Datasheet

Version 1.0

pycom
go invent

1.0 Overview 04

2.0 Features 04

3.0 Specifications 04

3.1 CPU 04
3.2 Memory 04
3.3 WiFi 04
3.4 Bluetooth 04
3.5 LoRa 04
3.6 Sigfox 04
3.7 LTE CAT–M1/NB–IoT 04
3.8 RTC 04
3.9 Security 04
3.10 Hash / encryption 04

4.0 Block Diagram 05

5.0 Pinout 05

6.0 Programming the device 06

6.1 UART 06
6.2 Wi–Fi 06
6.2.1 Telnet 06
6.2.2 FTP 06

7.0 Battery 06

8.0 Power 07

8.1 Current consumption by power modes/features measured at 5V 07

9.0 Memory Map 08

9.1 Flash 08
9.2 RAM 08
9.3 ROM and eFuses 08

10.0 WiFi 09

10.1 Supported features 09
10.2 Specifications 09

11.0 Bluetooth 10

11.1 Supported hardware features 10
11.2.1 Receiver – Basic Data Rate 10
11.2.2 Receiver – Enhanced Data Rate 11
11.2.3 Receiver – Bluetooth LE 12
11.2.4 Transmitter – Basic Data Rate 13
11.2.5 Transmitter – Enhanced Data Rate 14
11.2.6 Transmitter – Bluetooth LE 15

12.0 LoRa 15

12.1 Supported features 15
12.2 Specifications 16

13.0 Sigfox 17

14.0 LTE CAT–M1/NB–IoT 18

14.1 Supported features 18
14.2 Specifications
14.3 Supported LTE bands 18
14.4 SIM Card requirements 18

15.0 GNSS receiver 19

15.1 Support Satellite Systems 19
15.2 Position Accuracy 19
15.3 Time-To-First-Fix 19
15.4 Sensitivity 19

16.0 Accelerometer & Gyroscope Circuit 20

16.1 Integrated sensor 20
16.2 Connectivity 20
16.3 IMU functionalities 20

17.0 Pymesh 20

18.0 Electrical Characteristics 21

18.1 Absolute maximum ratings 21
18.2 Recommended Operating Condition 21
18.3 Input/Output characteristics 21
18.4 Wireless Charger 22

19.0 Mechanical Specifications 22

20.0 Integrations 23

21.0 Accessories 23

22.0 Ordering Information 23

23.0 Packaging 24

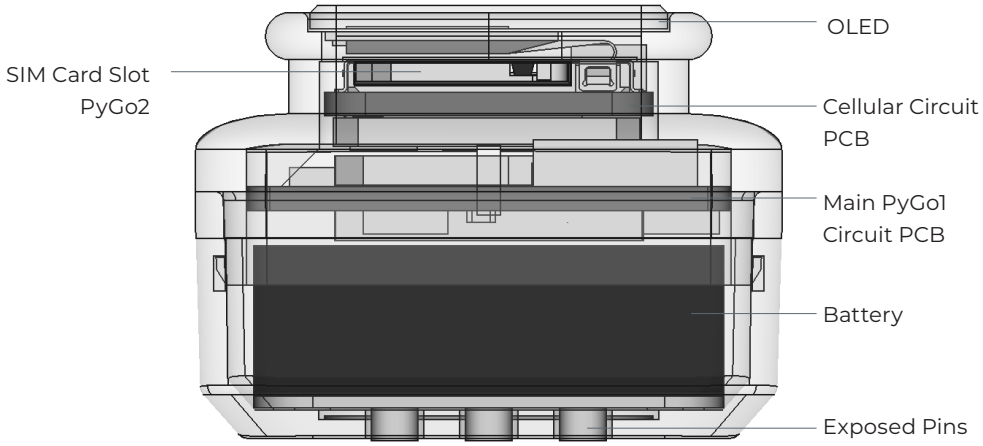
24.0 Certification 24

24.1 EU Regulatory Conformance 24
24.2 Federal Communication Commission Interference Statement 24
24.2.1 RF Warning Statement 24

