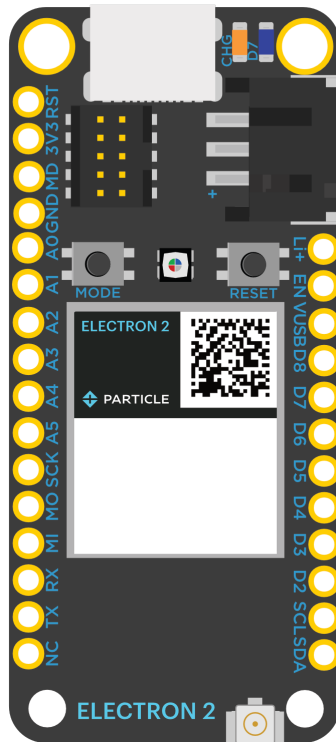# Electron 2 Datasheet

This is a preliminary datasheet and is subject to change.

Functional description

OVERVIEW

The Electron 2 is a powerful LTE Cat 1 bis-enabled development kit that supports cellular networks and Bluetooth LE (BLE). It is based on the Nordic nRF52840 and has built-in battery charging circuitry so it's easy to connect a Li-Po and deploy your local network in minutes.

The Electron 2 is great for connecting existing projects to the Particle Device Cloud where Wi-Fi is missing or unreliable. In most cases, it can be used as a drop-in replacement for Boron devices including the BRN404X, BRN404, BRN402, BRN314, or BRN310.

FEATURES

Features - ELC504EM (NorAm)

- Quectel EG800Q-NA cellular modem
- LTE Cat 1 bis (4G)
- Support for United States, Canada, and Mexico (North America, NorAm)
- LTE Cat 1 bands: 2, 4, 5, 12, 13, 66
- Embedded Particle EtherSIM e-sim

Features - ELC524EM (Europe)

- Quectel EG800Q-EU cellular modem
- LTE Cat 1 bis (4G)
- Support for selected countries in Europe, Middle East, Africa, Asia, Oceania (EMEAA)
- LTE Cat 1 bands: 1, 3, 5, 7, 8, 20, 28
- Embedded Particle EtherSIM e-sim

Features - all models

- Nordic Semiconductor nRF52840 SoC
- ARM Cortex-M4F 32-bit processor @ 64MHz
- 1MB flash, 256KB RAM
- Bluetooth 5: 2 Mbps, 1 Mbps, 500 Kbps, 125 Kbps
- Supports DSP instructions, HW accelerated Floating Point Unit (FPU) and encryption functions
- Up to +8 dBm TX power (down to -20 dBm in 4 dB steps)
- NFC-A tag
- On-board additional 8MB SPI flash
- 20 mixed signal GPIO (6 x Analog, 8 x PWM), UART, I2C, SPI
- USB-C connector
- Integrated Li-Po charging and battery connector (3-pin with temperature sensor)
- JTAG (SWD) Connector
- RGB status LED
- Reset and Mode buttons
- Built-in Particle EtherSIM e-sim
- On-board PCB antenna for BLE
- U.FL connectors for external antennas for cellular, BLE, and NFC
- Meets the Adafruit Feather specification in dimensions and pinout
- RoHS compliant (lead-free)
- Requires Device OS 6.3.0 (or later)

Decision guides

If you are unsure of whether to use the Electron 2 or another device, you can consult the decision guides.

Deciding between	Information
M.2 SoM	Electron 2 vs SoM decision guide

Migration information

Migrating from	Information
Boron	[Electron 2 from Boron migration guide](#)

CERTIFICATION

Changing the Particle module will require unintentional radiator testing of your completed assembly. This is the least expensive and least complicated of the certification tests.

You generally do not need to perform intentional radiator testing if using the antennas used for the Particle certification.

DEVICE OS SUPPORT

It is recommended that you use the latest version in the 6.x or later release line with the Electron 2.
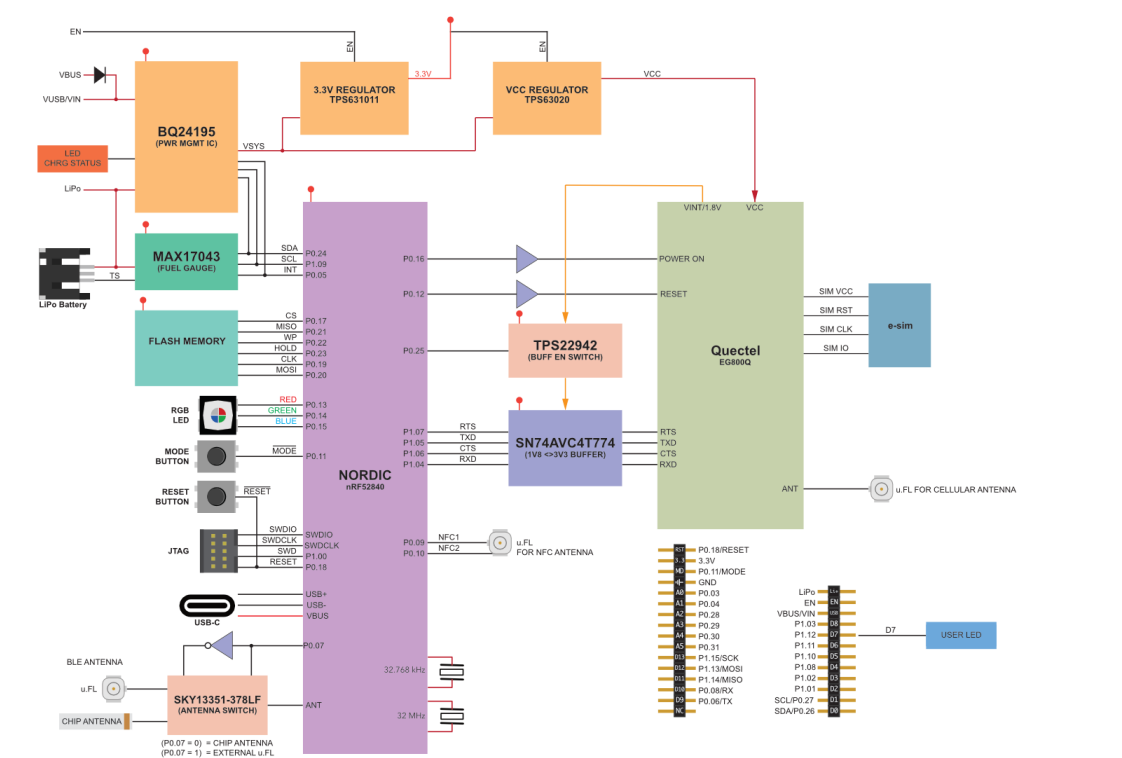
The minimum supported version is 6.3.0.

