Photon 2 Datasheet (pre)

Preliminary pre-release version 2022-03-02

Functional description

OVERVIEW

The Photon 2 is a development module with a microcontroller and Wi-Fi networking. The form-factor is similar to the Argon (Adafruit Feather), but the Photon 2 supports 2.4 GHz and 5 GHz Wi-Fi, BLE, and has much larger RAM and flash that can support larger applications.

It is intended to replace both the Photon and Argon modules. It contains the same module as the P2, making it easier to migrate from a pin-based development module to a SMD mass-production module if desired.

FEATURES

- 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 M4F CPU, 200 MHz
- 1024 KB (1 MB) user application maximum size
- 2 MB flash file system
- FCC, IC, and CE certified

Interfaces

[To be provided at a later date.]

POWER

USB C

The USB C port is the easiest way to power up the Photon 2. Please make sure that the USB port is able to provide at least 500mA.

VUSB Pin

The pin is internally connected to the VBUS of the USB port. The nominal output should be around 4.5 to 5 VDC when the device is plugged into the USB port and 0 when not connected to a USB source. You can use this pin to power peripherals that operate at such voltages. Do not exceed the current rating of the USB port, which is nominally rated to 500mA. This pin is also protected with an internal fuse rated at 1000mA.

It is also possible to use the VUSB to power the Photon 2 if not using the USB port.

LiPo

If you want to make your projects truly wireless, you can power the device with a single cell LiPo (3.7V). The Photon 2 has an on board LiPo charger that will charge and power the device when USB source is plugged in or power the device from the LiPo alone in the absence of the USB.

NOTE: Please pay attention to the polarity of the JST-PH LiPo connector. Not all LiPo batteries follow the same polarity convention!
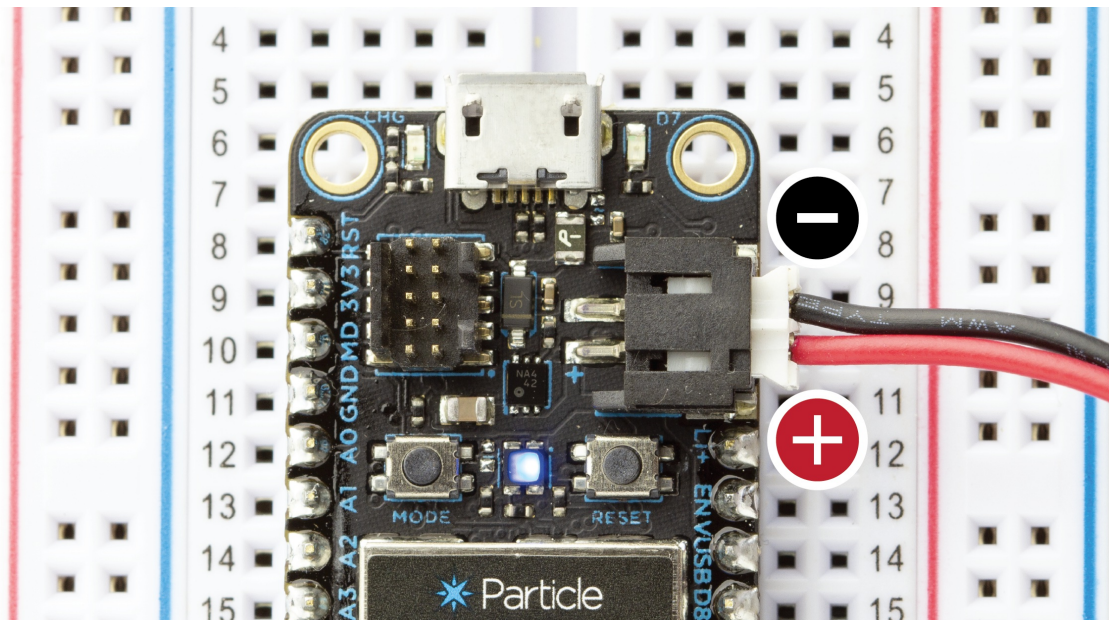
Li+ PIN

This pin is internally connected to the positive terminal of the LiPo connector. You can connect a single cell LiPo/Lithium Ion or a DC supply source to this pin for powering the Argon. Remember that the input voltage range on this pin is 3.6 to 4.2 VDC.

