM, GPIO, shared with pin 53	PB[3]
45	A6 / D29	A6 Analog in, GPIO, PWM, M.2 eval PMIC INT	PB[7]
50	MISO / D11	D11 GPIO, PWM, SPI MISO	PA[17]
52	MOSI / D12	D12 GPIO, PWM, SPI MOSI	PA[16]
53	A5 / D14	A5 Analog in, PWM, GPIO, SWCLK, shared with pin 43	PB[3]
66	D4	D4 GPIO, PWM	PB[18]
68	D5	D5 GPIO, PWM, I2S TX	PB[19]
70	D6	D6 GPIO, PWM, I2S CLK	PB[20]
72	D7	D7 GPIO, PWM, I2S WS	PB[21]

- All available PWM pins on the M-SoM share a single timer. This means that they must all share a single frequency, but can have different duty cycles.

PDM

Pulse density modulation digital microphones can be used with the [Microphone_PDM](#) library and the M-SoM, but only on specific pins:

Pin	Pin Name	Description	MCU
37	A3 / D16	A3 Analog in, PDM CLK, GPIO	PB[1]
41	A4 / D15	A4 Analog in, PDM DAT, GPIO	PB[2]

USB

The M-SoM 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+	PA[26]
13	USBDATA-	USB Data-	PA[25]
44	CELL USB D+	Cellular Modem USB Data+	
46	CELL USB D-	Cellular Modem USB Data-	

- The CELL USB connector does not need to be populated on your board. It is used for reprogramming the cellular modem firmware, which is rarely done as it often requires recertification of the device.

RGB LED

The M-SoM 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	PA[30]
63	RGBG	RGB LED Green	PB[23]
65	RGBB	RGB LED Blue	PB[22]

- On the M-SoM, Pin RGBR (PA[30]) has a 10K hardware pull-up in the module because it's a trap pin that controls the behavior of the internal 1.1V regulator. This does not affect the RGB LED but could affect your design if you are repurposing this pin as GPIO. You must not hold this pin low at boot.

BOOT MODE PINS

These pins have a special function at boot. Beware when using these pins as input as they can trigger special modes in the MCU.

Pin	Pin Name	Description	MCU
43	A5 / D14	SWCLK. 40K pull-down at boot.	PB[3]
53	A5 / D14	SWCLK. 40K pull-down at boot.	PB[3]
55	D27	SWDIO. 40K pull-up at boot. Low at boot triggers MCU test mode.	PA[27]
58	D24	Low at boot triggers ISP flash download	PA[7]
60	D25	Goes high at boot	PA[8]
61	RGBR	Low at boot triggers trap mode	PA[30]

BLE (BLUETOOTH LE)

If you wish to use Wi-Fi on the M-SoM you will need to provide a way to configure it. Wi-Fi setup works the same as the P2, Photon 2, and Argon, and uses BLE. See [Wi-Fi setup options](#) for more information.

BLE 5.3 BLE Central Mode and BLE Peripheral Mode are supported.

Full-speed BLE modes such as A2DP used for BLE audio are not supported.

Wi-Fi and BLE share the same antenna so you do not need to include a separate antenna to use both.

SLEEP

The M-SoM can wake from `STOP` or `ULTRA_LOW_POWER` sleep mode on any GPIO, `RISING`, `FALLING`, or `CHANGE`.

The M-SoM can only wake from `HIBERNATE` sleep mode on certain pins, `RISING`, `FALLING`, or `CHANGE`.

The M-SoM preserves the state of outputs during `STOP` or `ULTRA_LOW_POWER` sleep mode. In `HIBERNATE`, outputs are high-impedance.

Pin	Pin Name	Description	Interface	MCU
36	TX / D9	Serial TX, PWM, GPIO, SPI1 MOSI, I2S MCLK	Pin can wake from HIBERNATE sleep	PA[12]
38	RX / D10	Serial RX, PWM, GPIO, SPI1 MISO	Pin can wake from HIBERNATE sleep	PA[13]
40	D3	D3 GPIO, Serial1 CTS flow control (optional), SPI1 SS	Pin can wake from HIBERNATE sleep	PA[15]
42	D2	D2 GPIO, Serial RTS flow control (optional), SPI1 SCK	Pin can wake from HIBERNATE sleep	PA[14]
47	A7 / WKP	A7 Analog In, WKP, GPIO D28	Pin can wake from HIBERNATE sleep	PA[20]
48	D8	D8 GPIO, SPI SS	Pin can wake from HIBERNATE sleep	PA[19]
50	MISO / D11	D11 GPIO, PWM, SPI MISO	Pin can wake from HIBERNATE sleep	PA[17]

52	MOSI / D12	D12 GPIO, PWM, SPI MOSI	Pin can wake from HIBERNATE sleep	PA[16]
54	SCK / D13	D13 GPIO, SPI SCK	Pin can wake from HIBERNATE sleep	PA[18]

Most pins can use `INPUT_PULLUP` or `INPUT_PULLDOWN` in sleep modes. The exception is `HIBERNATE` sleep mode where pin D21 can only use an external hardware pull-up or pull down. It also cannot be used to wake from hibernate sleep mode.

Pin	Pin Name	Description	Interface	MCU
17	D21	D21 GPIO, I2S RX	No internal pull up or pull down in HIBERNATE sleep mode.	PA[0]

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.

