lopy4

Datasheet

Version 1.1

pycom

go invent

Size
55mm x 20mm x 3.5mm
(excluding headers)

Operating temperature:
–40 to 85 degrees celsius

1.0 Overview

The LoPy4 is a quadruple bearer MicroPython enabled development board (LoRa, Sigfox, WiFi, Bluetooth) – perfect enterprise grade IoT platform for your connected Things. With the latest Espressif chipset the LoPy4 offers a perfect combination of power, friendliness and flexibility. Create and connect your things everywhere. Fast.

2.0 Features

- Powerful CPU, BLE and state of the art WiFi radio.
- Simultaneous LoRa and Sigfox connectivity
- Can also double up as a Nano LoRa gateway
- MicroPython enabled
- Fits in a standard breadboard (with headers)
- Ultra–low power usage: a fraction compared to other connected micro controllers
- Available with or without pin headers soldered on

3.0 Specifications

3.1 CPU
- Xtensa® dual–core 32–bit LX6 microprocessor(s), up to 600 DMIPS
- Hardware floating point acceleration
- Python multi–threading
- An extra ULP–coprocessor that can monitor GPIOs, the ADC channels and control most of the internal peripherals during deep–sleep mode while only consuming ~25uA.

3.2 Memory
- RAM: 520KB + 4MB
- External flash: 8MB

3.3 WiFi
- 802.11b/g/n 16mbps

3.4 Bluetooth
- Low energy and classic

3.7 RTC
- Running at 150kHz

3.8 Security
- SSL/TLS support
- WPA Enterprise security

3.9 Hash / encryption
- SHA
- MD5
- DES
- AES

4.0 Block Diagram

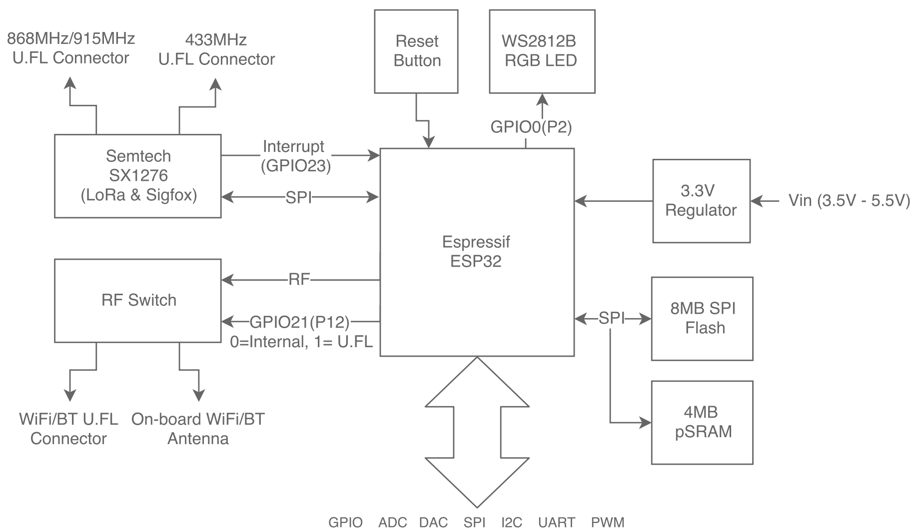

Figure 1 – System block diagram

5.0 Pinout

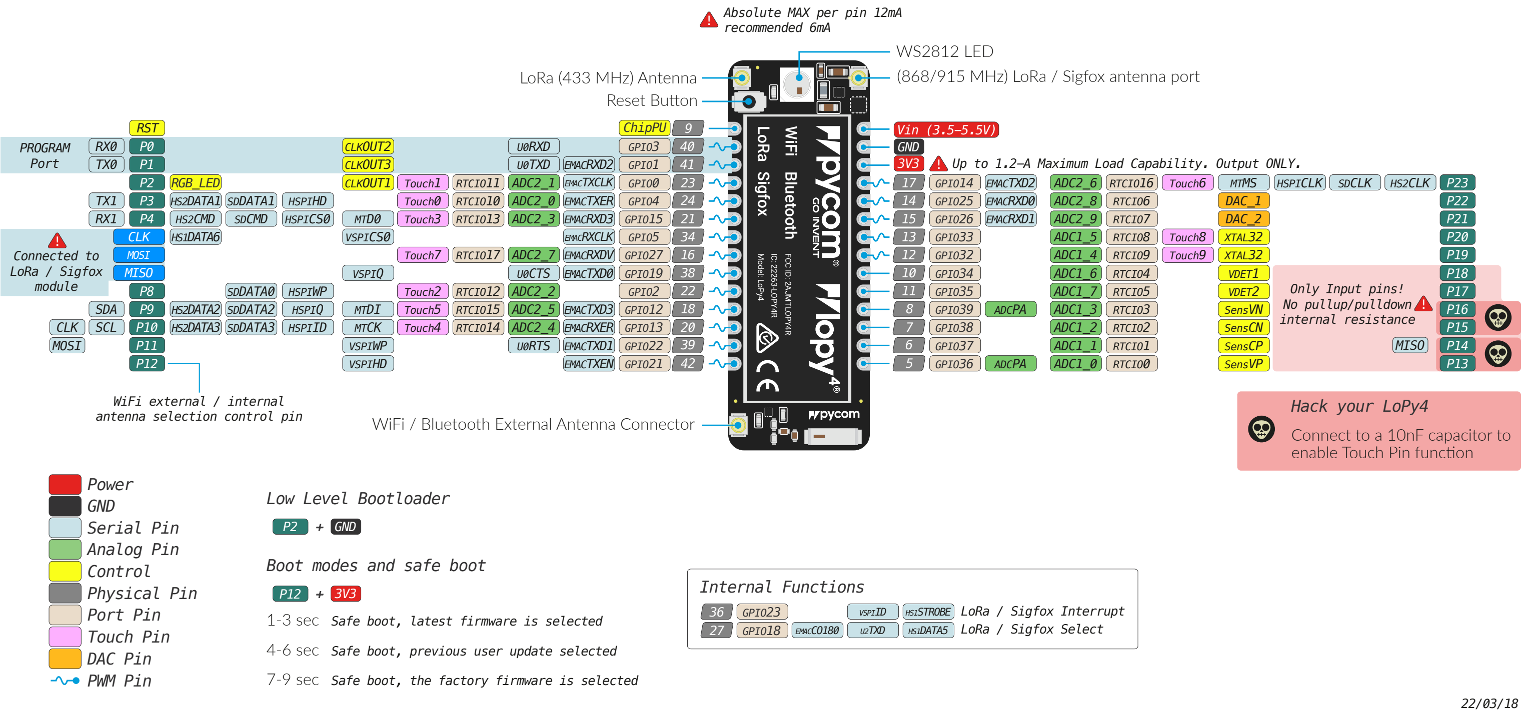

Figure 2 – Module pinout diagram

Note: The ESP32 supports remapping its peripherals to alternative pins. See below for a detailed list.