The Electron 2 is the `electron2` platform (37).
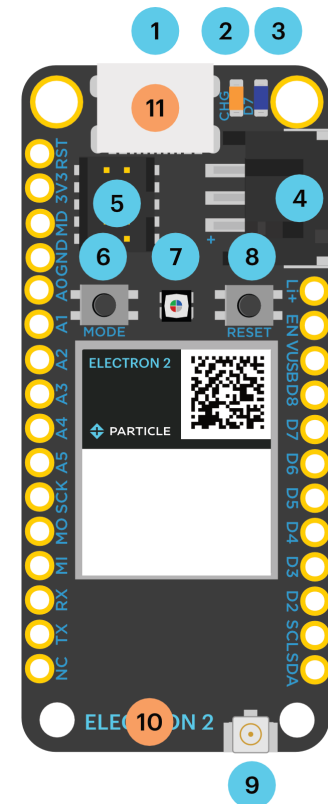
Products can only contain a single platform, so you will need separate products for Electron 2 and other devices such as the Boron, B-SoM, M-SoM, or Photon 2.

Interfaces

BLOCK DIAGRAM

LABELED DIAGRAM

Label	Description	Location
1	USB-C connector	Top
2	Battery Charge LED (Oranbge)	Top
3	User LED D6 (Blue)	Top

4	LiPo battery connector	Top
5	SWD debug connector	Top
6	MODE button	Top
7	RGB LED	Top
8	RESET button	Top
9	External BLE antenna U.FL connector	Top
10	Internal BLE antenna	Bottom
11	NFC U.FL connector	Bottom

POWER

USB-C PORT

The USB port is the easiest way to power up the Electron 2. The Electron 2 includes a USB-C connector on the module.

Note that the Electron 2 does not use USB-C PD mode to change the port voltage like the Muon and Tachyon; the USB-C port is used at the default of 5V.

The Electron 2 is compatible with most USB-C chargers for tablets. Power adapters for the Raspberry Pi 4 and 5 are generally compatible as well.

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.

LiPo

The Electron 2 has a 3-pin JST-PH (2mm pitch) battery connector that is the same as the Monitor One, Muon, and Tachyon for connection to a 3.7V LiPo battery pack with an integrated temperature sensor (10K NTC thermistor).

Some other Particle devices have a 3.7V LiPo battery without a temperature sensor using 2-pin JST-PH connector. This battery is not compatible and cannot be used with the Electron 2. A temperature sensor or equivalent resistance is required for proper operation; replacing the connector is not sufficient to use a battery without a temperature sensor.
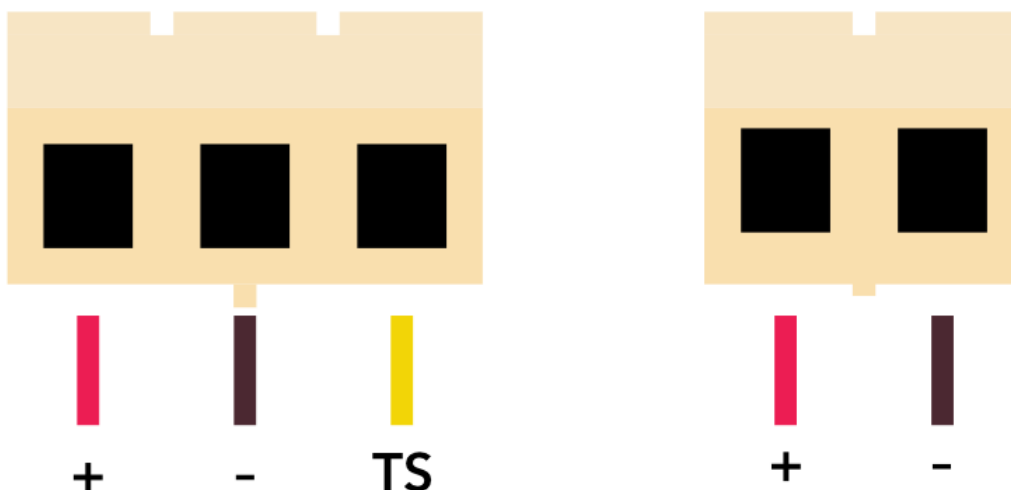
Facing the plug on the battery side

If purchasing a battery from a 3rd-party supplier, verify the polarity as the polarity is not standardized even for batteries using a JST-PH connector. See the battery guide for additional information.

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 Electron 2.

Li+ with external battery

If you are using an external LiPo battery and wish to use the built-in charger on the Electron 2, changes will be necessary from the Boron as you must simulate having a temperature sensor in the valid charging range to enable charging.

This can be done using a solder jumper on the bottom of the Electron 2. It consists of two half-moon shaped pads that must be soldered closed and will allow charging at any temperature with battery packs or external supplies that do not have a temperature sensor.
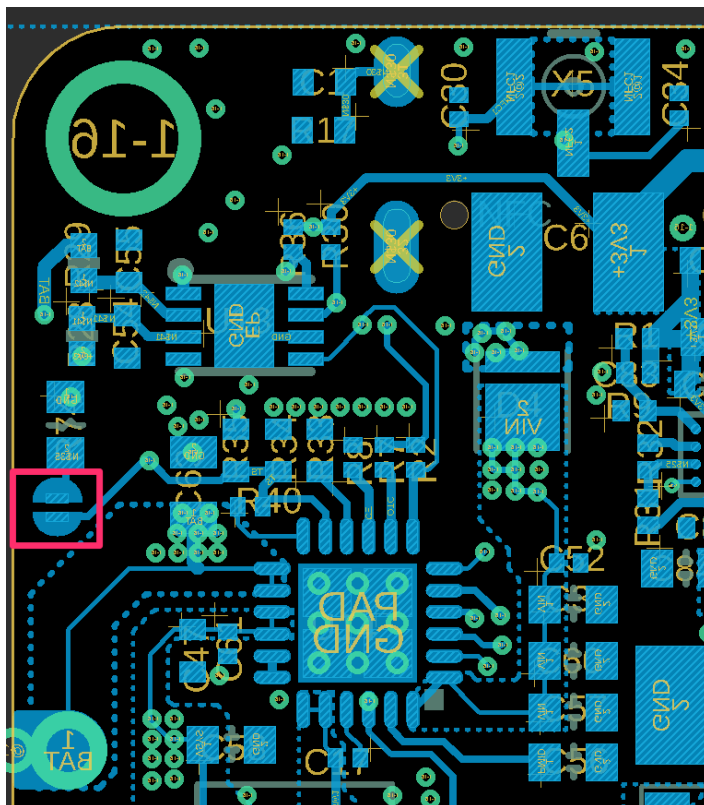
Facing bottom side of the Electron 2 with the battery connector on the left

Li+ as power input

When used as a power input (3.6 to 4.2 VDC), on the Boron it was necessary to disable charging in software through the PMIC settings. This is not necessary with the Electron 2 as charging will automatically be disabled in hardware because the battery temperature sensor will be missing and will signal out of valid temperature range in this case, disabling charging.