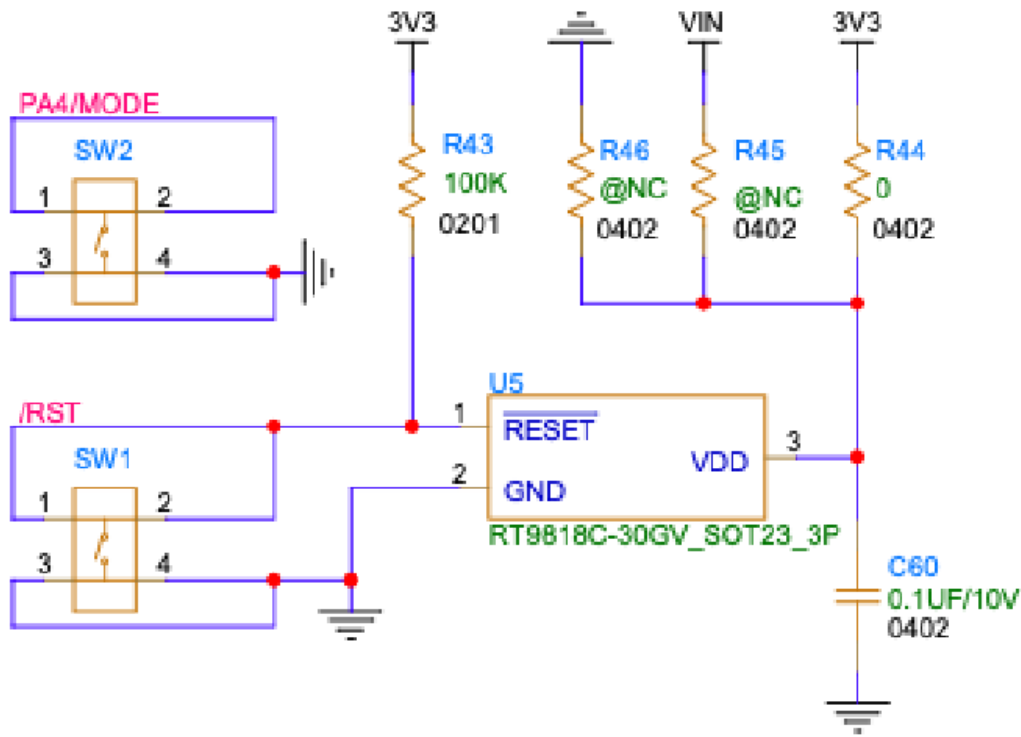
Pin	Pin Name	Description	MCU
32	MODE	MODE button. Pin number constant is BTN. External pull-up required!	PA[11]
34	RST	Hardware reset, active low. External pull-up required.	CHIP_EN

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.

SUPERVISORY RESET

In many cases, it may be desirable to include a supervisory reset IC in your design. The design below is from the Photon 2 and uses the small and inexpensive Richtec RT9818C. This chip will hold the MCU in reset until there is sufficient voltage to successfully boot. This can be helpful if your power supply cannot guarantee a sufficient slew rate.



Of note in this design, the VDD pin of the RT9818C is connected to 3V3. The design is configurable by moving a zero-ohm resistor to disable supervisory reset (by connecting to GND) or to use VIN. Note that the RT9818C has a maximum input voltage of 6V which is compatible with the Photon 2. Keep this in mind if using VIN on designs that have larger VIN voltages.

Of course you can simply wire VDD to 3V3 instead of including the configurable resistors.

PMIC NOTES

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

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

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

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

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

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

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

The input current limit is actually controlled by three factors:

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

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

CELLULAR MODEM USB PINS

The cellular modem USB pins are optional on custom base boards. These pins are used for low-level diagnostics and reprogramming the cellular modem firmware.

Note, however, the Particle has never done a cellular modem firmware upgrade in the field because doing so generally requires recertification, and is there is a high likelihood that the upgrade will fail, rendering the modem unusable.

Cellular modem could be reprogrammed by removing the SoM from your board and putting it in the M.2 SoM breakout board, which has the cellular modem USB connector.

#	Pin	Common	Function	nRF52	Description
44	Quectel USB D+	SOM0	IO		Data+ pin of the cellular modem USB port.
46	Quectel USB D-	SOM1	IO		Data- pin of the cellular modem USB port.
74	Quectel VBUS	SOM2 ³	IO		USB detect pin for cellular modem. 5V on this pin enables the Quectel USB interface.
75	Quectel RI	SOM9 ⁴	IO		Ring indicator

SIM PINS

- The SIM pins should be left unconnected
- You cannot use these pins for an external SIM card, despite their names

Pin	Pin Name	Description
69	SIM_RST	Leave unconnected, 1.8V/3V SIM Reset Output from cellular modem.
71	SIM_CLK	Leave unconnected, 1.8V/3V SIM Clock Output from cellular modem.
73	SIM_DATA	Leave unconnected, 1.8V/3V SIM Data I/O of cellular modem with internal 4.7 k pull-up.

Technical specification

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RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
Operating Temperature	T _{op}	-20		+70	°C
Humidity Range				95	%
Non condensing, relative humidity					
--}}					

I/O CHARACTERISTICS

Parameter	Symbol	Min	Typ	Peak	Unit
Input-High Voltage	V _{IH}	2.0			V
Input-Low Voltage	V _{IL}			0.8	V
Output drive strength (normal drive)				4	mA
Output drive strength (high drive)				12	mA
Total output drive (all pins)				200	mA

POWER CONSUMPTION (M635)

To be determined at a later date. When operated on LTE Cat M1 or 2G, should be similar to M404.

