

Datasheet
Version 1.1



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1.0 Overview

The Helium Hotspot contains the following Pycom and partner technology

- Pygate 868 Mhz or 915 Mhz
- Compute Module 4 adapter board
- Raspberry Pi Compute Module 4
- Pygate Case
- LoRa Antenna
- WiFi Antenna
- Power over Ethernet

The full helium hotspot enables users to connect to the Helium network and mine HNT coins once Authenticated on the network. It consists of a Pygate with a Compute Module 4 adapter board. This is designed for plugging Raspberry Pi Compute Module 4 onto the Pygate headers. In this configuration there is no need to add any additional development boards. The MCU is provided by the Raspberry Pi. The adapter board includes all necessary peripherals like SD-Card holder, power converter and a security chip.

2.0 Hotspot features

2.1 Pygate Adapter Board

- SD-Card holder for Raspberry Pi Compute 4 for SD boot and update
- Authentication IC through I2C for crypto transactions
- Fit into the standard Pygate case

2.2 Raspberry Pi CM4 Features:

- Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- Small Footprint 55mm × 40mm × 4.7mm module
- Options for 1GB, 2GB, 4GB or 8GB LPDDR4-3200 SDRAM with ECC
- Options for 0GB (CM4Lite), 8GB, 16GB, or 32GB eMMC Flash memory
- 2.4 GHz, 5.0 GHz IEEE 802.11 b/g/n/ac
- Bluetooth 5.0, BLE
- Electronic switch to select between PCB trace or external antenna
- SDIO 2.0 (CM4Lite)
- Single +5v PSU input

2.3 Hotspot Power supply options:

- USB Type-C
- PoE (Power Over Ethernet) via the optional adapter board

2.4 Available signals on headers:

- VCC supply.
- 3.3V from the Pycom module (Raspberry Pi Compute Module)
- VCC supply that goes off when the system enters sleep mode.
- 3V3 from the Gateway subsystem.
- UART Tx and UART Rx.
- GPS PPS input for adding an external GPS
- GND

2.5 Hotspot connectivity option

- WiFi: With the Raspberry Pi Compute Module 4.
- Ethernet: In combination with the Ethernet adapter board.
- Bluetooth 5.0
- LoRa

2.6 Hotspot Absolute maximum ratings :

- Operating temperature range: -20 to +75 °C
- Commercial temperature range: 0 to 70 °C
- Industrial temperature range: -40 to +85 °C
- Maximum RF LoRa Input Level: -10 dBm (0.1mW)