6.0 Pin Details

Table 1 – Module pinout

	ESP32 GPIO	Pin Name	Default Function	ADC	PWM	RTC†	Notes
1	–	–	Reset				Active Low, connected to on–board button
2	3	P0	RX0 (Programming)		•		Used by the bootloader and to program the module
3	1	P1	TX0 (Programming)		•		Used by the bootloader and to program the module
4	0	P2		2*	•	•	If tied to GND during boot the device will enter bootloader mode, Connected to the on–board RGB LED
5	4	P3	TX1	2*	•	•	
6	15	P4	RX1	2*	•	•	JTAG TDO, SD card CMD
7	5	–	LoRa/Sigfox radio SPI CLK		•		Not recommended for external use
8	27	–	LoRa/Sigfox radio SPI MOSI	2*	•	•	Not recommended for external use
9	19	–	LoRa/Sigfox radio SPI MISO		•		Not recommended for external use
10	2	P8		2*	•	•	SD card DAT0
11	12	P9	SDA	2*	•	•	JTAG TDI
12	13	P10	SCL (I2C) / CLK (SPI)	2*	•	•	JTAG TCK
13	22	P11	MOSI		•		
14	21	P12			•		If tied to 3.3V during boot the device enters safe boot mode, JTAG MISO
15	36	P13		1		•	Input only
16	37	P14	MISO	1		•	Input only
17	38	P15		1		•	Input only
18	39	P16		1		•	Input only

6.0 Pin Details

Table 1 – Module pinout

19	35	P17		1		•	Input only
20	34	P18		1		•	Input only
21	32	P19		1	•	•	
22	33	P20		1	•	•	
23	26	P21		2*	•	•	DAC,
24	25	P22		2*	•	•	DAC
25	14	P23		2*	•	•	JTAG TMS, SD card SCLK
26	–	–	Regulated 3.3V supply				Output only, do not feed 3.3V into this pin or you can damage the regulator
27	–	–	Ground				
28	–	–	Voltage Input				Accepts a voltage between 3.5V and 5.5V
–	18	–					LoRa reset
–	16	–					External WiFi/BT antenna switch, Low = on–board, High = U.FL
–	23	–					LoRa/Sigfox radio interrupt
–	17	–					LoRa/Sigfox radio chip select

† The pins on the RTC power domain can be used during deep sleep, specifically GPIO pins will maintain their state while in deep sleep.

* ADC2 is currently not supported in the micropython firmware

6.1 Remapping Pins

The ESP32 features comprehensive pin remapping functionality. This allows peripherals to be mapped onto almost any available GPIO pins. The above table merely shows the default assignments. For example, the default mapping has the SPI and I2C clocks overlapping, meaning both cannot be used simultaneously without remapping one to a different pin. For a detailed guide of what peripheral can be assigned to what pins please read “Appendix A – ESP32 Pin Lists” of the ESP32 datasheet.

7.0 ESP32 Peripherals

Table 2 – Peripherals

Peripheral	Count	Pins
UART	3	Remappable to any GPIO. Note: P13–18 can only be mapped to RX or CTS since they are input only.
I2C	2	Remappable to any GPIO except P13–18 since they are input only and I2C is bi–directional.
SPI	3	Remappable to any GPIO. Note: P13–18 can only be mapped to MISO since they are input only.
CAN*	1	Remappable to any GPIO. Note: P13–18 can only be mapped to RX since they are input only.
JTAG	1	TDO = P4, TDI = P9, TCK = P10, TMS = P24
PWM	1	All GPIO except P13–18 which are input only
ADC	18	Fixed mapping, see Table 1, Only ADC 1 is supported in our micropython firmware.
DAC	2	Only available on P21 and P22
SD	1	DAT0 = P8, SCLK = P23, CMD = P4

* Requires an external CAN bus transceiver, we recommend the SN65HVD230 from Texas Instruments.

For a more detailed description of the ESP32 peripherals along with peripherals not currently supported by our firmware, please check the ESP32 datasheet.

7.1 RTC

Our modules by default all use the internal RC oscillator at 150kHz for the RTC. If you require better accuracy/stability you can connect a 32.768 kHz crystal (or TCXO) externally on pins P19 and P20 (or P19 for a TXCO)

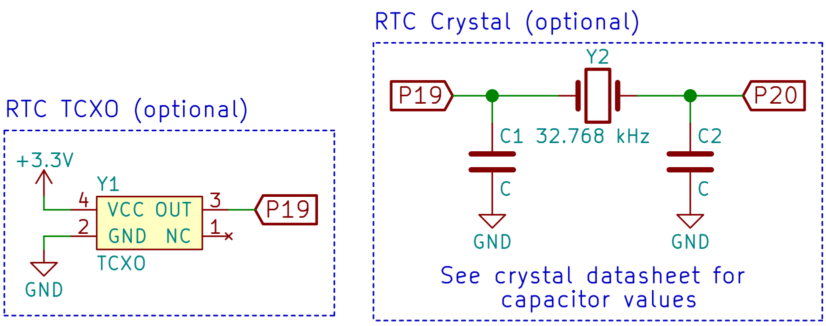

Figure 3 – External RTC crystal circuits

8.0 Programming the device

8.1 UART

By default, the modules run an interactive python REPL on UART0 which is connected to P0 (RX) and P1 (TX) running at 115200 baud. The easiest way to connect to the LoPy4 is via our expansion board, but any USB UART adapter will suffice. Code can be run via this interactive REPL or you can use our PyMakr plugin for Atom or Visual Studio Code to upload code to the board.

8.2 Wi–Fi

In older modules, the FiPy by default acts as a Wi-Fi access point.
SSID: fipy-wlan-XXXX
Password: www.pycom.io
Newer modules come pre-loaded with the Pybytes firmware that allows configuring the device OTA through an existing WiFi AP via SmartPhone app.
See https://docs.pycom.io/smart for details.
Once connected to the FiPy's Wi-Fi network you can access it in two ways.

8.2.1 Telnet

Running on port 23 is a telnet server. This acts in a very similar way to the UART. It presents you with an interactive REPL and can also be used to upload code via PyMakr.

8.2.2 FTP

The LoPy4 also runs a FTP server that allows you to copy files to and from the device, include an SD card if one is connected. To connect to this FTP server, you need to use plain FTP (un–encrypted) with the following credentials:
User: micro
Password: python

9.0 Boot modes

9.1 Bootloader mode

In order to update the firmware of the LoPy4 device, it needs to be placed into bootloader mode. In order to do this, P2 needs to be connected to ground when the device reboots. Once in bootloader mode you can use the Pycom firmware update tool to update to the latest official firmware. If you are developing your own firmware based on our open–source firmware, a flashing script is provided with the source code.

