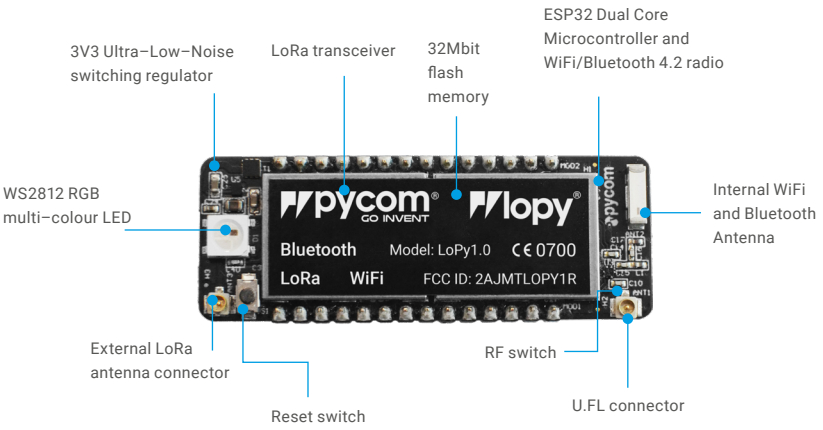
Datasheet

Version 1.0

pycom
GO INVENT



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

Operating temperature:
–40 to 85 degrees celsius

1.0 Overview

With LoRa, Wifi and BLE, the LoPy is the only triple bearer MicroPython enabled micro controller on the market today – the perfect enterprise grade IoT platform for your connected Things. With the latest Espressif chipset the LoPy 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. 1KM Wifi Range
- 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: 512KB
- External flash: 4MB

3.3 WiFi
- 802.11b/g/n 16mbps

3.4 Bluetooth
- Low energy and classic

3.5 LoRa
- LoRaWAN 1.0.2 stack - Class A and C devices
- Node range: Up to 40km
- Nano-gateway: Up to 22km (Capacity up to 100 nodes)