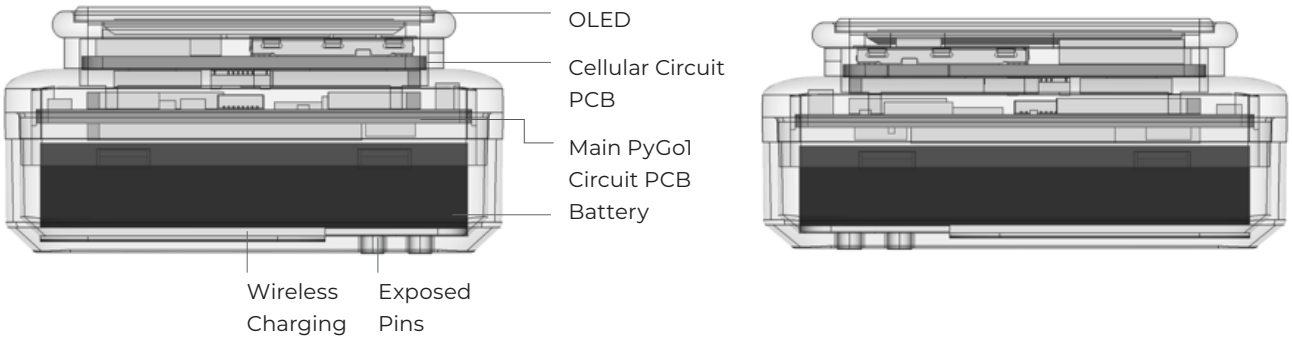
25.0 Manual Information to the End User 24

26.0 Revision History 25

Mechanical View -Sides

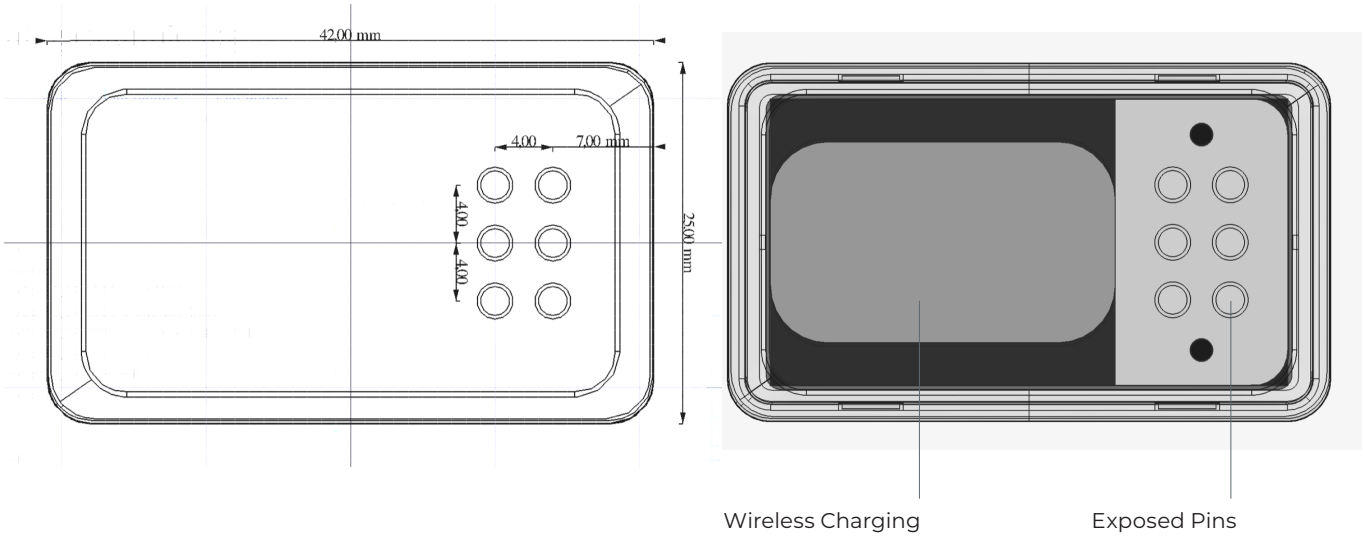


Mechanical View -Sides



Product case dimensions: 42 mm x 25 mm x 18.2 mm

Mechanical View -Bottom



1.0 Overview

With Sigfox, LoRa, WiFi, BLE and cellular LTE–CAT M1/ NB1, the PyGo is the latest Pycom MicroPython enabled device on the market today – the perfect enterprise grade IoT platform for your connected Things. Create and connect your things everywhere. Fast.