9.2 Safe boot

The micropython firmware features a safe boot feature that skips the boot.py and main.py scripts and goes straight to the REPL. This is useful if the device is programmed with code that causes the device to crash or become inaccessible. To access this mode, you need to connect P12 to 3.3V and reset the device. Upon entering safe boot mode, the on–board LED will begin to blink orange. Depending on the duration the pin is held at 3.3V, a different firmware will be run.

Table 3 – Boot modes

0–3 Seconds	3–6 Seconds
Current firmware without running boot.py or main.py	Previous firmware if the firmware was uploaded via OTA (without running boot.py and main.py)

10.0 Power

The LoPy4 features an on–board voltage regulator that takes 3.5V – 5.5V from the VIN pin and regulates it to 3.3V. It is important to only use the 3.3V as an output and not try to feed 3.3V into this pin as this could damage the regulator.

10.1 Current consumption by power modes/features measured at 5V

Table 4 – Power consumption by feature

Mode	Min	Avg.	Max	Units
Idle (no radios)	-	30	-	mA
LoRa Transmit†	-	105	-	mA
Sigfox Transmit*	-	60	-	mA
WiFi AP	-	93	-	mA
WiFi client	-	107	-	mA
Bluetooth	-	94	-	mA
Deep sleep	-	19.5	-	mA

† More details can be found in section 14.2

* More details can be found in section 15.2

11.0 Memory Map

11.1 Flash

Table 5 – Flash memory map

Name	Description	Start address	Size
NVS	Non–volatile RAM area. Used by the NVS API	0x9000	0x7000
Firmware Slot 0	First firmware slot. Factory firmware is flashed here	0x10000	0x1EF000
OTA info	Information about the current active firmware	0x1FF000	0x1000
Firmware Slot 1	Second firmware slot	0x210000	0x1EF000
Config	Config area for LoRa, Sigfox and LTE	0x3FF000	0x1000
File system	4MB file system	0x400000	0x400000

11.2 RAM

Table 6 – RAM memory map

Name	Description	Size
On–chip SRAM	Internal RAM memory used by the 2 xtensa CPUs	520KB
Fast RTC RAM	Fast RAM area accessible by the xtensa cores during boot and sleep modes	8KB
Slow RTC RAM	Slow RAM area accessible by the Ultra–Low Power Coprocessor during deep sleep	8KB
External pSRAM	External QSPI RAM memory clocked @ 40MHz	4MB

11.3 ROM and eFuses

Table 7 – Miscellaneous memory

Name	Description	Size
On–chip ROM	Contains core functions and boot code.	448KB
eFuse	256 bits are used for the system (MAC address and chip configuration) and the remaining 768 bits are reserved for customer applications, including Flash–Encryption and Chip–ID	1kbit

12.0 WiFi

12.1 Supported features

- 802.11 b/g/n/e/i
- 802.11 n (2.4 GHz), up to 150 Mbps
- 802.11 e: QoS for wireless multimedia technology
- WMM–PS, UAPSD
- A–MPDU and A–MSDU aggregation
- Block ACK
- Fragmentation and defragmentation
- Automatic Beacon monitoring/scanning
- 802.11 i security features: pre–authentication and TSN
- Wi–Fi Protected Access (WPA)/WPA2/WPA2–Enterprise/Wi–Fi Protected Setup (WPS)
- Infrastructure BSS Station mode/SoftAP mode
- Wi–Fi Direct (P2P), P2P Discovery, P2P Group Owner mode and P2P Power Management

12.2 Specifications

Table 8 – WiFi specifications

Description	Min	Typ.	Max	Unit
Input Frequency	2412	–	2484	MHz
Tx power Output power of PA for 72.2 Mbps	13	14	15	dBm
Output power of PA for 11b mode	19.5	20	20.5	dBm
		Sensitivity		
DSSS, 1Mbps	–	–	98	dBm
CCK, 11 Mbps	–	–	91	dBm
OFDM, 6 Mbps	–	–	93	dBm
OFDM, 54 Mbps	–	–	75	dBm
HT20, MCS0	–	–	93	dBm
HT20, MCS7	–	–	73	dBm
HT40, MCS0	–	–	90	dBm
HT40, MCS7	–	–	70	dBm
MCS32	–	–	89	dBm
		Adjacent channel rejection		
OFDM, 6 Mbps	–	37	–	dB
OFDM, 54 Mbps	–	21	–	dB
HT20, MCS0	–	37	–	dB
HT20, MCS7	–	20	–	dB

13.0 Bluetooth

13.1 Supported features

- Compliant with Bluetooth v4.2 BR/EDR and BLE specification
- Class–1, class–2 and class–3 transmitter without external power amplifier
- Enhanced power control
- +12 dBm transmitting power
- NZIF receiver with –97 dBm sensitivity
- Adaptive Frequency Hopping (AFH)
- Standard HCI based on SDIO/SPI/UART
- High–speed UART HCI, up to 4 Mbps
- BT 4.2 controller and host stack
- Service Discover Protocol (SDP)
- General Access Profile (GAP)
- Security Manage Protocol (SMP)
- ATT/GATT
- HID
- All GATT–based profile supported
- SPP–like GATT–based profile
- BLE Beacon
- A2DP/AVRCP/SPP, HSP/HFP, RFCOMM
- CVSD and SBC for audio codec
- Bluetooth Piconet and Scatternet

13.2 Specification

13.2.1 Receiver – Basic Data Rate

Table 9 – Receiver (basic data rate) specifications

Parameter		Min	Typ.	Max	Unit
Sensitivity @0.1% BER		–	–94	–	dBm
Maximum received signal @0.1% BER		0	–	–	dBm
Co–channel C/I		–	+7	–	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	–	–	–6	dB
	F = F0 – 1 MHz	–	–	–6	dB
	F = F0 + 2 MHz	–	–	–25	dB
	F = F0 – 2 MHz	–	–	–33	dB
	F = F0 + 3 MHz	–	–	–25	dB
	F = F0 – 3 MHz	–	–	–45	dB
Out–of–band blocking performance	30Mhz ~ 2000MHz	–10	–	–	dBm
	2000MHz ~ 2400MHz	–27	–	–	dBm
	2500MHz ~ 3000MHz	–27	–	–	dBm
	3000MHz ~ 12.5GHz	–10	–	–	dBm
Intermodulation		–36	–	–	dBm