3.0 Block Diagram for Hotspot

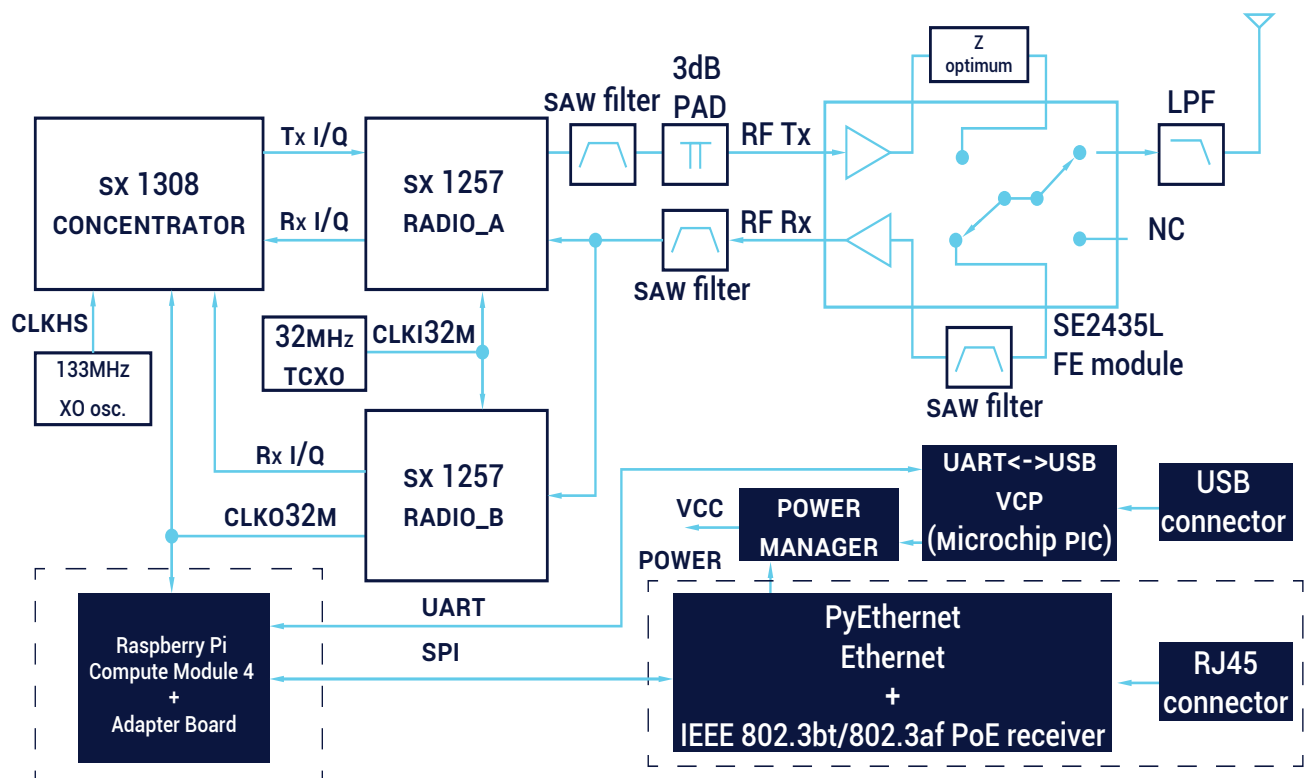


Figure 1 – Hotspot Block diagram

Note:

- * Blocks shown with a dashed outline are modules that are plugged into the Pygate
- ** PyEthernet module is not mandatory for the gateway operation, when Ethernet connectivity or Power over Ethernet functionality needed.

4.0 Pygate Overview

The Pygate is a super low-cost 8-channel LoRaWAN gateway that comes in the shape of a shield. It's got the well-known form factor from our other shields and you can connect Pygate adapter board.