RADIO SPECIFICATIONS

Realtek RTL872x for Wi-Fi 2.4 GHz

Feature	Description	Minimum	Typical	Maximum	Unit
Frequency Range	Center channel	2412	-	2484	MHz
Output power	1 Mbps CCK	-	20	21	dBm
	11 Mbps CCK	-	18	21	dBm
	BPSK rate 1/2, 6Mbps OFDM	-	20	21	dBm
	64QAM rate 3/4, 54Mbps OFDM	-	17	18	dBm
	HT20-MCS 0, BPSK rate 1/2	-	19	20	dBm
	HT20-MCS 7, 64QAM rate 5/6	-	16	17	dBm
	HT40-MCS 0, BPSK rate 1/2	-	19	20	dBm
	HT40-MCS 7, 64QAM rate 5/6	-	16	17	dBm
Tx EVM	BPSK rate 1/2, 6Mbps OFDM	-	-	-5	dB
	64QAM rate 3/4, 54Mbps OFDM	-	-	-25	dB
	HT20-MCS 0, BPSK rate 1/2	-	-	-5	dB
	HT20-MCS 7, 64QAM rate 5/6	-	-	-28	dB
	HT40-MCS 0, BPSK rate 1/2	-	-	-5	dB
	HT40-MCS 7, 64QAM rate 5/6	-	-	-28	dB
Output power variation		-1.5	-	1.5	dBm
Carrier suppression		-	-	-30	dBm

Realtek RTL872x for Wi-Fi 5 GHz

Feature	Description	Minimum	Typical	Maximum	Unit
Frequency Range	Center channel	5180	-	5825	MHz
Output power	BPSK rate 1/2, 6Mbps OFDM	-	19	19	dBm
	64QAM rate 3/4, 54Mbps OFDM	-	14	15	dBm
	HT20-MCS 0, BPSK rate 1/2	-	17	18	dBm
	HT20-MCS 7, 64QAM rate 5/6	-	13	14	dBm
	HT40-MCS 0, BPSK rate 1/2	-	17	18	dBm
	HT40-MCS 7, 64QAM rate 5/6	-	13	14	dBm
Tx EVM	BPSK rate 1/2, 6Mbps OFDM	-	-	-5	dB
	64QAM rate 3/4, 54Mbps OFDM	-	-	-25	dB
	HT20-MCS 0, BPSK rate 1/2	-	-	-5	dB
	HT20-MCS 7, 64QAM rate 5/6	-	-	-28	dB
	HT40-MCS 0, BPSK rate 1/2	-	-	-5	dB
	HT40-MCS 7, 64QAM rate 5/6	-	-	-28	dB
Output power variation		-1.5	-	1.5	dBm
Carrier suppression		-	-	-30	dBm

Realtek RTL872x for BLE

Feature	Description	Minimum	Typical	Maximum	Unit
Frequency Range		2402	-	2480	MHz
Tx Output power		-10	4.5		dBm

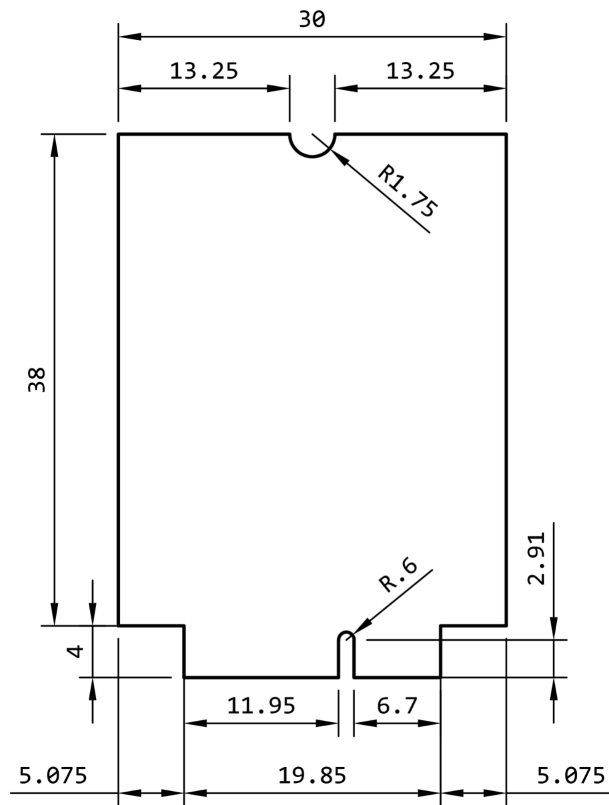
Cellular characteristics for BG95-S5 (M635e)

Parameter	Value
Protocol stack	3GPP Release 14
RAT	LTE Cat M1
	IoT-NTN
	EGPRS
LTE FDD Bands	Band 71 (600 MHz)
	Band 12 (700 MHz)
	Band 13 (700 MHz)
	Band 28 (700 MHz)
	Band 85 (700 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)
	Band 66 (2100 MHz)

GSM Bands	GSM850 (850 MHz)
	EGSM900 (900 MHz)
	DCS1800 (1800 MHz)
	PCS1900 (1900 MHz)
IoT-NTN Bands	B23/B256 (S-Band)
	B244 (L-Band)
Power class	Class 4 (33dBm $\pm$ 2dB) for GSM850
	Class 4 (33dBm $\pm$ 2dB) for EGSM900
	Class 1 (30dBm $\pm$ 2dB) for DCS1800
	Class 1 (30dBm $\pm$ 2dB) for PCS1900
	Class E2 (27dBm $\pm$ 3dB) for GSM850 8-PSK
	Class E2 (27dBm $\pm$ 3dB) for EGSM900 8-PSK
	Class E2 (26dBm $\pm$ 3dB) for DCS1800 8-PSK
	Class E2 (26dBm $\pm$ 3dB) for PCS1900 8-PSK
	Class 3 (23dBm $\pm$ 2dB) for LTE FDD bands
	Class 3 (23 dBm $\pm$ 2.7 dB) for IoT-NTN bands