13.2.2 Receiver – Enhanced Data Rate

Table 10 – Receiver (basic data rate) specifications

Parameter		Min	Typ.	Max	Unit
		π/4 DQPSK			
Sensitivity @0.1% BER		–	–90	–	dBm
Maximum received signal @0.1% BER		–	0	–	dBm
Co–channel C/I		–	11	–	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	–	–7	–	dB
	F = F0 – 1 MHz	–	–7	–	dB
	F = F0 + 2 MHz	–	–25	–	dB
	F = F0 – 2 MHz	–	–35	–	dB
	F = F0 + 3 MHz	–	–25	–	dB
	F = F0 – 3 MHz	–	–45	–	dB
		8DPSK			
Sensitivity @0.1% BER		–	–84	–	dBm
Maximum received signal @0.1% BER		–	–5	–	dBm
C/I c–channel		–	18	–	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	–	2	–	dB
	F = F0 – 1 MHz	–	2	–	dB
	F = F0 + 2 MHz	–	–25	–	dB
	F = F0 – 2 MHz	–	–25	–	dB
	F = F0 + 3 MHz	–	–25	–	dB
	F = F0 – 3 MHz	–	–38	–	dB

13.2.3 Receiver – Bluetooth LE

Table 11 – Receiver (BLE) specifications

Parameter		Min	Typ.	Max	Unit
Sensitivity @30.8% PER		–	–97	–	dBm
Maximum received signal @30.8% PER		0	–	–	dBm
Co–channel C/I		–	+10	–	dB
Adjacent channel selectivity C/I	F = F0 + 1MHz	–	–5	–	dB
	F = F0 – 1MHz	–	–5	–	dB
	F = F0 + 2MHz	–	–25	–	dB
	F = F0 – 2MHz	–	–35	–	dB
	F = F0 + 3MHz	–	–35	–	dB
	F = F0 – 3MHz	–	–45	–	dB
Out–of–band blocking performance	30MHz ~ 2000MHz	–10	–	–	dB
	2000MHz ~ 2400MHz	–27	–	–	dBm
	2500MHz ~ 3000MHz	–27	–	–	dBm
	3000MHz ~ 12.5GHZ	–10	–	–	dBm
Intermodulation		–36	–	–	dBm

13.2.4 Transmitter – Basic Data Rate

Table 12 – Transmitter (basic data rate) specifications

Parameter		Min	Typ.	Max	Unit
RF transmit power		–	0	–	dBm
Gain control step		–	±3	–	dBm
RF power control range		–12	–	+12	dBm
+20 dB bandwidth		–	0.9	–	MHz
Adjacent channel transmit power	F = F0 + 1 MHz	–	–24	–	dBm
	F = F0 – 1 MHz	–	–16.1	–	dBm
	F = F0 + 2 MHz	–	–40.8	–	dBm
	F = F0 – 2 MHz	–	–35.6	–	dBm
	F = F0 + 3 MHz	–	–45.7	–	dBm
	F = F0 – 3 MHz	–	–40.2	–	dBm
	F = F0 + >3 MHz	–	45.6	–	dBm
	F = F0 – >3 MHz	–	44.6	–	dBm
$\Delta f1_{avg}$		–	–	155	KHz
$\Delta f2_{max}$		133.7			KHz
$\Delta f2_{avg}/\Delta f1_{avg}$		–	0.92	–	–
ICFT		–	–7	–	KHz
Drift rate		–	0.7	–	KHz/50µs
Drift (1 slot packet)		–	6	–	KHz
Drift (5 slot packet)		–	6	–	KHz

13.2.5 Transmitter – Enhanced Data Rate

Table 13 – Transmitter (enhanced data rate) specifications

Parameter		Min	Typ.	Max	Unit
RF transmit power		–	0	–	dBm
Gain control step		–	±3	–	dBm
RF power control range		–12	–	+12	dBm
π/4 DQPSK max w0		–	–0.72	–	KHz
π/4 DQPSK max wi		–	–6	–	KHz
π/4 DQPSK max |wi + w0|		–	–7.42	–	KHz
8DPSK max w0		–	0.7	–	KHz
8DPSK max wi		–	–9.6	–	KHz
8DPSK max |wi + w0|			–10		KHz
π/4 DQPSK modulation accuracy	RMS DEVM	–	4.28	–	%
	99% DEVM	–	–	30	%
	Peak DEVM	–	13.3	–	%
8 DPSK modulation accuracy	RMS DEVM	–	5.8	–	%
	99% DEVM	–		20	%
	Peak DEVM	–	14	–	%
In–band spurious emissions	F = F0 + 1MHz	–	–34	–	dBm
	F = F0 – 1MHz	–	–40.2	–	dBm
	F = F0 + 2MHz	–	–34	–	dBm
	F = F0 – 2MHz	–	–36	–	dBm
	F = F0 + 3MHz	–	–38	–	dBm
	F = F0 – 3MHz	–	–40.3	–	dBm
	F = F0 ± >3MHz	–	–	–41.5	dBm
EDR differential phase coding		–	100	–	%

13.2.6 Transmitter – Bluetooth LE

Table 14 – Transmitter (BLE) specifications

Parameter		Min	Typ.	Max	Unit
RF transmit power		–	0	–	dBm
Gain control step		–	±3	–	dBm
RF power control range		–12	–	+12	dBm
Adjacent channel transmit power	F = F0 + 1MHz	–	–14.6	–	dBm
	F = F0 – 1MHz	–	–12.7	–	dBm
	F = F0 + 2MHz	–	–44.3	–	dBm
	F = F0 – 2MHz	–	–38.7	–	dBm
	F = F0 + 3MHz	–	–49.2	–	dBm
	F = F0 – 3MHz	–	–44.7	–	dBm
	F = F0 + >3MHz	–	–50	–	dBm
	F = F0 – >3MHz	–	–50	–	dBm
$\Delta f1_{avg}$		–	–	265	KHz
$\Delta f2_{max}$		247	–	–	KHz
$\Delta f2_{avg}/\Delta f1_{avg}$		–	–0.92	–	–
ICFT		–	–10	–	KHz
Drift rate		–	0.7	–	KHz/50μs
Drift		–	2	–	KHz

14.0 LoRa

14.1 Supported features

Table 15 – Supported LoRa features

Part Number	Frequency Range	LoRa Parameters			
		Spreading factor	Bandwidth	Effective Bitrate	Sensitivity
Semtech SX1276	137–1020MHz	6 – 12	7.8 – 500 kHz	0.018 – 37.5 kpbs	–111 to –148 dBm

The current micropython firmware supports LoRaWAN 1.0 acting as either a Class A or Class C node.