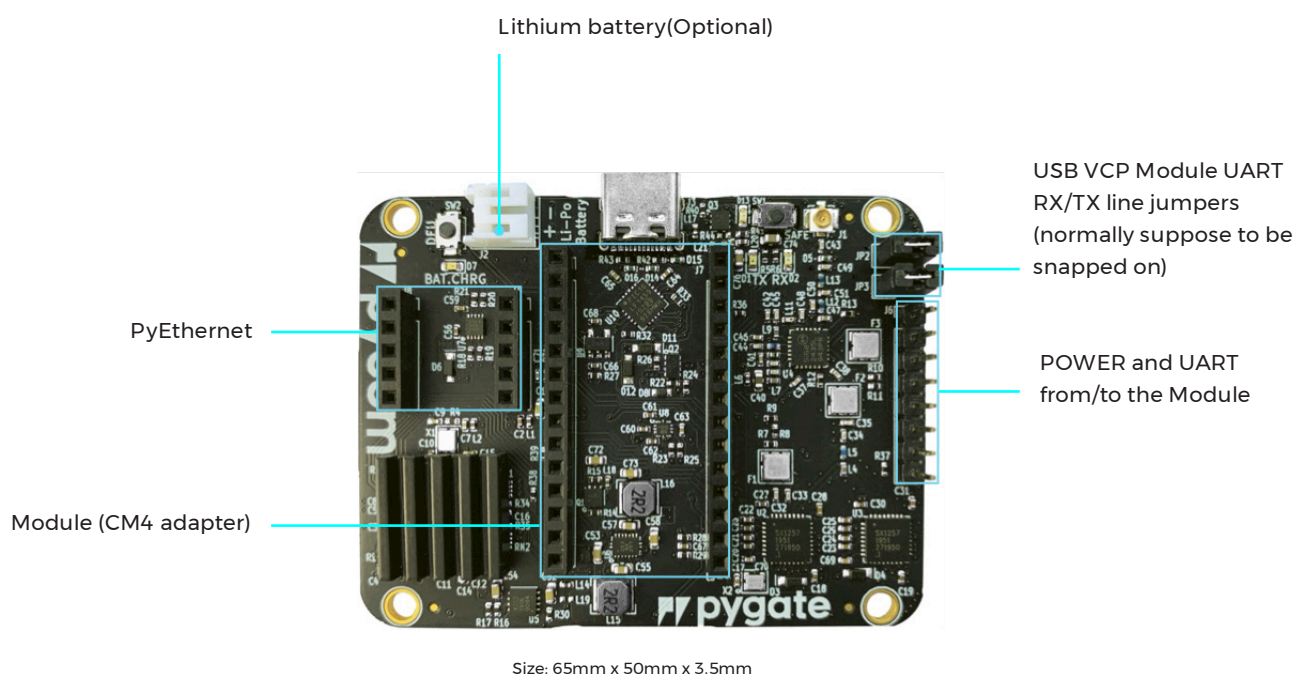


Figure 2 – Pygate pins and connector

5.0 Pygate Header Pinout

Module socket pinout

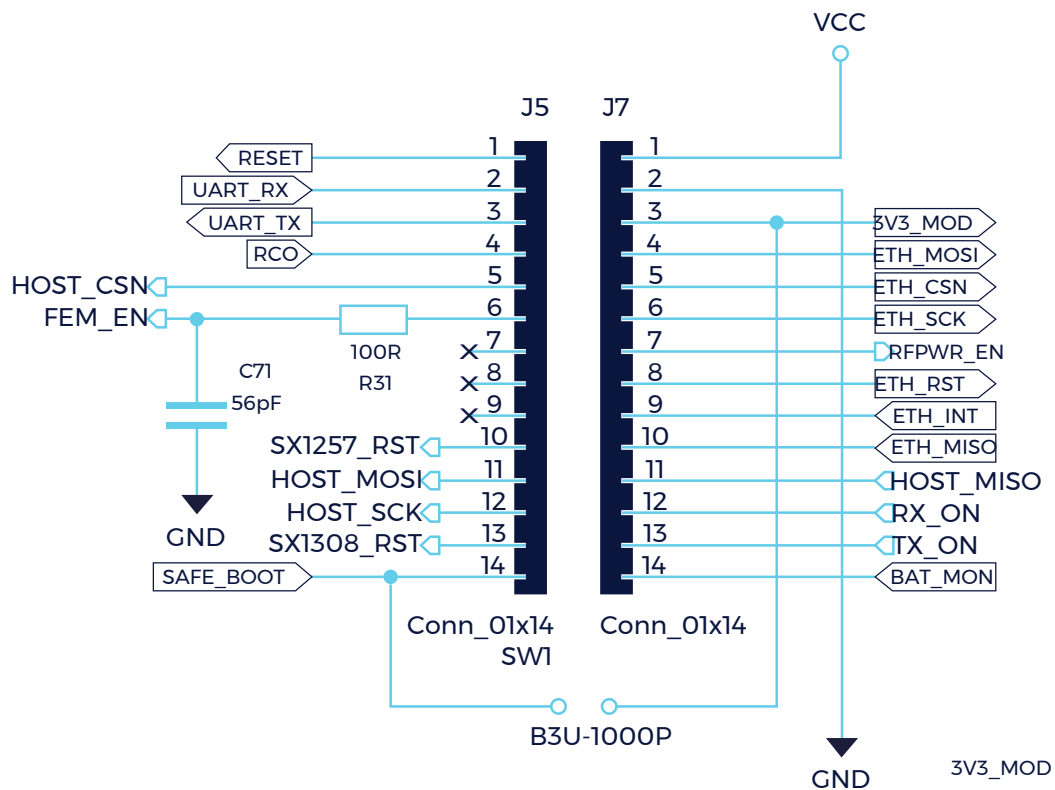


Figure 3 – Socket to Pycom module

6.0 Overview Hotspot Specification

6.1 CPU

Broadcom BCM2711 quad-core
Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GH