3V3 PIN

This pin is the output of the on board 3.3V step-down switching regulator. The regulator is rated at 1500mA maximum, however you must also budget for the power used by the MCU and the cellular modem.

Unlike the Photon, this pin *CANNOT* be used to power the Electron 2.

EN pin

The **EN** pin is not a power pin, per se, but it controls the 3V3 and cellular modem power. The EN pin is pulled high by a 100K resistor to VSYS (3.8V), which is powered by VUSB, the USB-C connector, or the LiPo battery. Because the pull-up can result in voltages above 3.3V 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.

ANTENNA

There are three radios on the Electron 2. A BLE radio (nRF52840) and a cellular radio. For the cellular radio, we have provided a u.FL connector to plug in the cellular antenna. This is required if you wish to use the cellular connectivity.

There are two options for the BLE antenna on the Electron 2. It comes with an on-board PCB antenna which is selected by default in the device OS and a u.FL connector if you wish to connect an external antenna. If you wish to use the external antenna, you'll need to issue an appropriate command in the firmware.

There is also an NFC tag receiver. This requires an external NFC antenna.

APPROVED ANTENNAS

Certified cellular antenna

The following antenna is included in single-unit packages that include an 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	700/850/900	1700/1800/1900	2100	2400	2600	Unit
Peak gain						
PARANTCW1EA	2.8	5.3	5.3	5.3	5.3	dBi

Particle devices are certified for use only with the designated antenna specified above. The use of alternative antennas with our modules could necessitate a recertification process. To fully understand the potential consequences of using a non-certified antenna, Particle strongly advises seeking consultation with a qualified RF expert.

Certified BLE antenna

The Electron 2 404X contains an onboard chip antenna for Bluetooth LE (BLE). You can optionally use an external 2.4 GHz BLE antenna.

Antenna	SKU	Links
Built-in chip antenna		Datasheet
Particle Wi-Fi Antenna 2.4GHz, [x1]	ANT-FLXV2	Datasheet | Retail Store
Particle Wi-Fi Antenna 2.4GHz, [x50]	ANT-FLXV2-50	Datasheet

Frequency	Antenna Type	Manufacturer	MFG. Part #	Gain
2400-2500 MHz	Chip Antenna	ACX	AT5020-E3R0HBA	0dBi peak
2400-2500 MHz	PCB Antenna	Particle	ANT-FLXV2	2.0dBi peak

Built-in chip antenna

General antenna parameters:

Parameter	Value	Unit
Manufacturer	ACX	
Model	AT5020-E3R0HBA	
Antenna Type	Chip	
Impedance	50	ohms
Peak Gain	0	dBi
Average Gain	-1.5	dBi
Max VSWR	2	

Particle external antenna ANT-FLXV2

General antenna parameters:

Parameter	Value	Unit
Antenna Type	Dipole	
Radiation Properties	Omnidirectional	
Polarization	Vertical	
Impedance	50	ohms
Peak Gain	2.0	dBi
Max VSWR	< 2.0	

Mechanical:

Parameter	Value	Unit

Parameter	Value	Unit
Dimensions	45.1 x 7.4 x 1.0	mm
Material	PCB	
Connector	U.FL (IPEX)	
Cable	Mini-coax 1.13mm	
Cable length	120	mm

Environmental:

Parameter	Value
Operating temperature	-20°C to 75°C
Storage temperature	-20°C to 75°C
ROHS Compliant	✓

Certified NFC antenna

Antenna	SKU	Links
Particle NFC Antenna, [x1]	ANT-NFC	Datasheet	Retail Store

General antenna parameters:

Parameter	Value	Unit
Frequency	13.56 MHz	
Communication Distance (max)	52	mm

Mechanical:

Parameter	Value	Unit
Dimensions	35 x 35	mm
Connector and cable	U.FL and 1.13mm mini coax	
Cable length	100	mm

Environmental:

Parameter	Value
Operating temperature	-20°C to 85°C
Storage temperature	-20°C to 85°C
ROHS Compliant	✓

PERIPHERALS AND GPIO

Peripheral Type	Qty	Input(I) / Output(O)
Digital	20	I/O
Analog (ADC)	6	I
UART	1	I/O
SPI	1	I/O
I2C	2	I/O
USB	1	I/O
PWM	8	O

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

SWD

The Electron 2 has a dedicated 10 pin debug connector that exposes the SWD interface of the nRF52840. This interface can be used to debug your code or reprogram your Electron 2 bootloader, device OS, or the user firmware using any standard SWD tools including our Gen 3 Debugger.

RESET

SWO

SWCLK

SWDIO

GND

GND

GND

3.3V
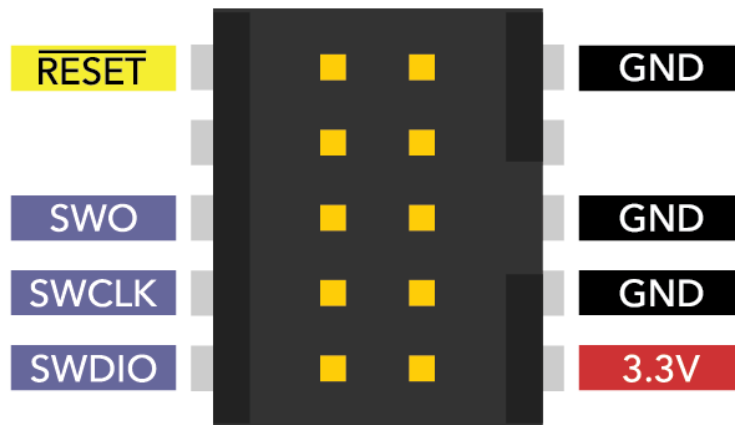
Memory map

NRF52840 FLASH LAYOUT OVERVIEW

- Bootloader (48KB, @0xF4000)
- User Application (256KB @ 0xB4000)
- System (656KB, @0x30000)
- SoftDevice (192KB)