Mechanical specifications

MECHANICAL DRAWING

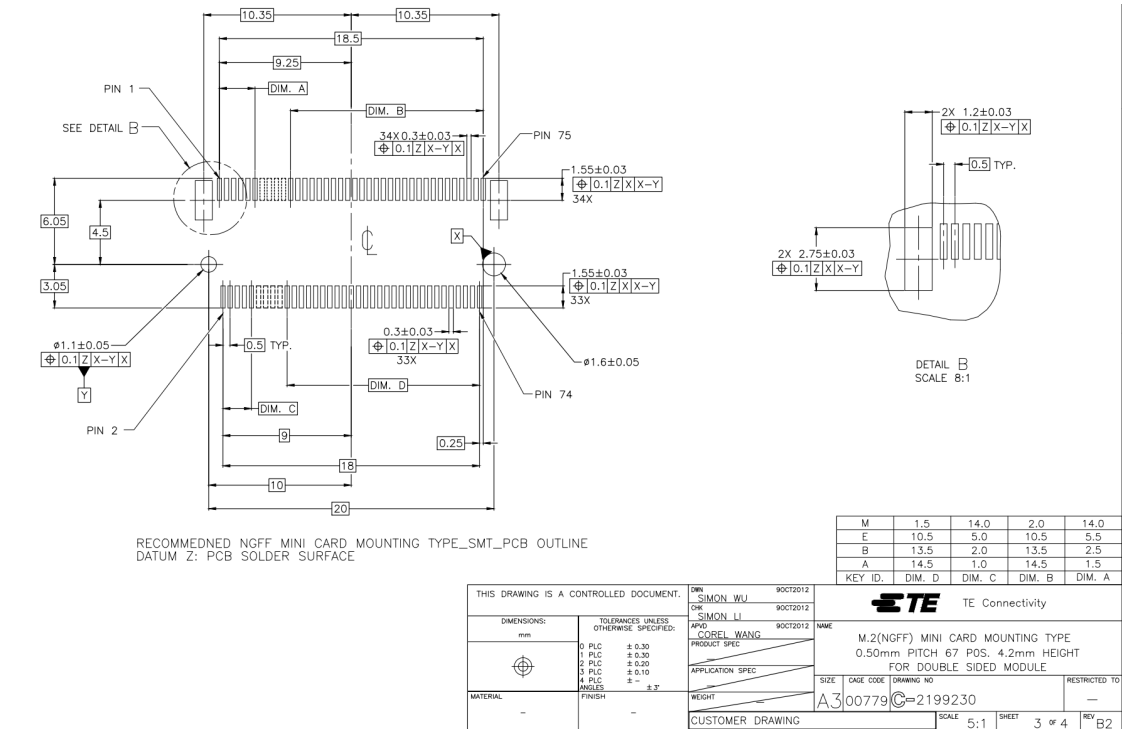


Dimensions are in millimeters.

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](#).



A device, footprint, and symbol for EagleCAD are available in the [hardware-libraries Github](#).

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.

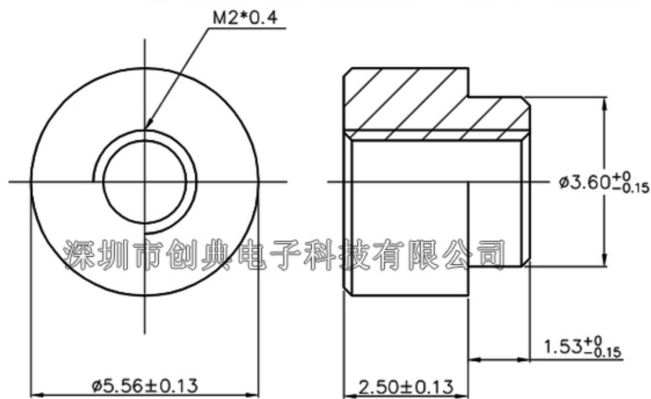
- This is one style of standoff.

宝贝实拍 PRODUCT PHOTOS



图纸参数 Drawing parameter

NGFF M. 2 4. 2H高配套铜柱

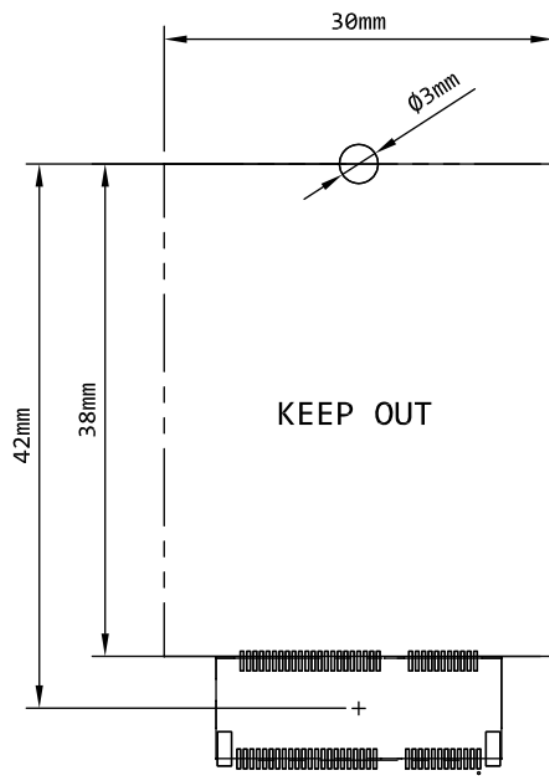


- An [alternative design](#) uses a [JAE SM3ZS067U410-NUT1-R1200](#) standoff. It's reflow soldered to your base board and has a threaded hole for a M2*3 screw to hold down the SoM. This may be easier to obtain.