6.2 Memory

- 2 GB LPDDR4-3200 SDRAM with ECC
- 64 GB uSD card

6.3 WiFi

- 2.4GHz and 5.0GHz IEEE 802.11b/g/n/ac with onboard and external antenna

Internal antenna: 3.5dBi @2.4GHz, 2.5dBi @5GHz
External antenna: 1.6dBi @2.4GHz, 2.0dBi @5GHz

6.4 Bluetooth

Bluetooth 5.0, BLE

Internal antenna: 3.5dBi @2.4GHz, 2.5dBi @5GHz
External antenna: 1.6dBi @2.4GHz, 2.0dBi @5GHz

6.5 LoRa

Operating Frequencies:

- 863-870MHz at 14dBm maximum
- 902-928MHz at 22dBm maximum

LoRa (868MHz/915MHz) & Sigfox Antenna Kit External antenna

- RF Cable Assemblies RP-SMA (Female)
JK-IPEX MHF U.FL 1.13 100MM • RP-SMA (Male)
Tilt Swivel Whip antenna
- ROHS Compliant
- Frequency: 824 ~ 960MHz
- VSWR: 3.0 MAX
- Gain: 0.87 dBi
- Impedance: 50 Ohm

6.6 Security

- SSL/TLS support
- WPA Enterprise security

6.7 Hash/encryption

- Using Microchip ATECC608A
- Crypto Authentication Device
 - Cryptographic Co-Processor with Secure Hardware-Based Key Storage
 - Protected storage for up to 16 keys, certificates or data
 - Can comply with the ECC608 provisioning process

6.8 Helium Network

- LoRa Network

7.0 LoRa Characteristics

Table 1 – LoRa Packet data field

Packet Buffer data Organization		
Offset from start pointer	Data Stored	Comment
0	PAYLOAD	PAYLOAD DATA
-		
-		
-		
-		
Payload size -1		
Payload size	CHANNEL	1-10 as described by block diagram
+1 Payload size	SF[3:0],CR[2:0], CRC_EN	
+2 Payload size	SNR Average	Averaged SNR in dB on the packet lenght
+3 Payload size	SNR MIN	Input/output pin. Pycom Module pin 6 and to SD_CMD
+4 Payload size	SNR MAX	Input/output pin. Pycom Module pin 10 and to SD_DAT
+5 Payload size	RSSI	External WiFi/BT antenna switch, Low = on-board, High = U.FL
+6 Payload size	TMESTAMP[7:0]	31 hit time stamp, 1 us step
+7 Payload size	TMESTAMP[15:8]	
+8 Payload size	TMESTAMP[23:16]	
+9 Payload size	TMESTAMP[31:24]	
+10 Payload size	CRC Value [7:0] CRC	Value of the computed CRC16
+11 Payload size	Value [15:8]	
+12 Payload size	MODEM ID	
+13 Payload size	RX MAX BIN POS[7:0]RX	Correlation peak position
+14 Payload size	MAX BIN POS[15:8]	

Table 1 – LoRa Packet data field

+15 Payload size	RX CORP SNR	Detection correlation SNR
+16 Payload size	RESERVED	
+17 Payload size	RESERVED	

Table 2 – Packet Structure of transmission

Byte	Subfield	Description	Comment
0	23:16	Channel Frequency	Fchan/32MHz*2 ¹⁹
1	15:8		
2	7:0		
3	31:24	Start Time	Value at the timer at which the modem has to start (in us)
4	23:16		
5	15:8		
6	7:0		
7	7:6	Reserved	
	5:5	Radio select	Select radio A (0) or B (1)
	4:4	Modulation Type	0:LoRa, 1: FSK
	3:0	Tx power	> 7:20dBm, otherwise 14 dBm