2.0 Features

- Powerful CPU
- MicroPython enabled
- Multi-GNSS receiver for GPS, GLONASS, SBAS and QZSS
- Ultra–low power usage
- Accelerometer & Gyroscope
- PYGO1 four networks: WiFi, BLE, LoRa, Sigfox
- PYGO2 five networks: WiFi, BLE, cellular LTE - CAT1 M1/NB1 LoRa and Sigfox

3.0 Specifications

3.1 CPU
- ESP32
- Xtensa® dual–core 32–bit LX6 microprocessor(s), up to 600 DMIPS
- Hardware floating point
- Python multi–threading
- An extra ULP–coprocessor that can monitor GPIOs, the ADC channels and control most of the internal peripherals during deep–sleepmode while only consuming 25uA.

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

3.3 WiFi
- 802.11b/g/n 150mbps

3.4 Bluetooth
- Low energy
- Classic (not supported in the firmware)

3.5 LoRa
- LoRaWAN stack – Class A and C devices
- Node range: Up to 10km Rural areas and up to 3km Urban areas (depending on conditions
- 868 MHz (Europe) at +14dBm maximum
- 915 MHz (North and South America, Australia and New Zealand) at +20dBm maximum

3.6 Sigfox
- Class 0 device. Maximum Tx power:
  +14dBm(Europe)
  +20dBm (America)
  +20dBm (Australia and New Zealand)
- Node range: Not tested

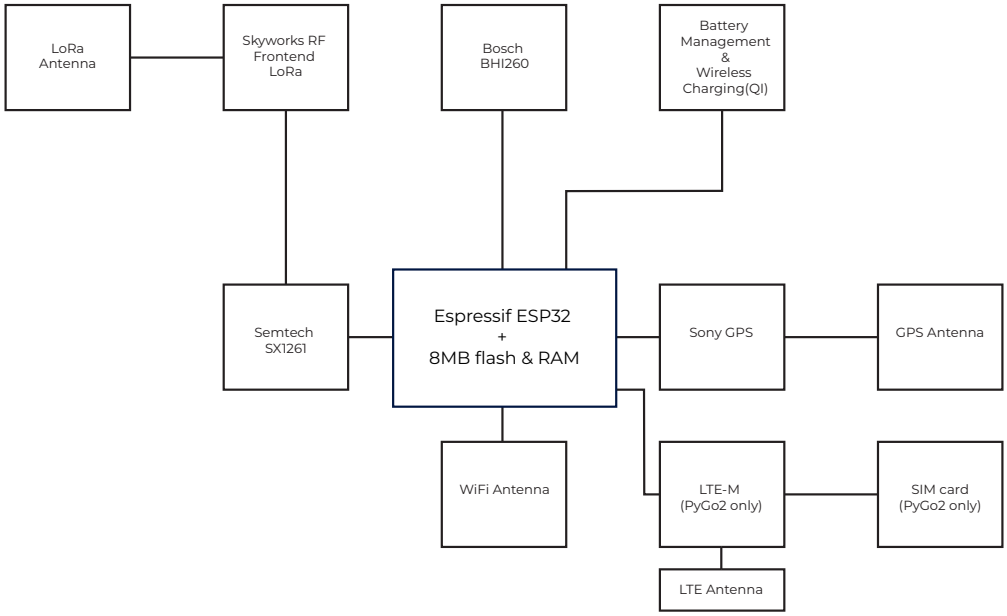
3.7 LTE CAT–M1/NB–IoT (PyGo 2 only)
- One single chip for both CAT M1 and NB1
- LTE Cat M1 +23 dBm
- NB-IoT (NB1) +23 dBm
- Nano SIM push pull holder
- 3GPP release 13 compliant
- 3GPP Rel. 13 eDRX and PSM modes
- PSM current: dormant window configurable
- OTA firmware upgrade
- Power Consumption
- Hibernation current: 1.5 uA (avg)
- eDRX current: <45 uA (avg) @ 8 Hyperframes
- PSM current: dormant window configurable
- Regulatory certificate:
  FCC/IC: HSW-TY1SC
  ETSI: EN 301 489-1 and EN 301 908-1
  TELEC: 003-180242
  Carrier Certifications: PTCRB (5.38), GCF (3.73)