14.2 Specifications

Table 16 – LoRa electrical characteristics

Symbol	Description	Conditions	Min	Typ.	Max	Unit
IDDR_L	Supply current in receiver LoRa mode, LNABoost Off	Bands 2&3 BW=7.8–62.5kHz	–	11.0	–	mA
		Bands 2&3 BW = 125kHz	–	11.5	–	mA
		Bands 2&3 BW=250KHz	–	12.4	–	mA
		Bands 2&3 BW=500KHz	–	13.8	–	mA
		Bands 1 BW=7.8–62.5kHz		9.9		mA
		Bands 1 BW=125KHz	–	10.3	–	mA
		Bands 1 BW=250KHz	–	11.1	–	mA
		Bands 1 BW=500KHz	–	12.6	–	mA
IDDT_L	Supply current in transmitter mode	RFOP = 13dBm	–	28	–	mA
		RFOP = 7dBm	–	20	–	mA
IDDT_H_L	Supply current in transmitter mode with an external impedance transformer	Using PA_BOOST pin RFOP = 17 dBm	–	90	–	mA
BI_L	Blocking Immunity, FRF=868MHz CW interferer	Offset = ±1 MHz	–	89	–	dB
		Offset = ±2 MHz	–	94	–	dB
		Offset = ±10 MHz	–	100	–	dB
IIP2_L	2nd order Input Intercept Point Unwanted tones are 20 MHz above the LO	Highest LNA gain	–	+50	–	dBm
IIP3_L_HF	3rd order Input Intercept point Unwanted tones are 1MHz and 1.995 MHz above the LO	Band 1 Highest LNA gain G1	–	–11	–	dBm
		LNA gain G2, 5dB sensitivity hit	–	–6	–	dBm
IIP3_L_LF	3rd order Input Intercept point Unwanted tones are 1MHz and 1.995 MHz above the LO	Band 2 Highest LNA gain G1	–	–22	–	dBm
		LNA gain G2, 2.5dB sensitivity hit	–	–15	–	dBm

14.2 Specifications

Table 16 – LoRa electrical characteristics

Symbol	Description	Conditions	Min	Typ.	Max	Unit
RFS_L10_ HF	RF sensitivity, Long–Range Mode, highest LNA gain, LNA Boost for Band 1, using split RX/TX pat, 10.4 kHz bandwidth	SF = 6	–	–131	–	dBm
		SF=7	–	–134	–	dBm
		SF = 8	–	–138	–	dBm
		SF = 11	–	–146	–	dBm
RFS_L62_ HF	RF sensitivity, Long–Range Mode, highest LNA gain, LNA Boost for Band 1, using split RX/TX pat, 62.5 kHz bandwidth	SF = 6	–	–121	–	dBm
		SF = 7	–	–126	–	dBm
		SF = 8	–	–129	–	dBm
		SF = 9	–	–132	–	dBm
		SF = 10	–	–135	–	dBm
		SF = 11	–	–137	–	dBm
		SF = 12	–	–139	–	dBm
RFS_L125_ HF	RF sensitivity, Long–Range Mode, highest LNA gain, LNA Boost for Band 1, using split RX/TX pat, 125 kHz bandwidth	SF = 6	–	–118	–	dBm
		SF = 7	–	–123	–	dBm
		SF = 8	–	–126	–	dBm
		SF = 9	–	–129	–	dBm
		SF = 10	–	–132	–	dBm
		SF = 11	–	–133	–	dBm
		SF = 12	–	–136	–	dBm

14.2 Specifications

Table 16 – LoRa electrical characteristics

Symbol	Description	Conditions	Min	Typ.	Max	Unit
RFS_L250_HF	RF sensitivity, Long–Range Mode, highest LNA gain, LNA Boost for Band 1, using split RX/TX pat, 250 kHz bandwidth	SF = 6	–	–115	–	dBm
		SF = 7	–	–120	–	dBm
		SF = 8	–	–123	–	dBm
		SF = 9	–	–125	–	dBm
		SF = 10	–	–128	–	dBm
		SF = 11	–	–130	–	dBm
		SF = 12	–	–133	–	dBm
RFS_L500_HF	RF sensitivity, Long–Range Mode, highest LNA gain, LNA Boost for Band 1, using split RX/TX pat, 500 kHz bandwidth	SF = 6	–	–111	–	dBm
		SF = 7	–	–116	–	dBm
		SF = 8	–	–119	–	dBm
		SF = 9	–	–122	–	dBm
		SF = 10	–	–125	–	dBm
		SF = 11	–	–128	–	dBm
		SF = 12	–	–130	–	dBm
RFS_L7.8_LF	RF sensitivity, Long–Range Mode, highest LNA gain, Band 2 or 3, using split RX/TX path 7.8 kHz bandwidth	SF = 11	–	–145	–	dBm
		SF = 12	–	–148	–	dBm
RFS_L10_LF	RF sensitivity, Long–Range Mode, highest LNA gain, Band 2 or 3, using split RX/TX path 10.4 kHz bandwidth	SF = 6	–	–132	–	dBm
		SF = 7	–	–136	–	dBm
		SF = 8	–	–138	–	dBm

14.2 Specifications

Table 16 – LoRa electrical characteristics

Symbol	Description	Conditions	Min	Typ.	Max	Unit
RFS_L62_LF	RF sensitivity, Long–Range Mode, highest LNA gain, Band 2 or 3, using split RX/TX path 62.5 kHz bandwidth	SF = 6	–	–123	–	dBm
		SF = 7	–	–128	–	dBm
		SF = 8	–	–131	–	dBm
		SF = 9	–	–134	–	dBm
		SF = 10	–	–135	–	dBm
		SF = 11	–	–137	–	dBm
		SF = 12	–	–140	–	dBm
RFS_L125_LF	RF sensitivity, Long–Range Mode, highest LNA gain, Band 2 or 3, using split RX/TX path 125 kHz bandwidth	SF = 6	–	–121	–	dBm
		SF = 7	–	–125	–	dBm
		SF = 8	–	–128	–	dBm
		SF = 9	–	–131	–	dBm
		SF = 10	–	–134	–	dBm
		SF = 11	–	–136	–	dBm
		SF = 12	–	–137	–	dBm
RFS_L250_LF	RF sensitivity, Long–Range Mode, highest LNA gain, Band 2 or 3, using split RX/TX path 250 kHz bandwidth	SF = 6	–	–118	–	dBm
		SF = 7	–	–122	–	dBm
		SF = 8	–	–125	–	dBm
		SF = 9	–	–128	–	dBm
		SF = 10	–	–131	–	dBm
		SF = 11	–	–133	–	dBm
		SF = 12	–	–134	–	dBm