Table 3 – LoRa Specification

Byte	Subfield	Description	Comment
9	7:7	Payload CRC16 enable	Enables CRC16
	6:4	Coding Rate	Coding Rate = $4/(4+CR)$
	3:0	SF	6 to 12
10	7:0	Payload length	numbers of bytes
11	7:3	Reserve	
	2:2	Implicit header enable	
	1:0	Modulation Bandwidth	2:500, 1:250, 0:125 kHz
12	15:8	Preamble symbol number	Number of symbols in the preamble
13	7:0		
14		Reserved	
15		Reserved	

Table 4 – FSK Specification

Byte	Subfield	Description	Comment
9	7:0	FSK frequency deviation	FSK frequency deviation
10	7:0	Payload length	numbers of bytes
11	0	Packet mode	0-> fixed length 1->Variable length
	1	CRC Enable	0-> No CRC 1-> CRC
	3:2	Dcfree ENC	00-> DC free encoding off 01-> Manchester encoding 10-> Whitening encoding 1-> RESERVED
	4	CRC IBM	0-> CCITT CRC 1-> IBM CRC
12	15:8	FSK Preamble size	The number preamble bytes send over the air before the sync pattern
13	7:0	FSK Preamble size	
14	15:8	FSK Bite rate	bit rate=32e6/(FSK bit Rate)
15	7:0	FSK Bite rate	
16		Payload First byte	Up to 128 bytes

8.0 Electrical Characteristics

8.1 Absolute maximum rating

Table 5 – Absolute maximum rating(for USB Only)

Symbol	Min	Typ.	Max	Unit
V_{IN}	5V Input Voltage	-0.5	6.0	V
V_{GPIO_ref}	GPIO Voltage	-0.5	3.6	V
V_{GPIO}	GPIO Input Voltage	-0.5	$V_{GPIO_ref} + 0.5v$	V

8.2 DC Characteristics

Table 6 – DC Characteristics

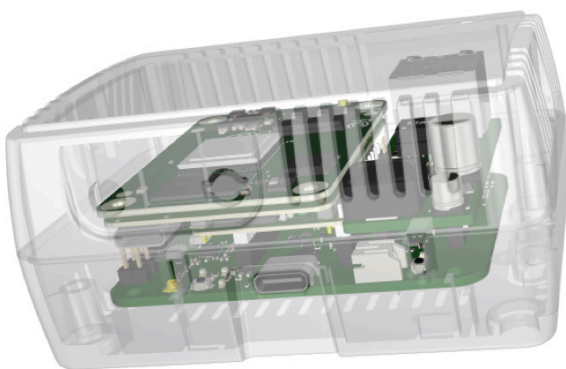
Parameter	Conditions	Symbol	Min	Typ.	Max	Unit
Input low Voltage	$V_{ref} = 3.3V$	$V_{IL(GPIO)}$	0	–	0.8	V
Input high Voltage	$V_{ref} = 3.3V$	$V_{IH(GPIO)}$	2.0	–	V_{GPIO_ref}	V
Input low Voltage	$V_{ref} = 1.8V$	$V_{IL(GPIO)}$	0	–	0.35	V
Input high Voltage	$V_{ref} = 1.8V$	$V_{IH(GPIO)}$	0.65	–	V_{GPIO_ref}	V
Input leakage current	–	$V_{IL(GPIO)}$	–	–	10	μA
Output low Voltage	–	$V_{OL(GPIO)}$	–	–	0.4	V
Output high Voltage	–	$V_{OH(GPIO)}$	$V_{GPIO_ref} - 0.4$	–	–	V
Output current	1mA	$I_{O(GPIO)}$	–	1.3	–	mA
Output current	2mA	$I_{O(GPIO)}$	–	2.6	–	mA
Output current	3mA	$I_{O(GPIO)}$	–	3.9	–	mA
Output current	4mA Default	$I_{O(GPIO)}$	–	5.3	–	mA
Output current	5mA	$I_{O(GPIO)}$	–	6.6	–	mA
Output current	6mA	$I_{O(GPIO)}$	–	7.9	–	mA
Output current	7mA	$I_{O(GPIO)}$	–	9.2	–	mA
Output current	8mA	$I_{O(GPIO)}$	–	10.5	–	mA
Pull up resistor	$V_{ref} = 3.3V$	$R_{PU(GPIO)}$	33	47	73	$K\Omega$
Pull down resistor	$V_{ref} = 3.3V$	$R_{PD(GPIO)}$	33	47	73	$K\Omega$
Pull up resistor	$V_{ref} = 1.8V$	$R_{PU(GPIO)}$	18	47	73	$K\Omega$
Pull down resistor	$V_{ref} = 1.8V$	$R_{PD(GPIO)}$	18	47	73	$K\Omega$