3V3 PIN

This pin is the output of the on board 3.3V step-down switching regulator. The regulator is rated at 500mA max. When using this pin to power other devices or peripherals remember to budget in the current requirement of the Argon first. This pin can also be used to power the Argon in absence of the USB or LiPo power. When powering over this pin, please connect the ENABLE pin to GND so that the on board regulator is disabled.

EN PIN

The **EN** pin is not a power pin, per se, but it controls the 3V3 power. The EN pin is pulled high by a 100K resistor to the higher of VUSB, the micro USB connector, or Li+. Because the pull-up can result in voltages near 5V you should never directly connect EN to a 3.3V GPIO pin. Instead, you should only pull EN low, such as by using an N-channel MOSFET or other open-collector transistor.

The EN pin can force the device into a deep power-down state where it uses very little power. It also can used to assure that the device is completely reset, similar to unplugging it, with one caveat:

If using the EN pin to deeply reset the device, you must be careful not to allow leakage current back into the nRF52 MCU by GPIO or by pull-ups to 3V3. If you only power external devices by 3V3 you won't run into this, as 3V3 is de-powered when EN is low.

However, if you have circuitry that is powered by a separate, external power supply, you must be careful. An externally powered circuit that drives a nRF52 GPIO high when EN is low can provide enough current to keep the nRF52 from powering down and resetting. Likewise, a pull-up to an external power supply can do the same thing. Be sure that in no circumstances can power by supplied to the nRF52 when 3V3 is de-powered.

ANTENNNA

- The Photon 2 includes an on-module PCB trace antenna and a U.FL connector that allows the user to connect an external antenna.
- The antenna is selected in software. The default is the PCB trace antenna.
- A single antenna is used for both Wi-Fi and BLE.

FCC APPROVED ANTENNAS

Antenna Type	Manufacturer	MFG. Part #	Gain
Dipole antenna	LumenRadio	104-1001	2.15dBi
PCB Antenna	Included	-	-

SWD/JTAG

The Photon 2 module supports programming and debugging use SWD (Serial Wire Debug) using the 10-pin micro JTAG connector on the top of the module.

When the bootloader starts, for a brief period of time a weak pull-up is applied to pin D8 and pull-down to pin D6 to detect whether a SWD debugger is attached. After boot, you can use these pins for regular GPIO, but beware of a possible GPIO state change caused by the pull-up or pull-down when using these pins as output.

Pin	JTAG	MCU Pin	Pull at boot
D8	SWDIO	PA[27]	Pull-up
D6	SWCLK	PB[3]	Pull-down
3V3	Power		
GND	Ground		
RST	Reset		

LED STATUS

System RGB LED

For a detailed explanation of different color codes of the RGB system LED, please take a look here.

Charge status LED

State	Description
ON	Charging in progress
OFF	Charging complete

Memory Map

FLASH LAYOUT OVERVIEW

[To be provided at a later date.]

DCT LAYOUT

[This information is from the P1, and is likely to remain the same, but is subject to change.]

The DCT area of flash memory has been mapped to a separate DFU media device so that we can incrementally update the application data. This allows one item (say, server public key) to be updated without erasing the other items.

DCT layout in `release/stable` [found here in firmware.](#)

Region	Offset	Size
system flags	0	32
version	32	2
device private key	34	1216
device public key	1250	384
ip config	1634	120
feature flags	1754	4
country code	1758	4
claim code	1762	63
claimed	1825	1
ssid prefix	1826	26
device code	1852	6
version string	1858	32
dns resolve	1890	128
reserved1	2018	64
server public key	2082	768
padding	2850	2
flash modules	2852	100
product store	2952	24
antenna selection	2976	1
cloud transport	2977	1
alt device public key	2978	128
alt device private key	3106	192
alt server public key	3298	192
alt server address	3490	128
device id	3618	12
radio flags	3630	1
mode button mirror	3631	32
led mirror	3663	96
led theme	3759	64
reserved2	3823	435