14.2 Specifications

Table 16 – LoRa electrical characteristics

Symbol	Description	Conditions	Min	Typ.	Max	Unit
RFS_L500_LF	RF sensitivity, Long–Range Mode, highest LNA gain, Band 2 or 3, using split RX/TX path 500 kHz bandwidth	SF = 6	–	–112	–	dBm
		SF = 7	–	–118	–	dBm
		SF = 8	–	–121	–	dBm
		SF = 9	–	–124	–	dBm
		SF = 10	–	–127	–	dBm
		SF = 11	–	–129	–	dBm
		SF = 12	–	–130	–	dBm
CCR_LCW	Co–channel rejection Single CW tone = Sens +6 dB 1% PER	SF = 7	–	5	–	dB
		SF = 8	–	9.5	–	dB
		SF = 9	–	12	–	dB
		SF = 10	–	14.4	–	dB
		SF = 11	–	17	–	dB
		SF = 12	–	19.5	–	dB
CCR_LL	Co–channel rejection	Interferer is a LoRa signal using the same BW and SF. Pw = sensitivity + 3dB	–	–6	–	dB
ACR_LCW	Adjacent channel rejection FRF = 868 MHz	Interferer is 1.5*BW_L from the wanted signal centre frequency 1% PER, Single CW tone = Sensitivity + 3dB				
		SF = 7	–	60	–	dB
		SF = 12	–	72	–	dB
IMR_LCW	Image rejection after calibration	1% PER, Single CW tone = sensitivity + 3dB	–	66	–	dB

14.2 Specifications

Table 17 – LoRa power consumption

Symbol	Description	Conditions	Min	Typ.	Max	Unit
FERR_L	Maximum tolerated frequency offset between transmitter and receiver, no sensitivity degradation, SF6 thru 12	All BW, +/–25% of BW The tighter limit applies (see below)	–	±25%	–	BW
	Maximum tolerated frequency offset between transmitter and receiver, no sensitivity degradation, SF10 thru 12	SF = 12	–50	–	50	ppm
		SF = 11	–100	–	100	ppm
		SF = 10	–200	–	200	ppm
IDDSL	Supply current in sleep mode		–	0.2	1	µA
IDDIDLE	Supply current in idle mode	RC oscillator enabled	–	1.5	–	µA
IDDST	Supply current in standby mode	Crystal oscillator enabled	–	1.6	1.8	mA
IDDFS	Supply current in synthesizer mode	FSRx	–	5.8	–	mA
IDDR	Supply current in receive mode	LnaBoost Off, Band 1	–	10.8	–	mA
		LnaBoost On, Band 1	–	11.5	–	mA
		Bands 2&3	–	12.0	–	mA
IDDT	Supply current in transmit mode with impedance matching	RFOP=+ 20 dBm on PA_BOOST	–	125	–	mA
		RFOP=+ 17 dBm on PA_BOOST	–	90	–	mA
		RFOP=+ 13 dBm on RFO pin on RFO_LF/HF pin	–	28	–	mA
		RFOP=+ 7 dBm on RFO pin on RFO_LF/HF pin	–	18	–	mA

15.0 Sigfox

15.1 Frequencies

Table 18 – Supported Sigfox regions

Region	Uplink Frequency (Hz)	Downlink Frequency (Hz)
RCZ1 (Europe)	868130000	869525000
RCZ2 (US)	902200000	905200000
RCZ4 (South America, Australia and New Zealand).	920800000	922300000

Table 19 – Regions with pending Sigfox certification

Region	Uplink Frequency (Hz)	Downlink Frequency (Hz)
RCZ3 (Korea and Japan)	923200000	922200000

15.2 Specifications

Table 19 – Sigfox modem performance

Parameter		Min	Typ.	Max	Unit
Data Rate	RCZ1	–	100	–	bps
	RCZ2	–	600	–	bps
	RCZ3	–	100	–	bps
	RCZ4	–	600	–	bps
TX Power	RCZ1	–	+14	–	dBm
	RCZ2	–	+20	–	dBm
	RCZ3	–	+14	–	dBm
	RCZ4	–	+20	–	dBm
RX Sensitivity		–	–126	–	dBm

Table 19 – Sigfox modem performance

Parameter		Min	Typ.	Max	Unit
Current Draw	RCZ1 TX	–	42	–	mA
	RCZ1 RX	–	11.2	–	mA
	RCZ2 TX	–	125	–	mA
	RCZ2 RX	–	11.2	–	mA
	RCZ3 TX	–	42	–	mA
	RCZ3 RX	–	11.2	–	mA
	RCZ4 TX	–	125	–	mA
	RCZ4 RX	–	11.2	–	mA

16.0 6LoWPAN

Pycom has added 6LoWPAN support to this module and plan to release a new firmware with this functionality in Q2 2018. Please see: https://docs.pycom.io/pymesh for more details.

17.0 Electrical Characteristics

17.1 Absolute maximum ratings

Table 20 – Absolute maximum ratings

Parameter	Symbol	Min	Typ.	Max	Unit
Input low voltage	V_{IL}	–0.3	–	$0.25 \times V_{3V3}$	V
Input high voltage	V_{IH}	$0.75 \times V_{3V3}$	–	$V_{3V3}+0.3$	V
Max Input sink current	I_{SINK}	–	6	12	mA
Input leakage current	I_{IL}	–	–	50	nA
Input pin capacitance	C_{pin}	–	–	2	pF
Output low voltage	V_{OL}	$0.1 \times V_{3V3}$	–	–	V
Output high voltage	V_{OH}	$0.8 \times V_{3V3}$	–	–	V
Max Output source current	I_{SOURCE}	–	6	12	mA