8.3 Power Consumption

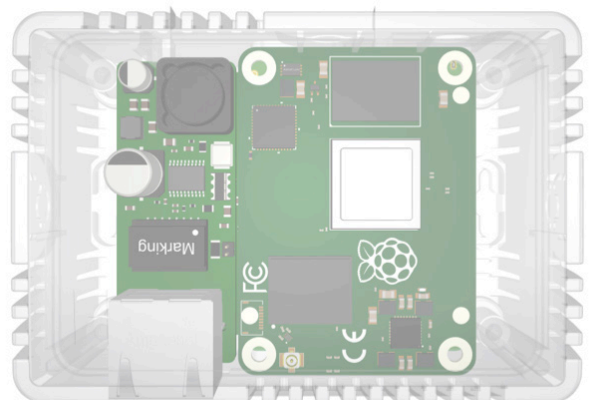
Table 7 – Power consumption

Parameter	Conditions	Symbol	Min	Typ.	Max	Unit
Shut down current	GLOBAL_EN=0v	I_{shutdown}	–	15	–	μA
Shut down current	GLOBAL_EN=2v	I_{shutdown}	–	8	–	mA
Idle current	GLOBAL_EN=2v	I_{idle}	–	400	–	mA
Operation current	GLOBAL_EN=2v	I_{load}	–	1400	–	mA

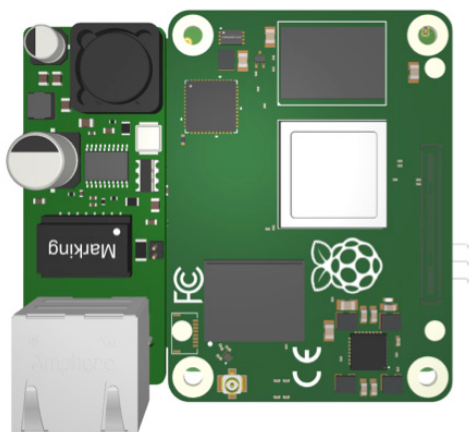
9.0 Mechanical Drawings of Hotspot



Side View of the Hotspot



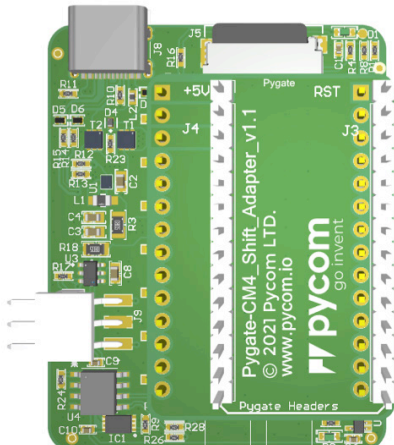
Top View of the Hotspot



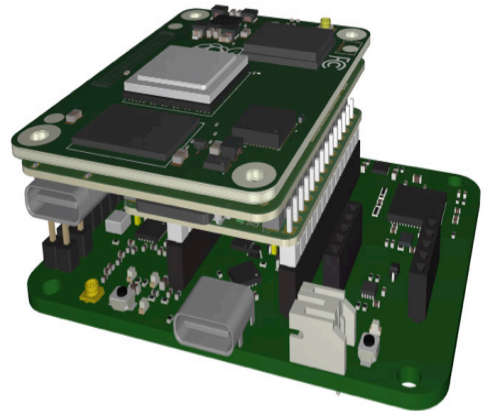
PoE ethernet Module with Raspberry Pi Compute Module 4 – Top View