3.6 RTC
- Running at 150kHz

3.7 Security
- SSL/TLS support
- WPA Enterprise security

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

4.0 Block Diagram

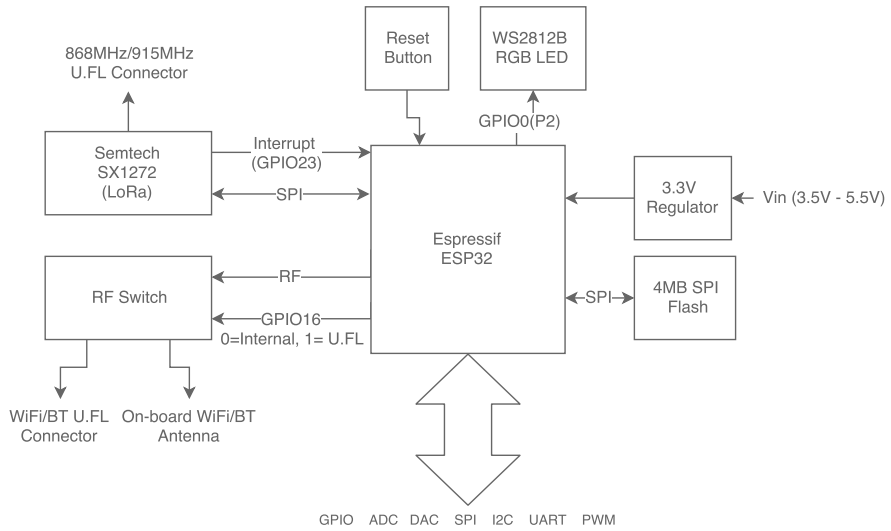


Figure 1 – System block diagram

5.0 Pinout

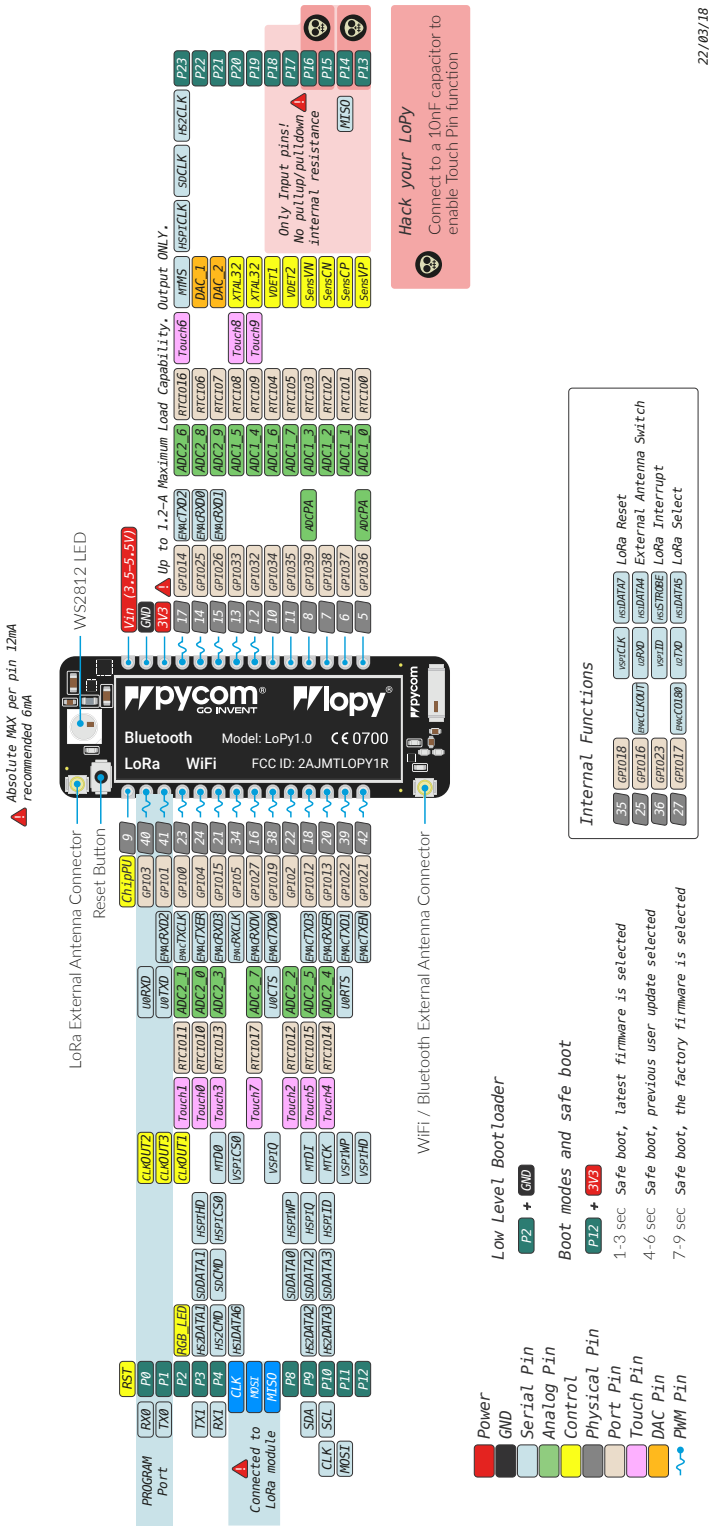


Figure 2 – Module pinout diagram

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

6.0 Pin Details

Table 1 – Module pinout

Module Pin	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 radio SPI CLK		•		Not recommended for external use
8	27	–	LoRa 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, not recommended for external use
18	39	P16		1		•	Input only
19	35	P17		1		•	Input only

6.0 Pin Details

Table 1 – Module pinout

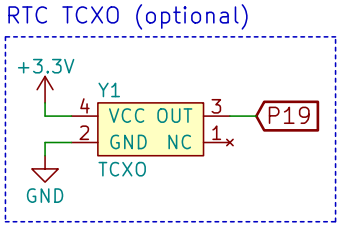
Module Pin	ESP32 GPIO	Pin Name	Default Function	ADC	PWM	RTC†	Notes
20	34	P18		1		•	Input only
21	32	P19		1	•	•	
22	33	P20		1	•	•	
23	26	P21		2*	•	•	DAC
24	25	P22		2*	•	•	DAC
25	14	P23		2*	•	•	JTAG TMS, SD card SCLK
26	–	–	Regulated 3.3V supply				Output only, do not feed 3.3V into this pin or you can 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 radio interrupt
–	17	–					LoRa radio chip select

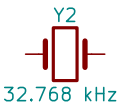
† The pins on the RTC power domain can be used during deep sleep, specifically GPIO pins will maintain their state while in deep sleep.

* 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.