18.0 Minimum Recommended Circuit

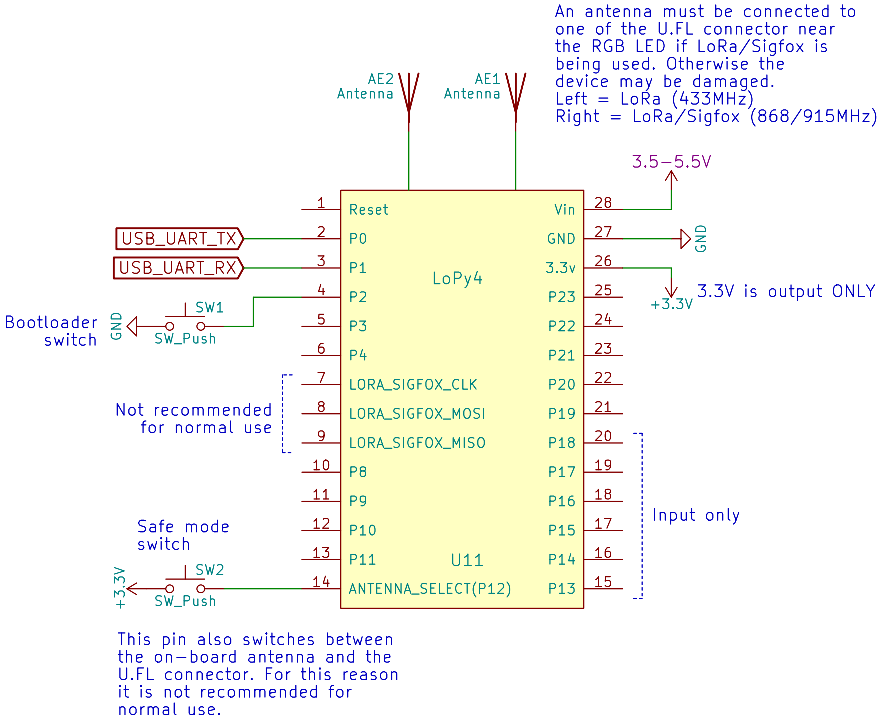

Figure 4 – Minimum required circuit

19.0 Mechanical Specifications

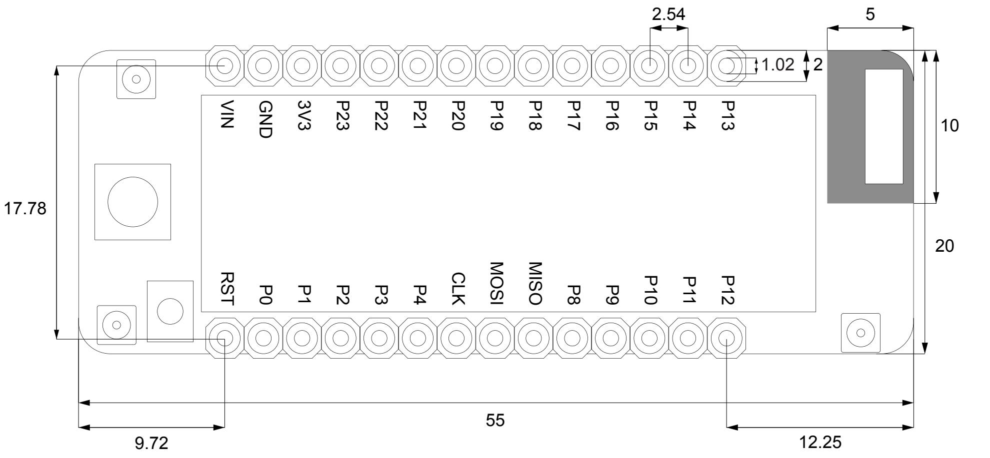

Figure 5 – Mechanical drawing (top down view) – Units: mm

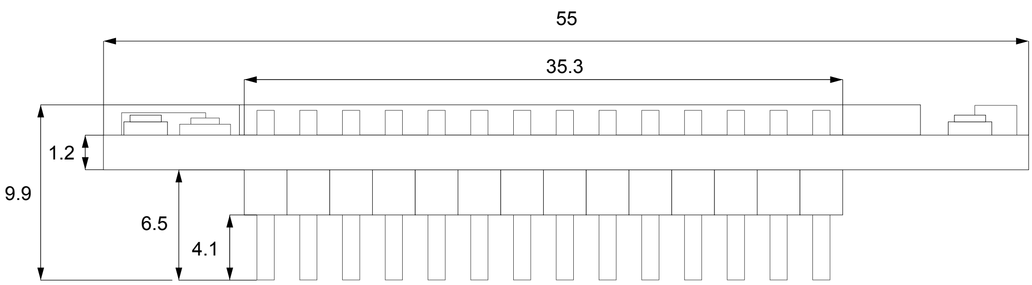

Figure 6 – Mechanical drawing (side view) – Units: mm

20.0 Recommended Land Patterns

20.1 Through hole

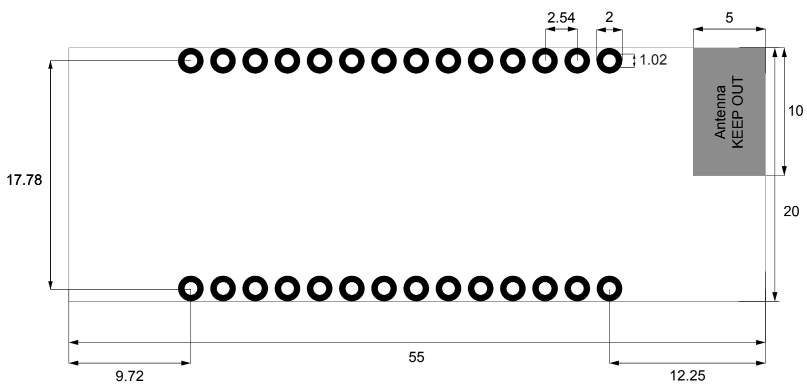

Figure 7 – Recommended land pattern (through hole) – Units: mm

20.2 Surface mount (LoPy without headers only)

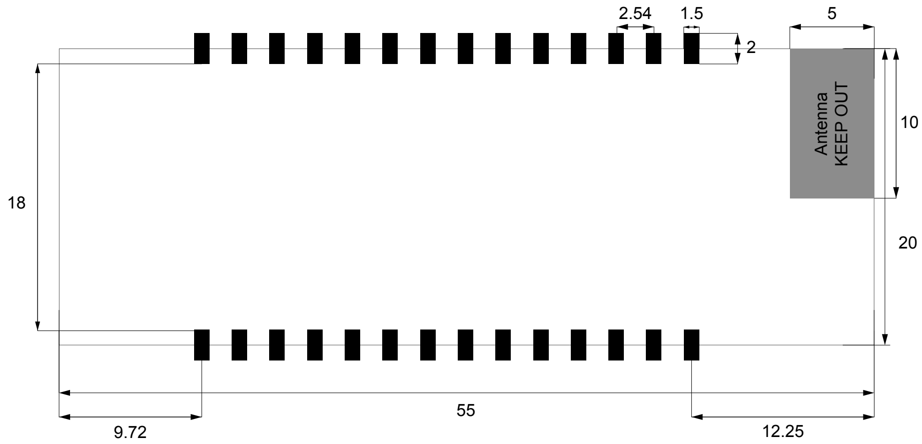

Figure 8 – Recommended land pattern (surface mount) – Units: mm

21.0 Soldering Profile

21.1 With headers

This device is not recommended for reflow soldering.
The plastic of the pin headers will melt, instead please hand solder the module or use sockets.