Adapter Board for Compute module for Pygate – Top View



Adapter Board for Compute module for Pygate – Bottom View



Assembled Pygate with the Adapter Board and Raspberry Pi
compute Module 4 – S ide view

10.0 Certification

RED Directive
CE
FCC
IC
RCM (pending)

More information follows below in sections

10.1 EU Regulatory Conformance

This device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC

10.2 Federal Communication Commission Compliance Statement

Contains FCC ID: 2AJMTPYGATE
Contains FCC ID: 2ABCB-RPICM4

10.2.1 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.

10.2.2 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 not authorized.

The device uses antennas with maximum gain as listed below:

- LoRa External antenna: 0.87dBi
- WiFi/BLE Internal antenna: 3.5dBi @2.4GHz, 2.5dBi @5GHz
- WiFi/BLE External antenna: 1.6dBi @2.4GHz, 2.0dBi @5GHz

10.2.3 Supplier's Declaration of Conformity (47 CFR § 2.1077 Compliance Information)

Product Name: Pycom Hotspot
Manufacturer: Pycom Ltd
Surrey Technology Park 2 Huxley Road, Guildford Surrey GU2 7RE, United Kingdom

Identification of the authorized co-located modules used in the assembly:

Module: Pygate

FCC ID: 2AJMTPYGATE, <https://fccid.io/2AJMTPYGATE>

Module: Raspberry Pi Compute Module 4 (CM4)

FCC ID: 2ABCB-RPICM4, <https://fccid.io/2ABCB-RPICM4>

Standard(s) applied:

FCC Part 15B - For Unintentional radiators.

FCC 47 CFR §1.1307 & §2.1091 - Maximum Permissible Exposure (MPE)

10.2.4 End Product Labelling

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

10.3 ISED Regulatory Approval

Contains IC: 22263-PYGATE
Contains IC: 20953-RPICM4

The device uses antennas with maximum gain as listed below:

- LoRa External antenna: 0.87dBi
- WiFi/BLE Internal antenna: 3.5dBi @2.4GHz, 2.5dBi @5GHz
- WiFi/BLE External antenna: 1.6dBi @2.4GHz, 2.0dBi @5GHz

10.3.1 ISED RSS Warning

ISED RSS Warning: This device complies with Innovation, Science and Economic Development Canada licence-exempt RSS standard(s). 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'ISED applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

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

10.3.2 ISED RF exposure statement:

This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Le rayonnement de la classe b respecte ISED fixaient un environnement non contrôlés. Installation et mise en œuvre de ce matériel devrait avec échangeur distance minimale entre 20 cm ton corps. Lanceurs ou ne peuvent pas coexister cette antenne ou capteurs avec d'autres.

10.4 Helium Certification

This Pycom Hotspot has been through official Helium certification and has passed.

11.0 Packaging

The Helium Hotspot comes in a cardboard package measuring 16.5 cm x 24.5 cm x 5cm.

12.0 Ordering

Table 8 – Ordering information

PRODUCT	DESCRIPTION		EAN	UPC
Helium Hotspot 868Mhz	Pygate and RPi based hotspot for Helium networks in Europe	NEW	0604565430526	604565430526
Helium Hotspot 915Mhz	Pygate and RPi based hotspot for Helium networks in USA, Canada and Australia	NEW	0604565430533	604565430533

13.0 Revision

Table 9 – Document revision history

Version	Date	Initial Release
Version 1.0	29 Oct 2021	First version
Version 1.1	10 Mar 2021	Small amends to first version
Version 1.12	10 Mar 2021	Upgrade from 32GB to 64GB uSD Card