RTC TCXO (optional)
+3.3V
Y1
4
2
VCC OUT
GND NC
3
1
P19
TCXO
GND


Y2
32.768 kHz

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 LoPy 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

By default, the LoPy also acts as a Wi–Fi access point.
SSID: lopy–wlan–XXXX
Password: www.pycom.io
Once connected to the LoPy'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 LoPy 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 LoPy 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 LoPy features an on–board voltage regulator that takes 3.5V – 5.5V from the V_{IN} 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)	–	37	–	mA
LoRa Transmit†	–	92.6	–	mA
WiFi AP	–	96.5	–	mA
WiFi client	–	107.3	–	mA
Bluetooth	–	94	–	mA
Deep sleep*	–	15.1	–	mA
Deep sleep with shield	–	531	–	µA

† More details can be found in section 14.2

* See section 10.2

10.2 Deep sleep

Due to a couple issues with the LoPy design the module draws more current than it should while in deep sleep. The DC–DC switching regulator always stays in high performance mode which is used to provide the lowest possible output ripple when the modules is in use. In this mode, it draws a quiescent current of 10mA. When the regulator is put into ECO mode, the quiescent current goes down to 10uA. Unfortunately, the pin used to control this mode is out of the RTC domain, and therefore not usable during deep sleep. This causes the regulator to always stay in PWM mode, keeping its quiescent current at 10mA. Alongside this the flash chip doesn't enter power down mode because the CS pin is floating during deep sleep. This causes the flash chip to consume around 2mA of current. Only the WiPY 2.0, LoPy 1.0 and SiPy 1.0 are affected by these issues. To work around this issue a "deep sleep shield" is available that attaches to the module and allows power to be cut off from the device. The device can then be re–enabled either on a timer or via pin interrupt. With the deep sleep shield the current consumption during deep sleep is between 7uA and 10uA depending on the wake sources configured.

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	0x180000
OTA info	Information about the current active firmware	0x190000	0x1000
Firmware Slot 1	Second firmware slot	0x1A0000	0x180000
File system	504KB file system on devices with 4MB flash	0x380000	0x7F000
Config	Config area for LoRa, Sigfox and LTE	0x3FF000	0x1000

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

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

13.2.2 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 SX1272	860–1020MHz	6 – 12	125 – 500 kHz	0.24 – 37.5 kpbs	–117 to –137 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 modem performance

Bandwidth (KHz)	Spreading Factor	Nominal Rb (bps)	Sensitivity (dBm)
125	6	9380	–122
125	12	293	–137
250	6	18750	–119
250	12	588	–134
500	6	37500	–116
500	12	1172	–131

14.2 Specifications

Table 17 – LoRa electrical characteristics

Symbol	Description	Conditions	Min	Typ.	Max	Unit
IDDR_L	Supply current in receiver LoRa mode	LNABoost Off, BW=125KHz	–	9.7	–	mA
		LNABoost Off, BW=250KHz	–	10.5	–	mA
		LNABoost Off, BW=500KHz	–	12	–	mA
		LNABoost On, BW=125KHz	–	10.8	–	mA
		LNABoost On, BW=250KHz	–	11.6	–	mA
		LNABoost On, BW=500KHz	–	13	–	mA
IDDT_L	Supply current in transmitter mode	RFOP = 13dBm	–	28	–	mA
		RFOP = 7dBm	–	18	–	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	–	82.5	–	dB
		Offset = ±2 MHz	–	86.5	–	dB
		Offset = ±10 MHz	–	89	–	dB
IIP3_L	3rd order input intercept point, highest LNA gain, FRF=868MHz, CW interferer	F1 = FRF + 1MHz F2 = FRF + 1.995MHz	–	–12.5	–	dBm
IIP2_L	2nd order input intercept point, highest LNA gain, FRF=868MHz, CW interferer	F1 = FRF + 20MHz F2 = FRF + 20MHz + Δf	–	57	–	dBm
BR_L	Bit rate, Long–Range Mode	From SF6, CR=4/5, BW=500 kHz to SF12, CR=4/8, BW = 125kHz	0.24	–	37.5	kbps