Note: Writing 0xFF to offset 34 (DEFAULT) or 3106 (ALTERNATE) will cause the device to re-generate a new private key on the next boot. Alternate keys are currently unsupported on the P1 but are used on the Electron as UDP/ECC keys. You should not need to use this feature unless your keys are corrupted.

```
// Regenerate Default Keys
echo -en "\xFF" > fillbyte && dfu-util -d 2b04:d00a -a 1 -s 34 -D fillbyte
// Regenerate Alternate Keys
echo -en "\xFF" > fillbyte && dfu-util -d 2b04:d00a -a 1 -s 3106 -D
fillbyte
```
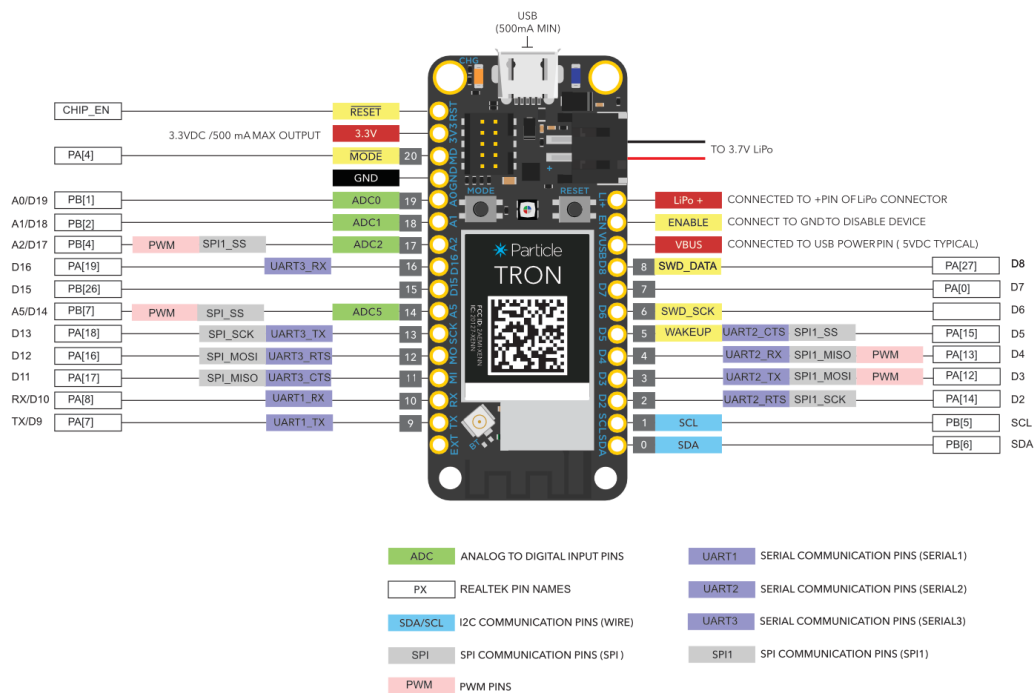
MEMORY MAP

[To be provided at a later date.]

Pin and button definition

Peripheral Type	Qty	Input(I) / Output(O)
Digital	20	I/O
Analog (ADC)	6	I
SPI	2	I/O
I2C	1	I/O
UART	3	I/O
USB	1	I/O
PWM	6	O

PIN MARKINGS

v0.8

GPIO AND PORT LISTING

Pin Name				MCU
A0 / D19	ADC_4			PB[1]
A1 / D18	ADC_5			PB[2]
A2 / D17	ADC_0			PB[4]
A5 / D14	ADC_3		SPI (SS)	PB[7]
D0 / A3	ADC_2	Wire (SDA)		PB[6]
D1 / A4	ADC_1	Wire (SCL)		PB[5]
D15				PB[26]
D16			Serial3 (RX)	PA[19]
D2		SPI1 (SCK)	Serial2 (RTS)	PA[14]
D3		SPI1 (MOSI)	Serial2 (TX)	PA[12]
D4		SPI1 (MISO)	Serial2 (RX)	PA[13]
D5 / WKP		SPI1 (SS)	Serial2 (CTS)	PA[15]

D6	SWCLK			PB[3]
D7				PA[0]
D8	SWDIO			PA[27]
MISO / D11		SPI (MISO)	Serial3 (CTS)	PA[17]
MOSI / D12		SPI (MOSI)	Serial3 (RTS)	PA[16]
RX / D10			Serial1 (RX)	PA[8]
SCK / D13		SPI (SCK)	Serial3 (TX)	PA[18]
TX / D9			Serial1 (TX)	PA[7]

ADC (ANALOG TO DIGITAL CONVERTER)

The Photon 2 supports six ADC inputs.