The screw should be connected to the ground plane on your base board.

DESIGN CONSIDERATIONS

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



REFERENCE DESIGN

The [M.2 breakout board design](#) design files for EagleCAD are available as a reference design.

Product Handling

ESD PRECAUTIONS

The M-SoM contains highly sensitive electronic circuitry and is an Electrostatic Sensitive Device (ESD). Handling an M-SoM 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 Particle M-SoM. ESD precautions should be implemented on the application board where the M-SoM is mounted. Failure to observe these precautions can result in severe damage to the M-SoM!

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.

Default settings

The M-SoM 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 Warnings and End Product Labeling Requirements

FEDERAL COMMUNICATION COMMISSION INTERFERENCE STATEMENT

This device complies with Part 15 of the FCC Rules.

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.

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 or more 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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This device is intended only for OEM integrators under the following conditions: (For module device use)

- (1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- (2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTICE TO OEM INTEGRATORS - FCC

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the Module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no

additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are compliant with the transmitter(s) rule(s). The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed. Important Note notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to Particle that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the Particle, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

5. This device is certified as a limited module due to lack of shielding. As this device doesn't not have a shield over the radio chip over the radio chip, additional testing and a Class II filing is required for installation in all host devices.

END PRODUCT LABELING - FCC

When the module is installed in the host device, the FCC label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text:

M635 for End Product Labeling: The final end product must be labeled in a visible area with the following

Contains FCC ID: 2AEMI-M635

The FCC ID can be used only when all FCC compliance requirements are met.

ANTENNA INSTALLATION - FCC

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users. (2) The transmitter module may not be co-located with any other transmitter or antenna. (3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

In the event that these conditions cannot 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 cannot 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.

To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device:

- 814–849 MHz : 2.01 dBi
- 698–716 MHz: 2.17 dBi
- 703–748 MHz : 2.5 dBi
- 777–787 MHz: 5.3 dBi
- 824–849 MHz: 2.01 dBi
- 1710–1755 MHz: 3.74 dBi
- 1755–1780 MHz : 4 dBi
- 1850–1915 MHz: 5.3 dBi
- 1626.5–1660.5: 3.91 dBi
- 1980–2010 MHz: 4.61dBi

- 2000–2020 MHz:4.37dBi
- BLE:2400 MHz-2483.5 MHz:3dBi
- WiFi:2400MHz-2483.5MHz:3dBi
- WiFi:5150MHz-5850MHz:6.8dBi

MANUAL INFORMATION TO THE END USER - FCC

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 users manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual. Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

OUTDOOR USE - FCC

To be compliant to FCC §15.407(a) the EIRP is not allowed to exceed 125 mW (21 dBm) at any elevation angle above 30° (measured from the horizon) when operated as an outdoor access point in U-NII-1 band, 5.150-5.250 GHz.

ISED Warnings and End Product Labeling Requirements

Innovation, Science and Economic Development

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s).

Operation is subject to the following two conditions:

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

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RADIATION EXPOSURE STATEMENT - ISED

This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Déclaration d'exposition aux radiations

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes:

1. L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
2. Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

To comply with ISED regulations limiting both maximum RF output power and human exposure to RF radiation, Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device:

This radio transmitter [20127-M635] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

PMN: M-Series LTE M1/2G/Satellite

Cet émetteur radio [20127-M635] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antennes énumérés ci-dessous, avec le gain maximal permis indiqué. L'utilisation avec cet appareil de types d'antennes non inclus dans cette liste et présentant un gain supérieur au gain maximal indiqué pour l'un des types énumérés est strictement interdite.

PMN: M-Series LTE M1/2G/Satellite

Antenna description	Antenna Model	Antenna Type
Wi-Fi Antenna	PARANTWMIEA	PCB Antenna
M-SoM Wide band LTE Cell Antenna	PARANTCWIEA	FPC Antenna
NTN and LTE cell antenna (External)	PARANTCNIEA	External Plastic Whip Antenna with SMA Connector }
GNSS FPC Antenna	PARANTGNIEA	FPC Antenna

- 824–849 MHz (GSM 850): 2.01 dBi
- 1850–1910 MHz (GSM 1900): 5.3 dBi
- 699–716 MHz (LTE B12): 2.17 dBi
- 703–748 MHz (LTE B28): 2.5 dBi
- 777–787 MHz (LTE B13): 5.3 dBi
- 824–849 MHz (LTE B5): 1.94 dBi
- 1710–1755 MHz (LTE B4): 2.74 dBi
- 1710–1780 MHz (LTE B66): 3.74 dBi
- 1850–1910 MHz (LTE B2): 5.3 dBi
- 1626.5–1660.5 (IOT-NTN B255): 3.91 dBi
- 1980–2010 MHz (IOT-NTN B256): 4.61dBi
- 2000–2020 MHz (IOT-NTN B23): 4.37dBi
- BLE:2400 MHz-2483.5 MHz: 3dBi
- WiFi:2400MHz-2483.5MHz: 3dBi
- WiFi:5150MHz-5850MHz: 6.8dBi

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC 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 Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

END PRODUCT LABELING - ISED

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users.