EXTERNAL SPI FLASH LAYOUT OVERVIEW (DFU OFFSET: 0X80000000)

- OTA (1500KB, @0x00289000)
- Reserved (420KB, @0x00220000)
- FAC (128KB, @0x00200000)
- LittleFS (2M, @0x00000000)

Pins and button definitions
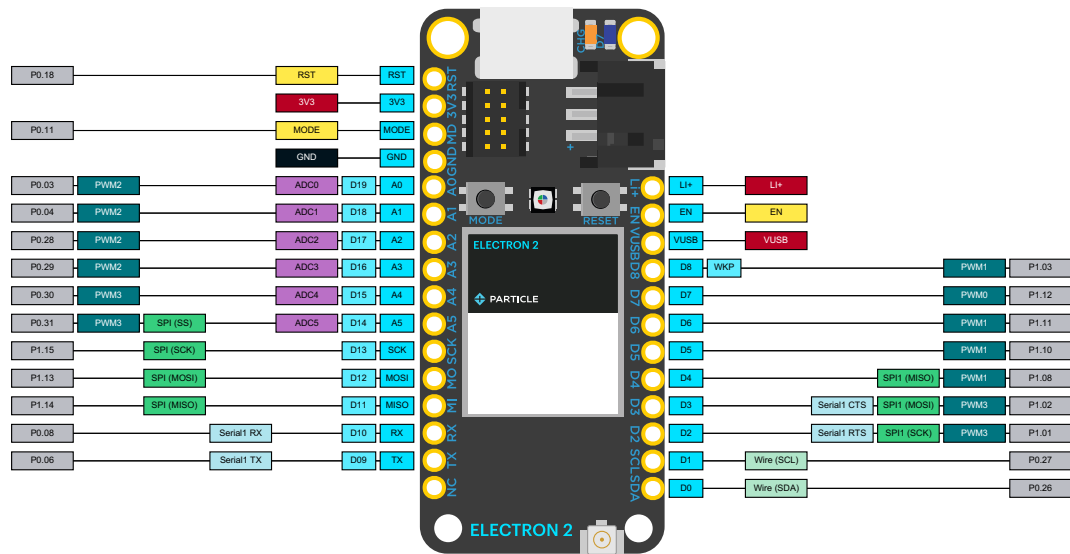
Pin	Description
Li+	This pin is internally connected to the positive terminal of the LiPo battery connector.
VUSB	This pin is internally connected to the USB (+ve) supply.
3V3	This pin is the output of the on-board 3.3V regulator.
GND	System ground pin.
EN	Device enable pin is internally pulled-up. To disable the device, connect this pin to GND.
RST	Active-low system reset input. This pin is internally pulled-up.
MD	This pin is internally connected to the MODE button. The MODE function is active-low.
RX	Primarily used as UART RX, but can also be used as a digital GPIO.
TX	Primarily used as UART TX, but can also be used as a digital GPIO.
SDA	Primarily used as data pin for I2C, but can also be used as a digital GPIO.
SCL	Primarily used as clock pin for I2C, but can also be used as a digital GPIO.
MO,MI,SCK	These are the SPI interface pins, but can also be used as a digital GPIO.
D2-D8	These are generic GPIO pins. D2-D8 are PWM-able.
A0-A5	These are analog input pins that can also act as standard digital GPIO. A0-A5 are PWM-able.

GPIO AND PORT LISTING

Pin Name				PWM	MCU
A0 / D19	ADC0			✓	P0.03
A1 / D18	ADC1			✓	P0.04
A2 / D17	ADC2			✓	P0.28
A3 / D16	ADC3			✓	P0.29
A4 / D15	ADC4			✓	P0.30
A5 / D14	ADC5		SPI (SS)	✓	P0.31
D0		Wire (SDA)			P0.26
D1		Wire (SCL)			P0.27
D2		SPI1 (SCK)	Serial1 RTS	✓	P1.01
D3		SPI1 (MOSI)	Serial1 CTS	✓	P1.02
D4		SPI1 (MISO)		✓	P1.08
D5				✓	P1.10
D6				✓	P1.11
D7				✓	P1.12
D8 / WKP				✓	P1.03
MISO / D11		SPI (MISO)			P1.14
MOSI / D12		SPI (MOSI)			P1.13
RX / D10			Serial1 RX		P0.08
SCK / D13		SPI (SCK)			P1.15
TX / D09			Serial1 TX		P0.06

ADC (ANALOG TO DIGITAL CONVERTER)

The Electron 2 supports 6 ADC inputs.

Pin Name	Description	Interface	MCU
A0 / D19	A0 Analog in, GPIO, PWM	ADC0	P0.03
A1 / D18	A1 Analog in, GPIO, PWM	ADC1	P0.04
A2 / D17	A2 Analog in, GPIO, PWM	ADC2	P0.28
A3 / D16	A3 Analog in, GPIO, PWM	ADC3	P0.29
A4 / D15	A4 Analog in, GPIO, PWM	ADC4	P0.30
A5 / D14	A5 Analog in, GPIO, PWM, SPI SS	ADC5	P0.31

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

UART SERIAL

The Electron 2 supports one UART serial interface.

Pin Name	Description	Interface	MCU
D2	SPI1 SCK, Serial1 RTS, GPIO, PWM	Serial1 RTS	P1.01
D3	SPI1 MOSI, Serial1 CTS, PWM, GPIO	Serial1 CTS	P1.02
RX / D10	Serial RX, GPIO	Serial1 RX	P0.08
TX / D09	Serial TX, GPIO	Serial1 TX	P0.06

- The UART pins are 3.3V and must not be connected directly to a RS-232C port or to a 5V TTL serial port
- Hardware flow control is optional; if not used then the RTS and CTS pins can be used as regular GPIO
- You cannot use hardware flow control and Ethernet at the same time.

SPI

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

Pin Name	Description	Interface	MCU
A5 / D14	A5 Analog in, GPIO, PWM, SPI SS	SPI (SS)	P0.31
D2	SPI1 SCK, Serial1 RTS, GPIO, PWM	SPI1 (SCK)	P1.01
D3	SPI1 MOSI, Serial1 CTS, PWM, GPIO	SPI1 (MOSI)	P1.02
D4	SPI1 MISO, PWM, GPIO	SPI1 (MISO)	P1.08
MISO / D11	SPI MISO, GPIO	SPI (MISO)	P1.14
MOSI / D12	SPI MOSI, GPIO	SPI (MOSI)	P1.13
SCK / D13	SPI SCK, GPIO	SPI (SCK)	P1.15

- 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
- You cannot use SPI1 and Ethernet at the same time.