3.8 RTC
- Running at 32KHz

3.9 Security
- SSL/TLS support
- WPA Enterprise security

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

4.0 Block Diagram



5.0 Pinout

Pin Number	Pin Name	Type	Description
1	GND	Power ground	Ground connection
2	P1	GPIO	GPIO21 of ESP32
3	SDA	I2C Data	I2C communications bus, 10K ohm pullup resistor in Pygo1
4	VCC	Power	Power connection +5V (Vmin +3.5 and Vmax +5.5 Volts)
5	P0	GPIO	GPIO25 of ESP32
6	SCL	I2C Clock	I2C communications bus, 10K ohm pullup resistor in Pygo1

6.0 Programming the device

6.1 Via the Pylife Mobile Application

6.2 UART (to be configured / activated via Mobile Application)
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 PYGO is via our PYGO charger, 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.

6.3 Wi–Fi (to be configured / activated via Mobile Application)
PyGo can also acts as a Wi–Fi
access point SSID: pygo–wlan–XXXX
Password: www.pycom.io
Once connected to the PyGo's Wi–Fi network you can access it in two ways

6.3.1 Telnet (to be configured / activated via Mobile Application)
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.

6.3.2 FTP (to be configured / activated via Mobile Application)
The PyGo also runs an 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

7.0 Battery

Lithium Polymer Battery Pack LP632036 420mAh 3.7V with Protection Circuit Module (PCM)

Table 1 – Electrical Specification

Rated Capacity	420mAh min, 430mAh typ.
Nominal Voltage	3.7V
Wat-Hour Rating	1.554Wh
Max. Operating Voltage Range	2.75V to 4.20V
Max. Charge Voltage	4.2V ±50mV
Max. Charge Current	210mA
Max. Continuous Discharge Current	420mA
Discharge Cut Off	2.75V
Internal Impedance	<200mΩ
Expected Cycle Life @ (0.5C/0.5C) @ 23±5	500 cycles ≥ 80%

Important Note: The performance of all batteries drops drastically at low temperatures; however, the elevated internal resistance will cause some warming effect by efficiency loss caused by voltage drop when applying a load current. At –20°C (–4°F) most batteries will perform at about 50% of maximum performance level.

8.0 Power

The PYGO 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.

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

Table 2 – Current consumption by power modes/features measured at 4.2V

Mode	Min	Avg.	Max	Units
Idle (no radios)	-	62.7	-	mA
LoRa Transmit*	-	-	290	mA
Sigfox Transmit†	-	192	-	mA
LTE Transmit	-	TBD	-	mA
WiFi AP	-	126	-	mA
WiFi client	-	137	-	mA
Bluetooth	-	121	-	mA
Deep sleep	-	15uA**	-	mA
GPS acquisition	-	16	-	mA
GPS tracking (8-ch)	-	9	-	mA

*More details can be found in section 14.2
**Deep Sleep current is an estimation and may be updated upon product release
† More details can be found in section 15.2

9.0 Memory Map

9.1 Flash

Table 3– 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
File system (2)	4MB file system on devices with 8MB flash	0x400000	0x400000

9.2 RAM

Table 4 – 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	-
Slow RTC RAM	Slow RAM area accessible by the Ultra–Low Power Coprocessor during deep sleep	-
External pSRAM	External QSPI RAM memory clocked @ 40MHz	8MB

9.3 ROM and eFuses

Table 5 – 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

10.0 WiFi

10.1 Supported features

- 802.11 b/g/n/e
- 802.11 n (2.4 GHz), up to 150 Mbps
- WMM–PS, UAPSD
- A–MPDU and A–MSDU aggregation
- Block ACK
- Fragmentation and defragmentation

10.2 Specifications

- Automatic Beacon monitoring/scanning
- Wi–Fi Protected Access (WPA)/WPA2/WPA2–Enterprise/Wi–Fi Protected Setup (WPS)
- Infrastructure BSS Station mode/SoftAP mode