M635 for End Product Labeling: The final end product must be labeled in a visible area with the following:

Contains IC: 20127-M635 HVIN: M635e

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante:

Contient des IC: 20127-M635 HVIN: M635e

MANUAL INFORMATION TO THE END USER - ISED

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

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module. Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

OUTDOOR USE - ISED

- Operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems; Operation in the 5600-5650 MHz band is not allowed in Canada. High-power radars are allocated as primary users (i.e., priority users) of the bands 5250-5350 MHz and 5650-5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.
- Le dispositif de fonctionnement dans la bande 5150-5250 MHz est réservé à une utilisation en intérieur pour réduire le risque d'interférences nuisibles à la co-canal systèmes mobiles par satellite
- Opération dans la bande 5600-5650 MHz n'est pas autorisée au Canada. Haute puissance radars sont désignés comme utilisateurs principaux (c.-à-utilisateurs prioritaires) des bandes 5250-5350 MHz et 5650-5850 MHz et que ces radars pourraient causer des interférences et / ou des dommages à dispositifs LAN-EL.

European Union (CE) Warnings and End Product Labeling Requirements

M635E - EUROPEAN UNION (CE)

We, Particle Industries, Inc, declare under our sole responsibility that the product, M404, to which this declaration relates, is in conformity with RED Directive 2014/53/EU and (EU) 2015/863 RoHS Directive 2011/65/EU (Recast).

The full text of the EU declaration of conformity is available at the following Internet address:

<https://www.particle.io/>

Radiation Exposure Statement: This equipment complies with radiation exposure limits set forth for an uncontrolled environment.

The operating frequency bands and the maximum transmitted power limit are listed below:

- BLE 2402-2480MHz 10dBm
- Wi-Fi 2.4GHz band 2412-2484MHz 20dBm
- Wi-Fi 5GHz band 5180-5825MHz 23dBm
- LTE B1 B3 B8 B20 B28 704.5-959.3MHz 1710.7-2687.5 MHz, 25dBm
- EGSM900 880-915 MHz, 33 dBm
- DCS1800 1710-1785 MHz, 30 dBm

UNITED KINGDOM

UKCA Conformity:

Radio Equipment Regulations 2017 (S.I. 2017/1206)

OUTDOOR USE (WORLD)

This device is restricted to indoor use when operating in the 5150 to 5350 MHz frequency range.

This restriction applies in: AT, BE, BG, CH, CY, CZ, DE, DK, EE, EL, ES, FI, FR, HR, HU, IE, IS, IT, LI, LT, LU, LV, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR, UA, UK(NI).

Certification documents

FCC (UNITED STATES) - M635E M-SOM M-SERIES LTE CAT M1/2G/NTN

- FCC ID: 2AEMI-M635
- [Test report FCC - Cellular](#)
- [Test report FCC - BLE](#)
- [Test report FCC - 2.4 GHz Wi-Fi](#)
- [Test report FCC - 5 GHz Wi-Fi](#)
- [Test report FCC - DFS](#)
- [Test report FCC - MPE](#)
- [Test report FCC Part 15 Subpart B](#)

ISED (CANADA) - M635E M-SOM M-SERIES LTE CAT M1/2G/NTN

- ISED ID: 20127-M635
- [Test report ISED - Cellular](#)
- [Test report ISED - BLE](#)
- [Test report ISED - 2.4 GHz Wi-Fi](#)
- [Test report ISED - 5 GHz Wi-Fi](#)
- [Test report ISED - DFS](#)
- [Test report ISED - MPE](#)
- [ICES-003 Test Report](#)

CE (EUROPEAN UNION) - M635E M-SOM M-SERIES LTE CAT M1/2G/NTN

- [RED Evaluation](#)
- [EMC Test Report](#)
- [EN-62368-1 Test Report](#) (safety)
- [EN 301 511 Test Report](#) (2G GSM)
- [EN 301 908-1 Test Report](#)
- [EN 301 908-13 Test Report](#) (4G)
- [EN 301 681 Test Report](#) (satellite)
- [EN 302 574-3 Test Report](#) (satellite)
- [EN 300 328 Test Report - BLE](#)
- [EN 300 328 Test Report - Wi-Fi 2.4 GHz](#)
- [EN 301 893 Test Report - Wi-Fi 5 GHz](#)
- [EN 300 440 Test Report - Wi-Fi 5.8 GHz](#)
- [EN 303 413 Test Report](#) (GNSS)
- [EN-62311 Test Report](#)

ROHS - M635E M-SOM M-SERIES LTE CAT M1/2G/NTN

- [RoHS Certificate](#)
- [RoHS Test Reports](#)