21.2 Without headers

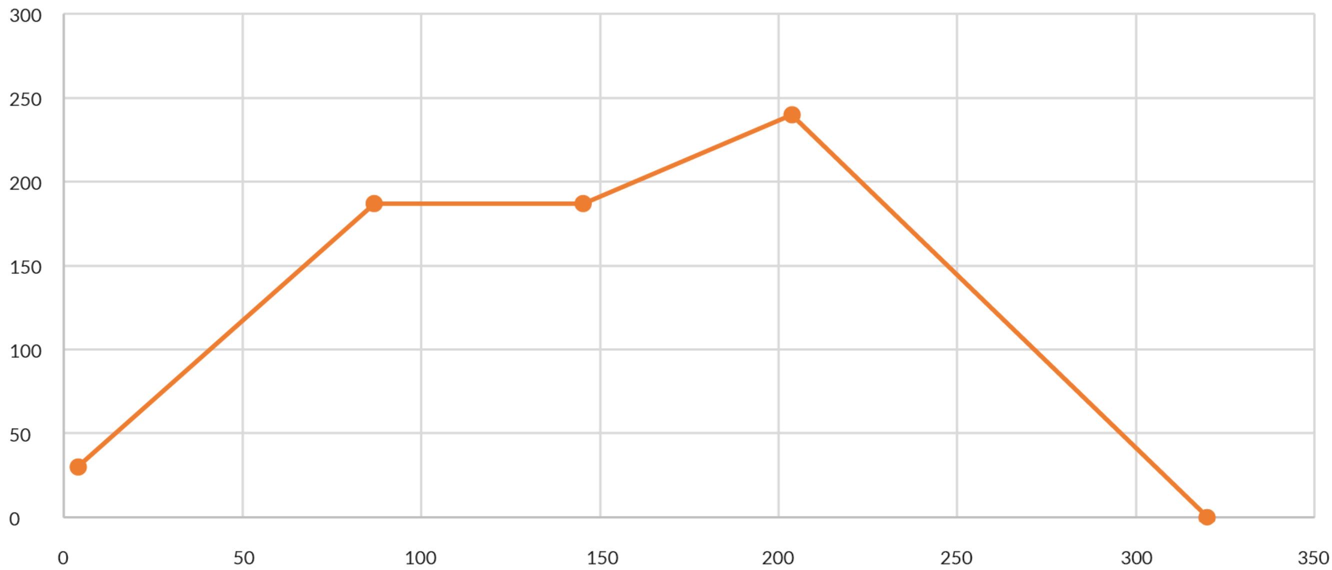

Figure 9 – Reflow soldering temperature profile (surface mount)

Table 22 – Soldering profile temperatures

Stage	Duration/Rate	Temperature
Ramp to soak	2°C/s	Ambient – 185°C
Soak	60s	185°C
Ramp to peak	1°C/s	240°C
Reflow	45s	>225°C
Cool down	2°C/s	

The above profile is based on Alpha CVP–390 solder paste, which has been successfully tested with our devices.

22.0 Ordering Information

Table 23 – Ordering information

Product EAN	Description
0700461908890	LoPy4 1.0 with Headers
0700461908616	LoPy4 1.0 without headers
0700461341703	868/915MHz LoRa/ Sigfox Antenna
0700461341680	External WiFi Antenna
0700461341697	IP67 Antenna Pigtail

Bundle	Contents
LoPy4 Multi–Pack	1x LoPy4 1x Expansion Board or Pysense or Pytrack 1x 868/915MHZ LoRa/Sigfox antenna Available in quantities of 1, 2 or 5

For more product accessories like expansion board or cases visit our website: http://www.pycom.io

23.0 Packaging

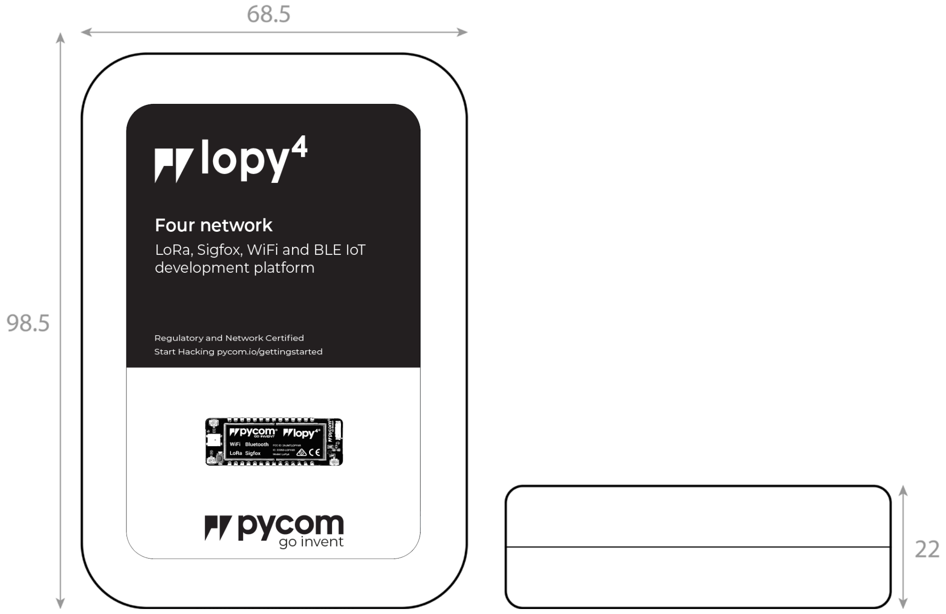

Figure 10 – Mechanical drawing of packaging – Units: mm

The module will come inside a reusable anti–static bag. If the module has headers it will also be inserted into anti–static foam.

Total weight inc. packaging (with headers): 31g

Total weight inc. packaging (without headers): 29g

24.0 Certification

FCC 2AJMTLOPY4R
IC 22263–LOPY4R
CE 0700
Copies of the certificates can be found on our website.

Regulator Information

24.1 EU Regulatory Conformance

Hereby, Pycom Ltd declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC

24.2 Federal Communication Commission Interference Statement

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.
2. This device must accept any interference received, including interference that may cause undesired operation.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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.

24.2.1 RF Warning Statement

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co–located or operating in conjunction with any other antenna or transmitter.

24.2.2 OEM integrator conditions

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 the two 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. To ensure compliance with all non–transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that the
after the module is installed and operational the host continues to be compliant with the Part 15B

unintentional radiator requirements.

The module is limited to OEM installation ONLY. The module is limited to installation in mobile or fixed application. We hereby acknowledge our responsibility to provide guidance to the host manufacturer in the event that they require assistance for ensuring compliance with the Part 15 Subpart B requirements.

IMPORTANT NOTE: 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.

24.2.3 End Product Labelling

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. The final end product must be labelled in a visible area with the following: “Contains FCC ID: 2AJMTLOPY4R”. The grantee’s FCC ID can be used only when all FCC compliance requirements are met.

The following FCC part 15.19 statement has to also be available on the label:

This device complies with Part 15 of 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.

24.2.4 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.

In the user manual of the end product, the end user has to beinformed that the equipment complies with FCC radio–frequency exposure guidelines set forth for an uncontrolled environment.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user’s authority to operate this equipment.

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

The maximum operating ambient temperature of the equipment declared by the manufacturer is –40~+85C

Receiver category 3

25.0 Revision History

Table 24 – Document revision history

Version 1.0	Initial Release
Version 1.1	Update March 2020