Pin Name	Description	Interface	MCU
A0 / D19	A0 Analog in, GPIO	ADC_4	PB[1]
A1 / D18	A1 Analog in, GPIO	ADC_5	PB[2]
A2 / D17	A2 Analog in, GPIO, PWM.	ADC_0	PB[4]
A5 / D14	A5 Analog in, PWM, SPI SS, GPIO	ADC_3	PB[7]
D0 / A3	D0 GPIO, PWM, I2C SDA, A3 Analog In	ADC_2	PB[6]
D1 / A4	D1 GPIO, PWM, I2C SCL, A4 Analog In	ADC_1	PB[5]

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

UART SERIAL

The Photon 2 supports two UART serial interfaces.

Pin Name	Description	Interface	MCU
D16	D16 GPIO, Serial3 RX. Was A3 on Argon.	Serial3 (RX)	PA[19]
SCK / D13	SPI SCK, D13 GPIO, Serial3 TX	Serial3 (TX)	PA[18]
MOSI / D12	SPI MOSI, D12 GPIO, Serial3 RTS	Serial3 (RTS)	PA[16]
MISO / D11	SPI MISO, D11 GPIO, Serial3 CTS	Serial3 (CTS)	PA[17]
RX / D10	Serial1 RX (received data), GPIO	Serial1 (RX)	PA[8]
TX / D9	Serial1 TX (transmitted data), GPIO	Serial1 (TX)	PA[7]
D2	D2 GPIO, Serial2 RTS, SPI1 SCK.	Serial2 (RTS)	PA[14]
D3	D3 GPIO, PWM, Serial2 TX, SPI1 MOSI.	Serial2 (TX)	PA[12]
D4	D4 GPIO, PWM, Serial2 RX, SPI1 MISO.	Serial2 (RX)	PA[13]
D5 / WKP	GPIO D5, Serial2 CTS, SPI1 SS.	Serial2 (CTS)	PA[15]

- 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 LP_UART peripheral
- Serial3 uses the RTL872x HS_UART0 peripheral

SPI

The Photon 2 supports two SPI (serial peripheral interconnect) ports.

Pin Name	Description	Interface	MCU
A5 / D14	A5 Analog in, PWM, SPI SS, GPIO	SPI (SS)	PB[7]
SCK / D13	SPI SCK, D13 GPIO, Serial3 TX	SPI (SCK)	PA[18]
MOSI / D12	SPI MOSI, D12 GPIO, Serial3 RTS	SPI (MOSI)	PA[16]
MISO / D11	SPI MISO, D11 GPIO, Serial3 CTS	SPI (MISO)	PA[17]
D2	D2 GPIO, Serial2 RTS, SPI1 SCK.	SPI1 (SCK)	PA[14]
D3	D3 GPIO, PWM, Serial2 TX, SPI1 MOSI.	SPI1 (MOSI)	PA[12]
D4	D4 GPIO, PWM, Serial2 RX, SPI1 MISO.	SPI1 (MISO)	PA[13]
D5 / WKP	GPIO D5, Serial2 CTS, SPI1 SS.	SPI1 (SS)	PA[15]

- 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 SPI1 peripheral (25 MHz maximum speed)
- SPI1 uses the RTL872x SPI0 peripheral (50 MHz maximum speed)

I2C

The Photon 2 supports one I2C (two-wire serial interface) port.

Pin Name	Description	Interface	MCU
D0 / A3	D0 GPIO, PWM, I2C SDA, A3 Analog In	Wire (SDA)	PB[6]
D1 / A4	D1 GPIO, PWM, I2C SCL, A4 Analog In	Wire (SCL)	PB[5]

- 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
- If not using I2C, pins D0 and D1 can be used as GPIO

COMPLETE PIN LISTING

Pin Name	Description	MCU
RST	Hardware reset. Pull low to reset; can leave unconnected in normal operation.	CHIP_EN
3V3	Regulated 3.3V DC output, maximum load 500 mA	
MODE	MODE button, has internal pull-up	PA[4]
GND	Ground.	
A0 / D19	A0 Analog in, GPIO	PB[1]
A1 / D18	A1 Analog in, GPIO	PB[2]
A2 / D17	A2 Analog in, GPIO, PWM.	PB[4]
D16	D16 GPIO, Serial3 RX. Was A3 on Argon.	PA[19]
D15	D15 GPIO, Was A4 on Argon.	PB[26]
A5 / D14	A5 Analog in, PWM, SPI SS, GPIO	PB[7]
SCK / D13	SPI SCK, D13 GPIO, Serial3 TX	PA[18]
MOSI / D12	SPI MOSI, D12 GPIO, Serial3 RTS	PA[16]
MISO / D11	SPI MISO, D11 GPIO, Serial3 CTS	PA[17]
RX / D10	Serial1 RX (received data), GPIO	PA[8]