Country compatibility

M635E - COUNTRY COMPATIBILITY

Country	Model	Technologies	Carriers
Afghanistan	M635E	2G	MTN
Albania	M635E	2G	Eagle, Telekom, Vodafone
Algeria	M635E	2G	Mobilis, Ooredoo
American Samoa	M635E	NTN	Skylo
Andorra	M635E	NTN	Skylo
Anguilla	M635E	2G	Flow
Antigua and Barbuda	M635E	2G	Flow
Argentina	M635E	2G, M1	Claro, Movistar, Personal
Armenia	M635E	2G	Beeline, Ucom
Aruba	M635E	2G	Setar
Australia	M635E	M1, NTN	Optus, Skylo, Telstra, Vodafone
Austria	M635E	2G, M1, NTN	3 (Drei), A1, Skylo, T-Mobile
Azerbaijan	M635E	2G	Azercell, Bakcell, NAR Mobile
Bahamas	M635E	2G	Aliv, BTC Bahamas
Bahrain	M635E	2G	Zain
Bangladesh	M635E	2G	Bangalink
Barbados	M635E	2G	Flow
Belarus	M635E	2G	A1
Belgium	M635E	2G, M1, NTN	Base, Orange, Proximus, Skylo
Bolivia	M635E	2G	Viva
Bosnia and Herzegovina	M635E	2G	HT Eronet
Botswana	M635E	2G	BeMobile
Brazil	M635E	2G, NTN	Skylo, TIM
Bulgaria	M635E	2G, NTN	A1, Skylo, Telenor, Vivacom
Burkina Faso	M635E	2G	Orange
Cabo Verde	M635E	2G	CVMóvel, Unitel T+
Cambodia	M635E	2G	Metfone
Canada	M635E	M1, NTN	Bell Mobility, Rogers Wireless, Skylo, Telus
Cayman Islands	M635E	2G	Flow
Chad	M635E	2G	Airtel
Colombia	M635E	2G	Movistar
Congo (Brazzaville)	M635E	2G	Airtel
Congo (Kinshasa)	M635E	2G	Airtel
Côte d'Ivoire	M635E	2G	MTN
Croatia	M635E	2G, M1, NTN	Hrvatski Telekom, Skylo, Tele2
Cyprus	M635E	2G	MTN
Czechia	M635E	2G, NTN	Skylo, T-Mobile, Vodafone
Denmark	M635E	2G, M1, NTN	Skylo, TDC, Telenor, Telia
Dominica	M635E	2G	Flow
Dominican Republic	M635E	2G	Altice Dominicana, Viva
Ecuador	M635E	2G	Claro, Movistar

Egypt	M635E	2G	Etisalat
El Salvador	M635E	2G	Telefonica
Estonia	M635E	2G, M1, NTN	Elisa, Skylo, Tele2, Telia
eSwatini	M635E	2G	MTN
Ethiopia	M635E	2G	Ethio Telecom
Faroe Islands	M635E	2G, NTN	Faroese Telecom, Skylo, Vodafone
Finland	M635E	2G, M1, NTN	DNA, Elisa, Skylo, Telia
France	M635E	2G, M1, NTN	Bouygues, Free Mobile, Orange, SFR, Skylo
French Guiana	M635E	2G	Digicel
Gabon	M635E	2G	Airtel
Georgia	M635E	2G	Beeline, Geocell
Germany	M635E	2G, M1, NTN	O2, Skylo, Telekom, Vodafone
Ghana	M635E	2G	AirtelTigo, MTN
Gibraltar	M635E	2G, NTN	Gibtel, Skylo
Greece	M635E	2G, NTN	Cosmote, Skylo, Wind
Grenada	M635E	2G	Flow
Guadeloupe	M635E	2G	Orange
Guatemala	M635E	2G	Movistar
Guernsey	M635E	2G, NTN	Skylo, Sure
Guinea	M635E	2G	MTN
Guinea-Bissau	M635E	2G	MTN
Guyana	M635E	2G	Digicel
Haiti	M635E	2G	Digicel
Holy See (Vatican City)	M635E	NTN	Skylo
Honduras	M635E	2G	Claro, Tigo
Hungary	M635E	2G, M1, NTN	Magyar Telekom, Skylo, Telenor, Vodafone
Iceland	M635E	M1, NTN	Nova, Siminn, Skylo, Vodafone
India	M635E	2G	Airtel
Indonesia	M635E	2G	Indosat, Telkomsel, XL Axiata
Ireland	M635E	2G, NTN	Skylo, Vodafone
Isle of Man	M635E	2G, NTN	Manx Telecom, Skylo, Sure
Italy	M635E	2G, NTN	Skylo, TIM, Vodafone, Wind
Japan	M635E	M1, NTN	KDDI, NTT DoCoMo, Skylo, Softbank
Jersey	M635E	2G, NTN	Jersey Telecom, Skylo, Sure
Jordan	M635E	2G	Zain
Kazakhstan	M635E	2G	Beeline, K-Cell
Kenya	M635E	2G	Airtel
Kosovo	M635E	NTN	Skylo
Kuwait	M635E	2G	Viva, Zain
Kyrgyzstan	M635E	2G	Beeline
Latvia	M635E	2G, M1, NTN	Bite, LMT, Skylo, Tele2
Liechtenstein	M635E	2G, NTN	Mobikom, Orange, Skylo
Lithuania	M635E	2G, M1, NTN	Bite, Omnitel, Skylo, Tele2
Luxembourg	M635E	2G, M1, NTN	Orange, POST, Skylo, Tango
Madagascar	M635E	2G	Airtel