14.2 Specifications

Table 17 – LoRa electrical characteristics

Symbol	Description	Conditions	Min	Typ.	Max	Unit
RFS_L125	RF sensitivity, Long–Range Mode, highest LNA gain, LNA boost, 125kHz bandwidth using split Rx/Tx path	SF = 6	–	–121	–	dBm
		SF = 7	–	–124	–	dBm
		SF = 8	–	–127	–	dBm
		SF = 9	–	–130	–	dBm
		SF = 10	–	–133	–	dBm
		SF = 11	–	–135	–	dBm
		SF = 12	–	–137	–	dBm
RFS_L250	RF sensitivity, Long–Range Mode, highest LNA gain, LNA boost, 250kHz bandwidth using split Rx/Tx path	SF = 6	–	–118	–	dBm
		SF = 7	–	–122	–	dBm
		SF = 8	–	–125	–	dBm
		SF = 9	–	–128	–	dBm
		SF = 10	–	–130	–	dBm
		SF = 11	–	–132	–	dBm
		SF = 12	–	–135	–	dBm
RFS_L500	RF sensitivity, Long–Range Mode, highest LNA gain, LNA boost, 500kHz bandwidth using split Rx/Tx path	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	–	–129	–	dBm

14.2 Specifications

Table 17 – LoRa electrical characteristics

Symbol	Description	Conditions	Min	Typ.	Max	Unit
CCR_LCW		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
FERR_L	Maximum tolerated frequency offset between transmitter and receiver, no sensitivity degradation	BW_L = 125kHz	–30	–	30	kHz
		BW_L = 250kHz	–60	–	60	kHz
		BW_L = 500kHz	–120	–	120	kHz

14.2 Specifications

Table 18 – LoRa power consumption

Symbol	Description	Conditions	Min	Typ.	Max	Unit
IDDSL	Supply current in sleep mode		–	0.1	1	µA
IDDIDLE	Supply current in idle mode	RC oscillator enabled	–	1.5	–	µA
IDDST	Supply current in standby mode	Crystal oscillator enabled	–	1.4	1.6	mA
IDDFS	Supply current in synthesizer mode	FSRx	–	4.5	–	mA
IDDR	Supply current in receive mode	LnaBoost Off	–	10.5	–	mA
		LnaBoost On	–	11.2	–	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	–	28	–	mA
		RFOP=+ 7 dBm on RFO pin	–	18	–	mA

15.0 6LoWPAN

Pycom is currently working on adding 6LoWPAN support to this module and plan to release a new firmware with this functionality in Q2 2018.

16.0 Electrical Characteristics

16.1 Absolute maximum ratings

Table 19 – Absolute maximum ratings

Parameter	Symbol	Min	Typ.	Max	Unit
Supply Input Voltage	V_{IN}	3.5	–	5.5	V
Supply Output Current	I_{OUT}	–	–	1.2	A
Supply Output Voltage	V_{3V3}	–	3.3	–	V
Storage Temperature	T_{STR}	–	–	–	°C
Operating Temperature	T_{OPR}	–40	–	85	°C
Moisture Sensitivity Level	MSL	–	1	–	–