Table 6 – WiFi specifications

Description	Min	Typ.	Max	Unit
Input Frequency	2412	–	2484	MHz
Tx power Output power of PA for 72.2	12	13	14	dBm
Output power of PA for 11b mode	18.5	19.5	20.5	dBm
		Sensitivity		
11b, 1 Mbps	–	–98	–	-
11b, 11 Mbps	–	–88	–	-
11g, 6 Mbps	–	–93	–	-
11g, 54 Mbps	–	–75	–	dBm
11n, HT20, MCS0	–	–93	–	dBm
11n, HT20, MCS7	–	–73	–	dBm
11n HT40, MCS0	–	–90	–	dBm
		Adjacent channel rejection		
11g, 6 Mbps	–	27	–	dB
11g, 54 Mbps	–	13	–	dB
11n, HT20, MCS0	–	27	–	dB
11n, HT20, MCS7	–	12	–	dB

11.0 Bluetooth

11.1 Supported hardware 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 –94 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

11.2.1 Receiver – Basic Data Rate

Table 7 – Receiver (basic data rate) specifications

Parameter	Conditions	Min	Typ.	Max	Unit
Sensitivity @0.1% BER		–90	–89	–88	dBm
Maximum received signal @0.1% BER		0	–	–	dBm
Co–channel C/I		0	+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 ~ 12.5 GHz	-10	–	–	dBm
Intermodulation		-36	–	–	dBm

11.2.2 Receiver – Enhanced Data Rate

Table 8 – Receiver (enhanced data rate) specifications

Parameter	Conditions	Min	Typ.	Max	Unit
		π/4 DQPSK			
Sensitivity @0.1% BER		–90	-89	-88	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	-83	-82	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

11.2.3 Receiver – Bluetooth LE

Table 9 – Receiver (BLE) specifications

Parameter	Conditions	Min	Typ.	Max	Unit
Sensitivity @30.8% PER	–	–94	–93	-92	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	–	–25	–	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

11.2.4 Transmitter – Basic Data Rate

Table 10 – Transmitter (basic data rate) specifications

Parameter	Conditions	Min	Typ.	Max	Unit
RF transmit power	–	–	0	–	dBm
Gain control step	–	–	3	–	dBm
RF power control range	–	–12	–	+9	dBm
+20 dB bandwidth	–	–	0.9	–	MHz
Adjacent channel transmit power	F = F0 ± 2 MHz	–	–47	–	dBm
	F = F0 ± 3 MHz	–	–55	–	dBm
	F = F0 ± >3 MHz	–	-60	–	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

11.2.5 Transmitter – Enhanced Data Rate

Table 11 – Transmitter (enhanced data rate) specifications

Parameter	Conditions	Min	Typ.	Max	Unit
RF transmit power		–	0	–	dBm
Gain control step		–	3	–	dB
RF power control range		–12	–	+9	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	–	100	–	%
	Peak DEVM	–	13.3	–	%
8 DPSK modulation accuracy	RMS DEVM	–	5.8	–	%
	99% DEVM	–	100	–	%
	Peak DEVM	–	14	–	%
In–band spurious emissions	F = F0 ± 1MHz	–	– 46	–	dBm
	F = F0 ± 2MHz	–	–40	–	dBm
	F = F0 ± 3MHz	–	–46	–	dBm
	F = F0 ± >3MHz	–	–	–53	dBm
EDR differential phase coding		–	100	–	%

11.2.6 Transmitter – Bluetooth LE

Table 12 – Transmitter (BLE) specifications

Parameter	Conditions	Min	Typ.	Max	Unit
RF transmit power		–	0	–	dBm
Gain control step		–	3	–	dBm
RF power control range		–12	–	+9	dBm
Adjacent channel transmit power	F = F0 ± 2MHz	–	–52	–	dBm
	F = F0 ± 3MHz	–	–58	–	dBm
	F = F0 ± >3MHz	–	–60	–	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

12.0 LoRa

12.1 Supported features

Table 15 – Supported LoRa features

LoRa Parameters					
Part Number	Frequency Range	Spreading factor	Bandwidth	Effective Bitrate	Sensitivity
Semtech chip	860–930MHz	5 – 12	7.8 – 500KHz	0.018 – 62.6 kbps	–117 to –148dBm