Malawi	M635E	2G	Airtel
Malaysia	M635E	2G	DiGi, Maxis
Malta	M635E	2G, M1, NTN	Go Mobile, Skylo
Mexico	M635E	M1, NTN	AT&T, Skylo, Telcel
Moldova	M635E	2G	Moldcell, Orange
Monaco	M635E	NTN	Skylo
Mongolia	M635E	2G	Mobicom, Unitel
Montenegro	M635E	2G	T-Mobile, Telenor
Morocco	M635E	2G	Inwi, Medi Telecom
Mozambique	M635E	2G	Vodacom
Myanmar	M635E	2G	MPT
Namibia	M635E	2G	Telecom Namibia
Netherlands	M635E	2G, M1, NTN	KPN, Skylo, T-Mobile, Vodafone
New Zealand	M635E	M1, NTN	Skylo, Spark, Vodafone
Nicaragua	M635E	2G	Movistar
Nigeria	M635E	2G	9mobile, Airtel, Glo
North Macedonia	M635E	2G, NTN	Skylo, Vip operator
Norway	M635E	2G, M1, NTN	Skylo, TDC, Telenor, Telia
Oman	M635E	2G	Ooredoo
Pakistan	M635E	2G	Mobilink, Ufone, Warid
Palestine	M635E	2G	Jawwal
Panama	M635E	2G	Movistar
Papua New Guinea	M635E	2G	bmobile
Paraguay	M635E	2G	Personal, Tigo, Vox
Peru	M635E	2G	Entel
Philippines	M635E	2G	Globe, Smart
Poland	M635E	2G, M1, NTN	Orange, Play, Plus, Skylo, T-Mobile
Portugal	M635E	2G, M1, NTN	NOS, Skylo, TMN, Vodafone
Puerto Rico	M635E	NTN	Skylo
Qatar	M635E	2G	Ooredoo, Vodafone
Romania	M635E	2G, M1, NTN	Orange, Skylo, Telekom Romania, Vodafone
Russia	M635E	2G	Beeline, Megafon, MTS, Tele2
Rwanda	M635E	2G	Airtel, MTN
Saint Kitts and Nevis	M635E	2G	Flow
Saint Lucia	M635E	2G	Flow
San Marino	M635E	NTN	Skylo
Serbia	M635E	2G	Telenor, VIP
Seychelles	M635E	2G	Airtel
Singapore	M635E	M1	SingTel
Sint Maarten	M635E	2G	TelCell
Slovakia	M635E	2G, M1, NTN	O2, Orange, Skylo, Telekom
Slovenia	M635E	2G, M1, NTN	A1, Mobitel, Skylo
South Africa	M635E	2G	Cell C, MTN, Vodacom
South Korea	M635E	M1	KT, SK Telecom
South Sudan	M635E	2G	MTN

Spain	M635E	2G, M1, NTN	Orange, Skylo, Telefonica, Vodafone, Yoigo
Suriname	M635E	2G	Telesur
Sweden	M635E	2G, M1, NTN	3 (Tre), Skylo, Tele2, Telenor, Telia
Switzerland	M635E	M1, NTN	Salt, Skylo, Sunrise, Swisscom
Taiwan	M635E	M1	Chunghwa
Tajikistan	M635E	2G	Beeline, Tcell
Tanzania	M635E	2G	Airtel
Trinidad and Tobago	M635E	2G	TSTT
Tunisia	M635E	2G	Orange Tunisie, Tunisie Telecom
Turks and Caicos Islands	M635E	2G	Flow
Uganda	M635E	2G	Africell, Airtel, MTN
Ukraine	M635E	2G	Kyivstar, Life, MTS
United Arab Emirates	M635E	M1	Etisalat
United Kingdom	M635E	2G, M1, NTN	EE, O2, Skylo, Vodafone
United States	M635E	M1, NTN	AT&T, Skylo, T-Mobile (USA), Verizon ⁷
Uruguay	M635E	2G	Antel
Uzbekistan	M635E	2G	Beeline
Virgin Islands (British)	M635E	2G	CCT, Flow
Zambia	M635E	2G	Airtel

M635E - CERTIFIED BANDS

Technology	Band	FCC	CE
2G	850 MHz	✓	
2G	900 MHz		
2G	1800 MHz		
2G	1900 MHz	✓	
LTE Cat M1	B1 (2100 MHz)		✓
LTE Cat M1	B2 (1900 MHz)	✓	
LTE Cat M1	B3 (1800 MHz)		✓
LTE Cat M1	B4 (1700 MHz)	✓	
LTE Cat M1	B5 (850 MHz)	✓	
LTE Cat M1	B8 (900 MHz)		✓
LTE Cat M1	B12 (700 MHz)	✓	
LTE Cat M1	B13 (700 MHz)	✓	
LTE Cat M1	B18 (850 MHz) ¹		
LTE Cat M1	B19 (850 MHz) ¹		
LTE Cat M1	B20 (800 MHz)		✓
LTE Cat M1	B25 (1900 MHz)	✓	
LTE Cat M1	B26 (850 MHz)	✓	
LTE Cat M1	B27 (800 MHz)		
LTE Cat M1	B28 (700 MHz)		✓
LTE Cat M1	B66 (2100 MHz)	✓	
LTE Cat M1	B85 (700 MHz)		
IoT NTN	n255 (1.6 GHz)	✓	✓
IoT NTN	n256 (2.0 GHz)	✓	✓

- ¹B18 and B19 are used only in Japan

Ordering information

SKU	Description	Region	Modem	EtherSIM	Lifecycle	Replacement
M635EMEA	M-Series LTE M1/2G/Satellite Kit (Global, EtherSIM), [x1]	Global	BG95-S5	✓	In development	

Revision history

Revision	Date	Author	Comments
001	2026-07-15	RK	Split from M-SoM datasheet for certification
002	2026-07-16	RK	Additional ISED updates
003	2026-07-27	RK	FCC and ISED certification document links