TX / D9	Serial1 TX (transmitted data), GPIO	PA[7]
D0 / A3	D0 GPIO, PWM, I2C SDA, A3 Analog In	PB[6]
D1 / A4	D1 GPIO, PWM, I2C SCL, A4 Analog In	PB[5]
D2	D2 GPIO, Serial2 RTS, SPI1 SCK.	PA[14]
D3	D3 GPIO, PWM, Serial2 TX, SPI1 MOSI.	PA[12]
D4	D4 GPIO, PWM, Serial2 RX, SPI1 MISO.	PA[13]
D5 / WKP	GPIO D5, Serial2 CTS, SPI1 SS.	PA[15]
D6	D6 GPIO, SWCLK.	PB[3]
D7	D7 GPIO. Blue LED.	PA[0]
D8	GPIO, PWM, SWDIO	PA[27]
VUSB	Power out (when powered by USB) 5 VDC at 1A maximum. Power in with limitations.	
EN	Power supply enable. Connect to GND to power down. Has internal weak (100K) pull-up.	
LI+	Connected to JST PH LiPo battery connector. 3.7V in or out.	

Technical specification

ABSOLUTE MAXIMUM RATINGS

[To be provided at a later date.]

RECOMMENDED OPERATING CONDITIONS

[To be provided at a later date.]

WI-FI SPECIFICATIONS

[To be provided at a later date.]

I/O CHARACTERISTICS

[To be provided at a later date.]

Mechanical specifications

OVERALL DIMENSIONS

[To be provided at a later date.]

MODULE DIMENSIONS

[To be provided at a later date.]

Ordering information

[To be provided at a later date.]

Photon 2 modules are available from store.particle.io.

SKU	Description	Region	Lifecycle	Replacement

Qualification and approvals

- RoHS
- CE
- FCC ID: [To be provided at a later date.]
- IC: [To be provided at a later date.]

Product handling

TAPE AND REEL INFO

[To be provided at a later date.]

MOISTURE SENSITIVITY LEVELS

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. The P1 module is rated level 3. In general, this precaution applies for Photons without headers. When reflowing a P1 directly onto an application PCB, increased moisture levels prior to reflow can damage sensitive electronics on the P1. A bake process to reduce moisture may be required.

For more information regarding moisture sensitivity levels, labeling, storage and drying see the MSL standard see IPC/JEDEC J-STD-020 (can be downloaded from www.jedec.org).

ESD PRECAUTIONS

The P1 module contains highly sensitive electronic circuitry and is an Electrostatic Sensitive Device (ESD). Handling a P1 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 P1 modules. ESD precautions should be implemented on the application board where the P1 module is mounted. Failure to observe these precautions can result in severe damage to the P1 module!

Default settings

The P2 module 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.

You may use the Particle Web IDE to code, compile and flash a user application OTA (Over The Air). Particle Workbench is a full-featured desktop IDE for Windows, Mac, and Linux based on VSCode and supports both cloud-based and local gcc-arm compiles. The Particle CLI provides a command-line interface for cloud-based compiles and flashing code over USB.

Glossary

Radio Frequency

SMT

Surface Mount Technology (often associated with SMD which is a surface mount device).

AP

Access Point

USB

Universal Serial Bus

Quiescent current

Current consumed in the deepest sleep state

FT

Five-tolerant; Refers to a pin being tolerant to 5V.

3V3

+3.3V; The regulated +3.3V supply rail. Also used to note a pin is only 3.3V tolerant.

RTC

Real Time Clock

OTA

Over The Air; describing how firmware is transferred to the device.

FCC IC CE Warnings and End Product Labeling Requirements

Federal Communication Commission Interference Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

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

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

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

Contains FCC ID: [To be provided at a later date]

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

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

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

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

L'exploitation est autorisée aux deux conditions suivantes:

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

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

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

Contains transmitter module IC: [To be provided at a later date]

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

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

Revision history

Revision	Date	Author	Comments
pre	2022-03-02	RK	Pre-release initial version

Known Errata

Contact

Web

https://www.particle.io

Community Forums

https://community.particle.io

Email

https://support.particle.io