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

12.2 Specifications

Table 13 – LoRa modem performance

Symbol	Description	Conditions	Min	Typ.	Max	Unit
RXS_LB	Sensitivity LoRa	BW_L=10.4 kHz, SF=7	-	-134	-	dBm
		BW_L=10.4 kHz, SF=12	-	-148	-	dBm
		BW_L=125 kHz, SF=7	-	-124	-	dBm
		BW_L=125 kHz, SF=12	-	-137	-	dBm
		BW_L=250 kHz, SF=7	-	-121	-	dBm
		BW_L=250 kHz, SF=12	-	-134	-	dBm
		BW_L=500 kHz, SF=7	-	-117	-	dBm
		BW_L=500 kHz, SF=12	-	-129	-	dBm
CCR_L	Co-channel-rejection	SF=7	–	5	–	mA
		SF=12	–	19	–	mA
ACR_L	Adjacent Channel rejection	Offset = ±1.5 x BW_L	–	–	–	dB
		BW_L=125kHz, SF=7	–	60	–	dB
		BW_L=125kHz, SF=12	–	72	–	dB
BI_L	Blocking Immunity	BW_L=125kHz, SF=12	–	–	–	–
		Offset = ±1 MHz	–	88	–	dB
		Offset = ±2 MHz	–	90	–	dB
		Offset = ±10 MHz	–	99	–	dB
3rd order input intercept IIP3_L point		Unwanted tones are 1 MHz and 1.96 MHz above LO	–	5	–	dBm

Table 14 – LoRa – LoRa power consumption

Symbol	Description	Condition	Min	Typ.	Max	Unit
IDDOFF	SLEEP mode	Lora transceiver in sleep mode	-	5	-	mA
IDDFS	Synthesizer mode	DC-DC mode used	-	7.1	-	mA
IDDRX	Supply in Receive mode with DC-DC	Lora 125 kHz	-	9.6	-	mA
		Rx Boosted, Lora 125 kHz	-	10.3	-	mA
IDDTX	Supply in Transmit mode	+20 dBm	-	-	290	mA

13.0 Sigfox

TBA

14.0 LTE CAT–M1/NB–IoT (PyGo2 only)

14.1 Supported features

- LTE universal modem supports (low-band and mid-band):
  Low-band B5/B8/B12/B13/B14/B17/B18/B19/B20/B26/B28
  Mid-band B1/B2/B3/B4/B25
- 3GPP release 13 LTE Advanced Pro
- Supports narrowband LTE UE categories M1/NB1
- Integrated baseband, RF, RAM memory and power management
- Reduced TX power class option
- Extended DRX (eDRX) and PSM features for long sleep duration use cases
- Control via AT commands according to 3GPP TS27.005, 27.007 and customized AT commands
- IPv4/IPv6 stack with TCP and UDP protocol
- SSL/TLS

14.2 Specifications

Table 15– Supported LTE modes

Parameter		Min	Typ.	Max	Unit
Data rate	LTE Cat M1 in 1.4 Mhz, HD–FDD – DL	–	300	–	kbps
	LTE Cat M1 in 1.4 Mhz, HD–FDD – UP	–	375	–	kbps
	LTE Cat NB1 in 200 kHz, HD–FDD – DL	–	40	–	kbps
	LTE Cat NB1 in 200 kHz, HD–FDD – UL	–	55	–	kbps

14.3 Supported LTE bands

Table 16 – Supported LTE bands

Bands	TX Frequencies	RX Frequencies
Low Bands 5, 8, 12, 13, 17, 18, 19, 20, 26, 28	699 to 915 MHz	728 o 960 MHz
Mid Bands 1, 2, 3, 4	1710 to 1980 MHz	1805 to 2170 MHz

14.4 SIM Card requirements

Table 17 – SIM card specifications

Parameter	Min.	Typ.	Max	Unit
Form factor	–	Nano–SIM	–	–
Variant	–	USIM	–	–
Supply Voltage	–	1.8	–	v

15.0 GNSS receiver

15.1 Support Satellite Systems

- GPS (L1 C/A)
- GLONASS (L1O F)
- QZSS (L1 C/A)
- SBAS (L1 C/A)

15.2 Position Accuracy

Item	GPS	GPS & GLONASS	Unit	Remarks
2DRMS	1.0	1.0	m	Signal strength is -130 dBm

15.3 Time-To-First-Fix

Item	GPS	GPS & GLONASS	Unit	Remarks
Cold Start	35	35	s	Signal strength is -130 dBm
Hot Start	2	2	s	

15.4 Sensitivity

Item	GPS	GPS & GLONASS	Unit	Remarks
Cold Start	-147	-147	dBm	
Hot Start	-160	-160	dBm	
Tracking	-161	-161	dBm	