16.2 Input/Output characteristics

Table 20 – Input/Output characteristics

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

17.0 Minimum Recommended Circuit

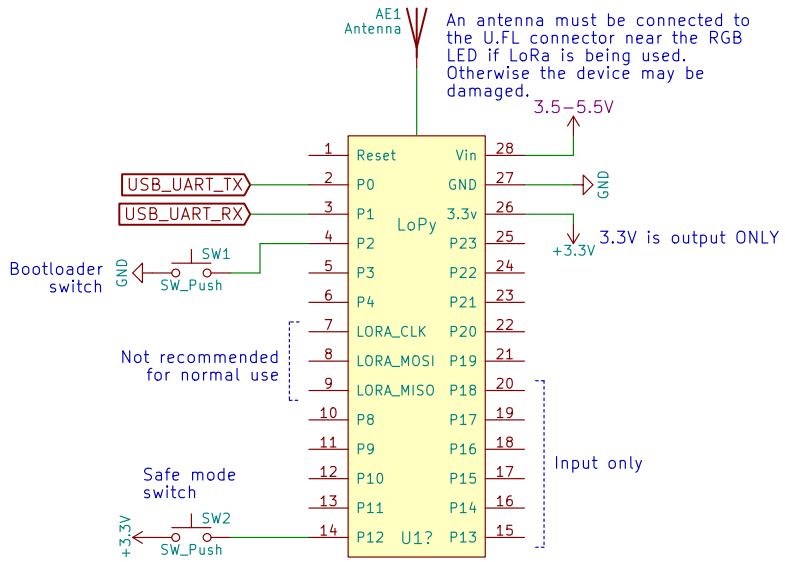


Figure 4 – Minimum required circuit

18.0 Mechanical Specifications

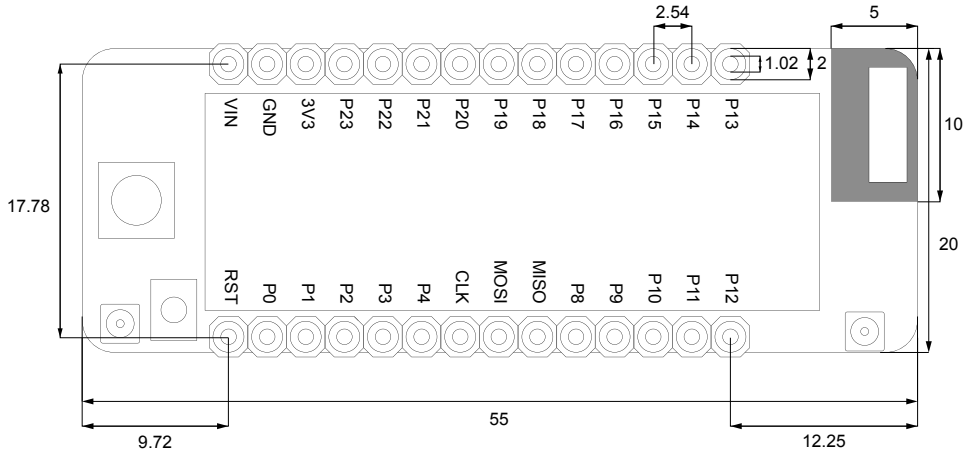


Figure 5 – Mechanical drawing (top down view) – Units: mm

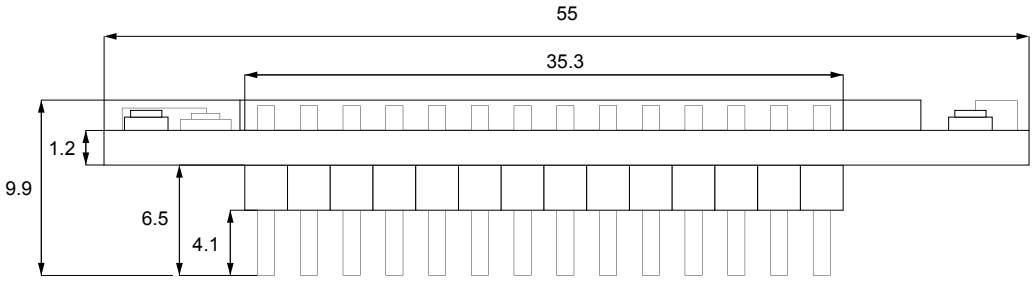


Figure 6 – Mechanical drawing (side view) – Units: mm

19.0 Recommended Land Patterns

19.1 Through hole

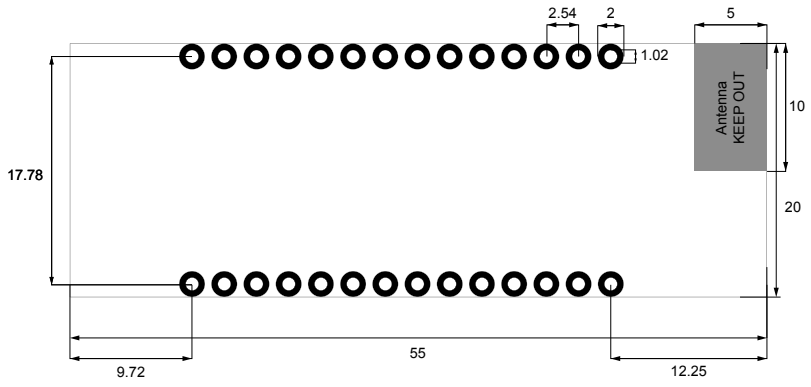


Figure 7 – Recommended land pattern (through hole) – Units: mm

19.2 Surface mount (LoPy without headers only)

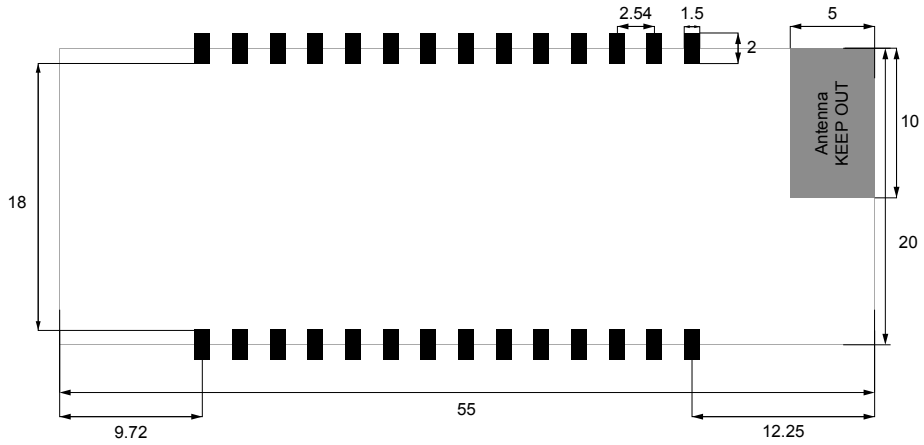


Figure 8 – Recommended land pattern (surface mount) – Units: mm

20.0 Soldering Profile

20.1 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.

20.2 Without headers

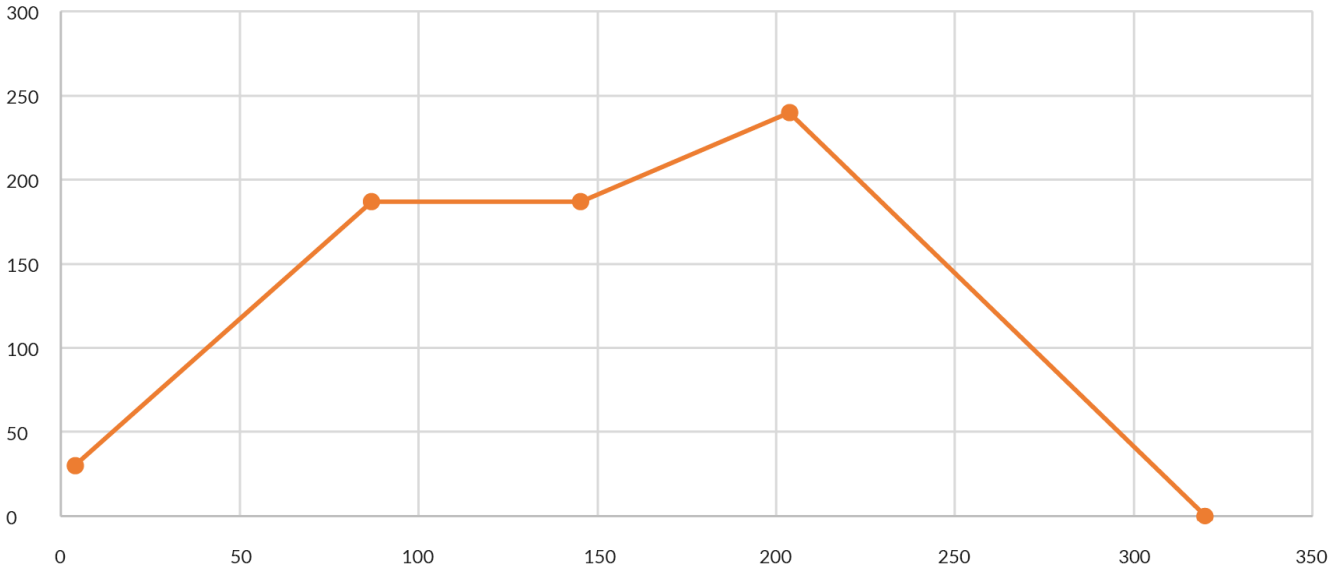


Figure 9 – Reflow soldering temperature profile (surface mount)

Table 23– 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.

21.0 Ordering Information

Table 21 – Soldering profile temperatures

Product EAN	Description
0700461341628	LoPy 1.0 with Headers
0700461242727	LoPy 1.0 without headers
0700461341703	LoRa Antenna
0700461341680	External WiFi Antenna
0700461341697	IP67 Antenna Pigtail

Bundle	Contents
LoPy Multi–Pack	1x LoPy 1x Expansion Board or Pysense or Pytrack 1x LoRa 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

22.0 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

23.0 Certification

FCC 2AJMTLOPY1R
CE 0700
Copies of the certificates can be found on our website.

Regulator Information

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.

23.2.3 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: 2AJMTLOPY1R”. 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.

23.2.4 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

24.0 Revision History

Table 24 – Document revision history

Version 1.0	**Initial Release**