I2C

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

Pin Name	Description	Interface	MCU
D0	I2C SDA, GPIO	Wire (SDA)	P0.26
D1	I2C SCL, GPIO	Wire (SCL)	P0.27

- The I2C port is 3.3V and must not be connected directly a 5V I2C bus
- Maximum bus speed is 400 kHz
- External pull-up resistors are recommended for I2C as the internal pull-up is 13K.
- If not using I2C, pins D0 and D1 can be used as GPIO or analog input.

PWM

The Electron 2 supports PWM (pulse-width modulation) on the following pins:

Pin Name	Description	Timer	MCU
A0 / D19	A0 Analog in, GPIO, PWM	PWM2	P0.03
A1 / D18	A1 Analog in, GPIO, PWM	PWM2	P0.04
A2 / D17	A2 Analog in, GPIO, PWM	PWM2	P0.28
A3 / D16	A3 Analog in, GPIO, PWM	PWM2	P0.29
A4 / D15	A4 Analog in, GPIO, PWM	PWM3	P0.30
A5 / D14	A5 Analog in, GPIO, PWM, SPI SS	PWM3	P0.31
D2	SPI1 SCK, Serial1 RTS, GPIO, PWM	PWM3	P1.01

D3	SPI1 MOSI, Serial1 CTS, PWM, GPIO	PWM3	P1.02
D4	SPI1 MISO, PWM, GPIO	PWM1	P1.08
D5	PWM, GPIO	PWM1	P1.10
D6	PWM, GPIO	PWM1	P1.11
D7	PWM, GPIO	PWM0	P1.12
D8 / WKP	GPIO, PWM	PWM1	P1.03

- PWM that share the same timer (`PMW2` for example) must share the same frequency but can have different duty cycles.
- Pin `D7` (PWM0) share a timer with the RGB LED and you should not change its frequency but it can have a different duty cycle.

COMPLETE MODULE PIN DETAILS

{{collapse op="start" label="Show pin details"}}

1 RST

Details	
Pin Number	1
Pin Name	RST
Description	Hardware reset. Pull low to reset; can leave unconnected in normal operation.
MCU Pin	P0.18

2 3V3

Details	
Pin Number	2
Pin Name	3V3
Description	Regulated 3.3V DC output, maximum load 1000 mA

3 MODE

Details	
Pin Number	3
Pin Name	MODE
Description	MODE button, has internal pull-up
MCU Pin	P0.11

4 GND

Details	
Pin Number	4
Pin Name	GND
Description	Ground.

5 A0

Details	
Pin Number	5
Pin Name	A0
Pin Alternate Name	D19
Description	A0 Analog in, GPIO, PWM
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogRead	Yes
Supports analogWrite (PWM)	Yes
Supports tone	A0, A1, A2, and A3 must have the same frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.03

6 A1

	Details
Pin Number	6
Pin Name	A1
Pin Alternate Name	D18
Description	A1 Analog in, GPIO, PWM
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogRead	Yes
Supports analogWrite (PWM)	Yes
Supports tone	A0, A1, A2, and A3 must have the same frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.04

7 A2

	Details
Pin Number	7
Pin Name	A2
Pin Alternate Name	D17
Description	A2 Analog in, GPIO, PWM
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogRead	Yes
Supports analogWrite (PWM)	Yes
Supports tone	A0, A1, A2, and A3 must have the same frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.28

8 A3

	Details
Pin Number	8
Pin Name	A3
Pin Alternate Name	D16
Description	A3 Analog in, GPIO, PWM
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogRead	Yes
Supports analogWrite (PWM)	Yes
Supports tone	A0, A1, A2, and A3 must have the same frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.29

9 A4

	Details
Pin Number	9
Pin Name	A4
Pin Alternate Name	D15
Description	A4 Analog in, GPIO, PWM
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogRead	Yes
Supports analogWrite (PWM)	Yes
Supports tone	A4, A5, D2, and D3 must have the same frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.30

10 A5

	Details
Pin Number	10
Pin Name	A5
Pin Alternate Name	D14
Description	A5 Analog in, GPIO, PWM, SPI SS
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogRead	Yes
Supports analogWrite (PWM)	Yes
Supports tone	A4, A5, D2, and D3 must have the same frequency.
SPI interface	SS. Use SPI object. This is only the default SS/CS pin, you can use any GPIO instead.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.31

11 SCK

	Details
Pin Number	11
Pin Name	SCK
Pin Alternate Name	D13
Description	SPI SCK, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
SPI interface	SCK. Use SPI object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.15

12 MOSI

	Details

Pin Number	12
Pin Name	MOSI
Pin Alternate Name	D12
Description	SPI MOSI, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
SPI interface	MOSI. Use SPI object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.13

13 MISO

	Details
Pin Number	13
Pin Name	MISO
Pin Alternate Name	D11
Description	SPI MISO, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
SPI interface	MISO. Use SPI object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.14

14 RX

	Details
Pin Number	14
Pin Name	RX
Pin Alternate Name	D10
Description	Serial RX, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
UART serial	RX. Use Serial1 object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.08

15 TX

	Details
Pin Number	15
Pin Name	TX
Pin Alternate Name	D09
Description	Serial TX, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes

UART serial	TX. Use Serial1 object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.06

16 D0

Details	
Pin Number	16
Pin Name	D0
Description	I2C SDA, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
I2C interface	SDA. Use Wire object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.26

17 D1

Details	
Pin Number	17
Pin Name	D1
Description	I2C SCL, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
I2C interface	SCL. Use Wire object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P0.27

18 D2

Details	
Pin Number	18
Pin Name	D2
Description	SPI1 SCK, Serial1 RTS, GPIO, PWM
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogWrite (PWM)	Yes
Supports tone	A4, A5, D2, and D3 must have the same frequency.
UART serial	RTS. Use Serial1 object.
SPI interface	SCK. Use SPI1 object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.01

19 D3

	Details
Pin Number	19
Pin Name	D3
Description	SPI1 MOSI, Serial1 CTS, PWM, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogWrite (PWM)	Yes
Supports tone	A4, A5, D2, and D3 must have the same frequency.
UART serial	CTS. Use Serial1 object.
SPI interface	MOSI. Use SPI1 object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.02