16.0 Accelerometer & Gyroscope

16.1 Integrated sensor (6-DoF IMU)
- 16-bit 3-axis accelerometer
- 16-bit 3-axis gyroscope

16.2 Connectivity
- I2C up to 3.4MHz
  Current consumption Fuser2
  (running CoreMark)
- Long Run mode (20 MHz) 950 µA
- Turbo mode (50 MHz) 2.8 mA
  Sensor fusion (Hub+IMU) operation (calculating game rotation vector)
- 800 Hz ODR 1.2 mA
- 100 Hz ODR 1.0mA
  Stand by current - 8 µA
  Sensor fusion performance
- Static accuracy (head., pitch, roll) - 2, 2, 2 degrees
- Dynamic accuracy (head., pitch, roll)-7, 2, 2 degrees
- Calibration time < 1 second
- Orientation stabilization time - 0.2 second

16.3 IMU functionalities

The embedded IMU (Inertial Movement Unit), apart from accelerometer and gyroscope MEMS, has an embedded CPU core which can run advanced algorithms for detecting:
- step counter and step detector
- significant motion - this means when user changed
- significantly position (approximately 5 steps were made)
- activity recognition: still, walking, running, on bicycle, in vehicle (still or moving) and tilting,
- glance and pickup,
- wrist tilt.

More features, like tapping the screen (and double- tap) could be added later, as firmware modules that will be executed by the integrated CPU core.
The most advanced feature is the Pedestrian Dead-reckoning, what will be experimentally available. Over prolonged periods of time, the absolute location, from GPS, needs to be used for re-positioning on the map

17.0 Pymesh

Pymesh is the raw-LoRa mesh networking. It is based on the ported Thread protocol with different timeouts to accommodate the lowest data rate 586bps, for SF11, bandwidth 125kHz LoRa parameters. The maximum speed is 18.7kbps, setting SF7 and bandwidth to 500kHz.

All the LoRa RAW transmission settings can be configured (frequency, SF, bandwidth, code-rate AES128bits key), and they all need to be the same for a single Pymesh network (otherwise nodes will not “understand” each-other). In the current firmware up to 16 hops are allowed (due to protocol), but we have an experimental increase to 32 hops.

We did tests with 30-50 nodes in a full-mesh (each node is in the radio range of the other node), and measurements shows up to 100 nodes in the same area. If nodes are more dispersed, up to 256 nodes is the maximum number of nodes. There are experimental topologies, that protocol-wise, allow for 1k nodes in the same mesh network.

Based on AES128bits, each node is authenticated in order to be accepted in the mesh. Additionally, all the traffic is encrypted using the same key, with the exception of the advertisement messages

18.0 Electrical Characteristics

18.1 Absolute maximum ratings

Table 18 – Absolute maximum ratings

Parameter	Symbol	Min	Typ.	Max	Unit
Supply Input Voltage	Vcc	+3.5	-	+5.5	V
Storage temperature	T_{STR}	-40	–	+85	°C
Operating Temperature	T_{OPR}	–40	–	+85	°C
Moisture Sensitivity Level	MSL	–	1	–	–

18.2 Recommended Operating Condition

Table 19 – Recommended Operating Condition

Parameter	Symbol	Min	Typ.	Max	Unit
Supply Input Voltage	Vcc	-	+5	-	V
Storage Temperature	T_{STR}	-40	–	+85	°C
Operating Temperature	T_{ORP}	–40	+25	+85	°C

18.3 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

18.4 Wireless Charger

- Qi compliant works with Apple wireless chargers
- Complies with the Qi v1.2 communication protocol
- Integrated Wireless Power Supply Receiver Solution - Optimized for 2.5-W Applications
- 93% Overall Peak AC-DC Efficiency
- Full Synchronous Rectifier
- Wireless Power Consortium (WPC) v1.2 Compliant Communication Control
- Output Voltage Conditioning
- Wireless Power Consortium (WPC) v1.2 Compliant (FOD Enabled) Highly Accurate Current Sense
- Dynamic Rectifier Control for Improved Load Transient Response
- Dynamic Efficiency Scaling for Optimized Performance Over Wide Range of Output Power
- Adaptive Communication Limit for Robust Communication
- Low-power Dissipative Rectifier Overvoltage Clamp (VRECT-OVP = 15 V)
- Thermal Shutdown
  Multifunction NTC and Control Pin for Temperature Monitoring, Charge Complete and Fault Host Control

All trademarks are the property of their respective owners.

19.0 Mechanical information

3D models for the following are available on our website (links to be inserted!):

- PyGo1 and PyGo 2 in case
- PyGo1 Board as Stand Alone
- PyGo2 add on Board

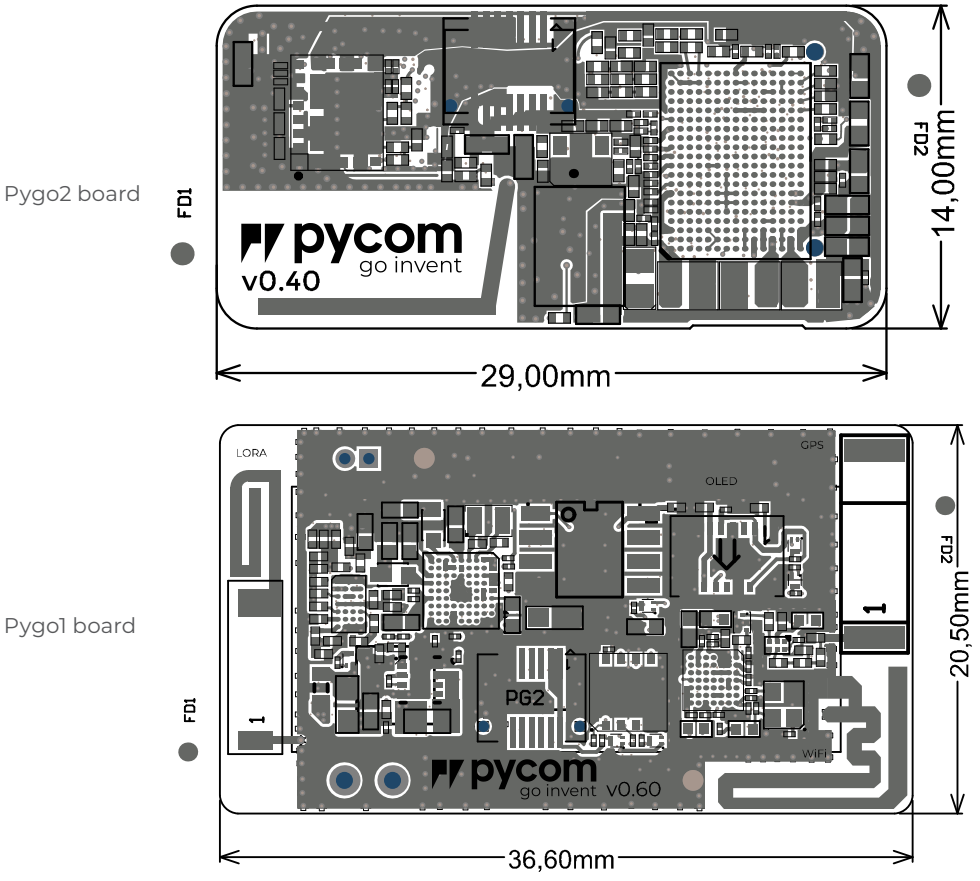


Figure 1 – Mechanical drawing (top view) – Units: mm

20.0 Integrations

20.1 OEM integrator condis
TBA
20.2 Casing Requirement
TBA
20.3 End product labelling
TBA

21.0 Accessories

21.1 Charge Cradle
21.2 Carry Accessories
TBA

22.0 Ordering Information

Table 21 – Ordering information

Product EAN	Description	Notes
	PyGo1 in Case	
	PyGo2 in Case	
	PyGo Charge Cradle	
	PyGo1 Stand Alone Board for integration	
	PyGo1+2 Stand Alone Boards for integration	

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

23.0 Packaging

24.0 Certification

FLTE modem certificate:

-FCC/IC: HSW-TY1SC

-ETSI: EN 301 489-1 and EN 301 908-1

-TELEC: 003-180242

Carrier Certifications: PTCRB (5.38), GCF (3.73)

Regulatory 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.

25.0 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 be informed 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 –20 - +85C

Receiver category 3

26.0 Revision History

Table 21 – Document revision history

Version 1.0	Initial Release: 12/8/20