20 D4

	Details
Pin Number	20
Pin Name	D4
Description	SPI1 MISO, PWM, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogWrite (PWM)	Yes
Supports tone	D4, D5, D6, and D7 must have the same frequency.
SPI interface	MISO. Use SPI1 object.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.08

21 D5

	Details
Pin Number	21
Pin Name	D5
Description	PWM, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogWrite (PWM)	Yes
Supports tone	D4, D5, D6, and D7 must have the same frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.10

22 D6

	Details
Pin Number	22
Pin Name	D6

Description	PWM, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogWrite (PWM)	Yes
Supports tone	D4, D5, D6, and D7 must have the same frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.11

23 D7

	Details
Pin Number	23
Pin Name	D7
Description	PWM, GPIO
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogWrite (PWM)	PWM is shared with the RGB LED, you can specify a different duty cycle but should not change the frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.12

24 D8

	Details
Pin Number	24
Pin Name	D8
Pin Alternate Name	WKP
Description	GPIO, PWM
Supports digitalRead	Yes
Supports digitalWrite	Yes
Supports analogWrite (PWM)	Yes
Supports tone	D4, D5, D6, and D7 must have the same frequency.
Supports attachInterrupt	Yes. You can only have 8 active interrupt pins.
Internal pull resistance	13K
MCU Pin	P1.03

25 VUSB

	Details
Pin Number	25
Pin Name	VUSB
Description	Power out (when powered by USB) 5 VDC at 1A maximum. Power in with limitations.
Input is 5V Tolerant	Yes

26 EN

	Details

Pin Number	26
Pin Name	EN
Description	Power supply enable. Connect to GND to power down. Has internal weak (100K) pull-up.

27 LI+

Details	
Pin Number	27
Pin Name	LI+
Description	Connected to JST PH LiPo battery connector. 3.7V in or out.

{{collapse op="end"}}

System RGB LED

For a detailed explanation of different color codes of the RGB system LED, please see the status LED guide.

Charge status LED

State	Description
ON	Charging in progress
OFF	Charging complete
Blink at 1Hz	Fault condition[1]
Flickering	Battery disconnected[2]

Notes:

[1] A fault condition can occur due to several reasons, for example, battery over/under voltage, temperature fault or safety timer fault. You can find the root cause by reading the fault register of the power management IC in firmware.

[2] Once the device is in normal operating mode it will eventually detect the battery is disconnected and stop flickering. It will continue to flicker if in DFU mode (blinking yellow) as battery detection is not done when in the bootloader or DFU mode.

Technical specifications

ABSOLUTE MAXIMUM RATINGS [1]

Parameter	Symbol	Min	Typ	Max	Unit
Supply Input Voltage	V_{IN-MAX}			+6.2	V
Battery Input Voltage	V_{LiPo}			+6.5	V
Supply Output Current	$I_{3V3-MAX-L}$			1000	mA
Storage Temperature	T_{stg}	-30		+75	°C
ESD Susceptibility HBM (Human Body Mode)	V_{ESD}			1	kV

[1] Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
LiPo Battery Voltage	V_{LiPo}	+3.3		+4.4	V
Supply Input Voltage	V_{3V3}	+3.0	+3.3	+3.6	V
Supply Output Voltage	V_{3V3}		+3.3		V
Operating Temperature	T_{op}	-20		+60	°C
Humidity Range Non condensing, relative humidity				95	%

POWER CONSUMPTION

Parameter	Symbol	Min	Typ	Peak	Unit
Operating current (uC on, peripherals and radio disabled)	I_{idle}	3.41	3.97	7.69	mA
Operating current (uC on, BLE advertising)	I_{ble_adv}	3.38	4.91	7.85	mA
Operating current (uC on, BLE connected but idle)	$I_{ble\_conn\_idle}$	3.41	4.9	7.79	mA
Operating current (uC on, BLE scanning)	I_{ble_scan}		6.1	13.8	mA
Operating current (uC on, cellular on but not connected)	I_{cell_idle}	3.77	9.05	46.4	mA
Operating current (uC on, cellular connecting to tower)	$I_{cell\_conn\_twr}$		13.6	242.7	mA
Operating current (uC on, cellular connecting to cloud)	$I_{cell\_conn\_cloud}$		12.1	171	mA
Operating current (uC on, cellular connected but idle)	$I_{cell\_cloud\_idle}$		10.6	57	mA
Operating current (uC on, cellular connected and transmitting)	$I_{cell\_cloud\_tx}$		30	213	mA
STOP mode sleep, GPIO wake-up	I_{stop_gpio}		613	4.1	uA
STOP mode sleep, RTC wake-up	I_{stop_intrtc}		602	3.69	uA
ULP mode sleep, GPIO wake-up	I_{ulp_gpio}		113	3.72	uA
ULP mode sleep, RTC wake-up	I_{ulp_intrtc}		119	3.41	uA
HIBERNATE mode sleep, GPIO wake-up	I_{hib_gpio}		106	3.26	uA

[1]The min, and particularly peak, values may consist of very short transients. The typical (typ) values are the best indicator of overall power consumption over time. The peak values indicate the absolute minimum capacity of the power supply necessary, not overall consumption.

RADIO SPECIFICATIONS

Electron 2 has two radio modules, the nRF52 MCU BLE radio, and a cellular module, depending on the model.

Nordic Semiconductor nRF52840 for BLE

Feature	Description
Feature	Bluetooth LE 5
Operating Frequencies	2400 to 2480 MHz
Output Power	Programmable -20dBm to +8dBm
PLL channel spacing	1 MHz
On the air data rate	125 to 2000 kbps

Nordic Semiconductor nRF52840 for NFC tag

Feature	Description
Feature	NFC Tag-A
Frequency	13.56 MHz

I/O CHARACTERISTICS

These specifications are based on the nRF52840 datasheet.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input high voltage	V_{IH}		0.7*3.3	--	3.3	V
Input low voltage	V_{IL}		0		0.3*3.3	V
Current at GND+0.4 V, output set low, high drive	$I_{OL,HDL}$	V_{3V3} >= 2.7V	6	10	15	mA
Current at V_{3V3}-0.4 V, output set high, high drive	$I_{OH,HDH}$	V_{3V3} >= 2.7V	6	9	14	mA
Current at GND+0.4 V, output set low, standard drive	$I_{OL,SD}$	V_{3V3} >= 2.7V	1	2	4	mA
Current at V_{3V3}-0.4 V, output set high, standard drive	$I_{OH,SD}$	V_{3V3} >= 2.7V	1	2	4	mA
Pull-up resistance	R_{PU}		11	13	16	kΩ
Pull-down resistance	R_{PD}		11	13	16	kΩ

GPIO default to standard drive (2mA) but can be reconfigured to high drive (9mA) in Device OS 2.0.0 and later using the `pinSetDriveStrength()` function.

Mechanical specifications

DIMENSIONS AND WEIGHT
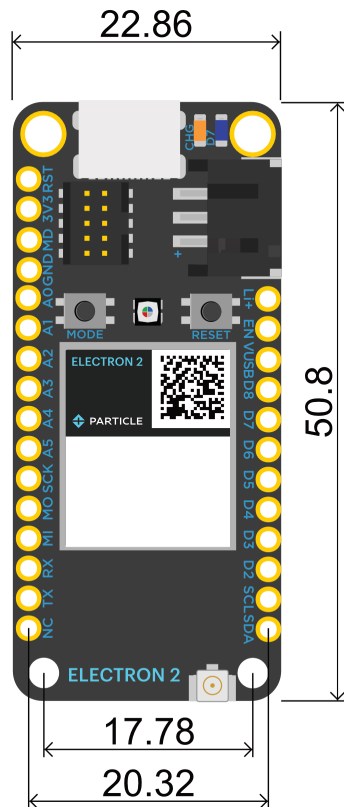
Dimension	mm	inches
Width	22.86	0.9
Length	50.80	2.0
Spacing between rows of pins	20.32	0.8
Spacing between pins	2.54	0.1
Width between holes	17.78	0.7
Length between holes	45.72	1.8

- Weight = 10 grams

3D MODELS

To be provided at a later date. The module is the same size as the Boron, however the dimensions of the shield are different.

MATING CONNECTORS

The Electron 2 uses two single row 0.1" pitch male header pins. One of them is 16 pin while the other is 12 pin. It can be mounted with matching 0.1" pitch female headers with a typical height of 0.335" (8.5mm). When you search for parts like these it can be difficult to navigate the thousands of parts available online so here are a few good choices for the Electron 2:

Description	MFG	MFG Part Number
16-pin 0.1" (2.54mm) Female Header	Sullins	PPTC161LFBN-RC
16-pin 0.1" (2.54mm) Female Header	TE	6-535541-4
12-pin 0.1" (2.54mm) Female Header	Sullins	PPTC121LFBN-RC

Land pattern

The Electron 2 can be directly soldered onto the PCB or be mounted with the above mentioned female headers.
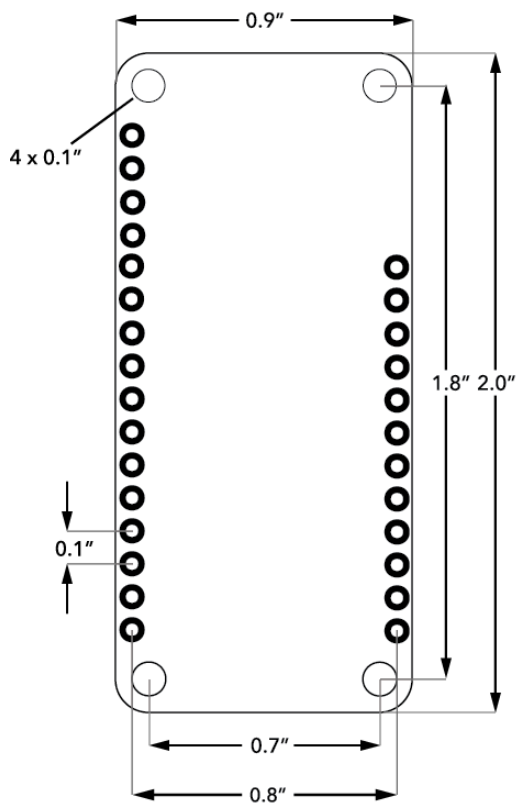
This land pattern is the same as the Boron and Argon.

Schematic

To be provided at a later date.

Assembly

WATER SOLUBLE FLUX

When attaching a Electron 2 to your base board, we recommend using a socket. As there are components on the bottom side of the Electron 2 there is no version available with castellated holes, solder pads, or similar techniques for direct surface mounting.

The pin headers on the bottom of the Electron 2 are not intended to be reflowed using paste-in-hole.

If you decide to wave solder or hand-solder the Electron 2 directly to your base board, water soluble flux should not be used. There are components within the Electron 2 module that are moisture-sensitive, and wash water can get trapped under the RF shields, causing damage.

Use no-clean flux instead if you must solder the Electron 2 module.

CONFORMAL COATINGS

Electron 2 modules should not use a conformal coating to protect the module from water. Some components on the module cannot be coated and would need to be masked off during coating. This will make the coating process difficult to implement and test.

Furthermore, the buttons cannot be protected by using a coating. Using an enclosure that protects both your base board and the Electron 2 module as a single waterproof assembly is recommended instead.

Qualification and approvals

To be provided at a later date.

Product handling

ESD PRECAUTIONS

The Electron 2 contains highly sensitive electronic circuitry and is an Electrostatic Sensitive Device (ESD). Handling Electron 2 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 Electron 2. ESD precautions should be implemented on the application board where the Electron 2 is mounted. Failure to observe these precautions can result in severe damage to the Electron 2!

BREADBOARDING

The breadboard provided with the Electron 2 is specifically designed to require low insertion force. This makes it easy to plug the Electron 2 in and out of the breadboard. If you end up using a different breadboard, remember that it may require more force. In this case, always remember to pinch-hold your precious Electron 2 by the sides (along the header pins) when plugging-unplugging and not by the USB connector (don't be this person).

Default settings

The Electron 2 comes preprogrammed 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 ISED 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: xxx

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 ISED: (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.

Certification documents

To be provided at a later date.

Country compatibility

| Country | ELC504EM (NorAm) | | | ELC524EM (Europe) | |
	Rec	Carriers		Rec	Carriers
Albania					Eagle, Telekom, Vodafone
Algeria					Mobilis, Ooredoo
Anguilla		Flow			
Antigua and Barbuda		Flow			
Argentina		Movistar, Personal			Personal
Armenia					Ucom
Aruba					Setar
Australia					Optus, Telstra, Vodafone
Austria					3 (Drei), A1, T-Mobile
Azerbaijan					Azercell, Bakcell, NAR Mobile
Bahamas		Aliv			
Bahrain					Zain
Bangladesh					Bangalink, GrameenPhone
Barbados		Flow			
Belarus					A1
Belgium					Base, Orange, Proximus
Belize		Smart			
Bolivia		Viva			
Botswana					BeMobile
Brazil				1	Claro, TIM, Vivo
Brunei					DST
Burkina Faso					Orange
Cabo Verde					CVMóvel
Canada		Bell Mobility, Rogers Wireless, Telus, Videotron			
Chad					Airtel
Chile					Claro, Entel, Movistar
Colombia		Movistar, Tigo			Tigo
Congo (Brazzaville)					Airtel
Congo (Kinshasa)					Airtel
Costa Rica					Movistar
Croatia					Hrvatski Telekom, Tele2
Cyprus					MTN, PrimeTel
Czechia					O2, T-Mobile, Vodafone
Denmark					3 (Tre), TDC, Telenor, Telia
Dominica		Flow			
Dominican Republic		Altice Dominicana, Claro			Altice Dominicana
Ecuador		Claro, Movistar			
Egypt					Etisalat, Orange
El Salvador		Telefonica			
Estonia					Elisa, Tele2, Telia
eSwatini					MTN

Country		
Ethiopia		Ethio Telecom
Finland		DNA, Elisa, Telia
France		Bouygues, Free Mobile, Orange, SFR
Gabon		Airtel
Georgia		Beeline, Geocell
Germany		O2, Telekom, Vodafone
Ghana		MTN, Vodafone
Gibraltar		Gibtel
Greece		Cosmote, Vodafone, Wind
Guadeloupe		Orange
Guatemala	Claro, Movistar	
Guinea		MTN
Guinea-Bissau		MTN
Honduras	Claro, Tigo	
Hong Kong		CMHK, CSL, SmarTone
Hungary		Magyar Telekom, Telenor, Vodafone
Iceland		Nova, Siminn, Vodafone
India [1]		Jio
Indonesia		Indosat, Telkomsel, XL Axiata
Ireland		3 (Tre), Meteor, O2, Vodafone
Israel		Hot Mobile, Orange, Pelephone
Italy		TIM, Vodafone, Wind
Jamaica	Digicel, Flow	Digicel
Jersey		Jersey Telecom
Jordan		Zain
Kazakhstan		Beeline, K-Cell
Kenya		Airtel
Kuwait		Viva, Zain
Latvia		Bite, LMT, Tele2
Liechtenstein		Mobilkom, Orange
Lithuania		Bite, Omnitel, Tele2
Luxembourg		Orange, POST, Tango
Macao		CTM
Madagascar		Airtel
Malawi		Airtel
Malaysia		Celcom, DiGi, Maxis
Malta		Go Mobile, Vodafone
Mexico	AT&T, Telcel	
Moldova		Orange
Montenegro		Mtel, T-Mobile, Telenor
Morocco		Inwi, Medi Telecom
Mozambique		Vodacom
Namibia		Telecom Namibia
Netherlands		KPN, T-Mobile, Vodafone

Country	Operator	Operator
New Zealand		2degrees, Spark, Vodafone
Nigeria		9mobile, Airtel, Glo, MTN
North Macedonia		Vip operator
Norway		TDC, Telenor, Telia
Pakistan	Telenor	Telenor, Warid
Panama		Movistar
Paraguay	Personal, Vox	
Peru	Claro, Entel, Movistar	
Philippines		Globe, Smart
Poland		Orange, Play, Plus, T-Mobile
Portugal		NOS, TMN, Vodafone
Qatar		Ooredoo, Vodafone
Romania		Orange, Telekom Romania, Vodafone
Russia		[1] Beeline, MTS, Megafon, Tele2
Saint Kitts and Nevis		Flow
Saint Vincent and the Grenadines	Flow	Flow
Serbia		Telenor, VIP
Seychelles		Airtel
Singapore		[1] SingTel, StarHub
Slovakia		O2, Orange, Telekom
Slovenia		A1, Mobitel
South Africa		Cell C, MTN, Vodacom
South Korea		KT, LG U+, SK Telecom
Spain		Orange, Telefonica, Vodafone, Yoigo
Sri Lanka		Dialog, Mobitel
Sweden		3 (Tre), Tele2, Telenor, Telia
Switzerland		Salt, Sunrise, Swisscom
Taiwan		Chunghwa, FarEasTone, T Star, Taiwan Mobile
Tajikistan		Tcell
Tanzania		Airtel
Thailand		AIS, DTAC, True Move
Trinidad and Tobago		TSTT
Tunisia		Orange Tunisie, Tunisie Telecom
Uganda		Africell, MTN
Ukraine		Kyivstar, Life, MTS
United Kingdom		3, EE, O2, Vodafone
United States	AT&T, Alaska Wireless, T-Mobile (USA), Verizon	
Uruguay	Antel, Claro, Movistar	
Uzbekistan		Beeline
Venezuela	Movistar	
Vietnam		Viettel
Virgin Islands (British)	Flow	

Virgin Islands (U.S.)	T-Mobile (USA)	
Zambia		Airtel

	Recommended and supported
	Not officially supported, but is likely to work
[1]	Permanent roaming restrictions may apply

Ordering information

SKU	Description	Region	Modem	EtherSIM	Lifecycle	Replacement
ELC504EMEA	Electron 2 LTE CAT-1 bis (NorAm), [x1]	Americas	EG800Q-NA	✓	In development	
ELC504EMTY	Electron 2 LTE CAT-1 bis (NorAm), [x50]	Americas	EG800Q-NA	✓	In development	
ELC524EMEA	Electron 2 LTE CAT-1 bis (Europe), [x1]	EMEAA	EG800Q-EU	✓	In development	
ELC524EMTY	Electron 2 LTE CAT-1 bis (Europe), [x50]	EMEAA	EG800Q-EU	✓	In development	

SKU	Description	Region	Modem	EtherSIM	Lifecycle	Replacement
ELC504EMEA	Electron 2 LTE CAT-1 bis (NorAm), [x1]	Americas	EG800Q-NA	✓	In development	
ELC504EMTY	Electron 2 LTE CAT-1 bis (NorAm), [x50]	Americas	EG800Q-NA	✓	In development	

Revision history

Revision	Date	Author	Comments
pre	2025-03-25	RK	Preliminary version
	2025-09-02	RK	Added power consumption
	2025-09-03	RK	Corrected the BLE operating frequency to 2400 to 2480 MHz

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