# G01

Datasheet

Version 1.0

pycom
GO INVENT

ESP32 Dual Core
Microcontroller and
WiFi/Bluetooth 4.2 radio

8MB flash
memory

LTE CAT M1 / NB1
transceiver

Size                              40mm x 16mm x 2.7mm

## 1.0    Overview

With WiFi, BLE and cellular LTE–CAT M1/NB1, the
G01 OEM Module is the latest Pycom triple–bearer
MicroPython enabled micro controller 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, BLE and state of the art WiFi radio. 1KM
  Wifi Range
– MicroPython enabled
– Can be directly surface mount inside your product like
  a regular component
– Ultra–low power usage: a fraction compared to other
  connected micro controllers

## 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

### 3.5　LTE CAT–M1/NB–IoT
- One single chip for both CAT M1 and NB1
- 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
- Peak power estimations:
  TX current = 420mA peak @1.5Watt
  RX current = 330mA peak @1.2Watt
- Extended DRX (eDRX) and PSM features for long sleep duration use cases

### 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
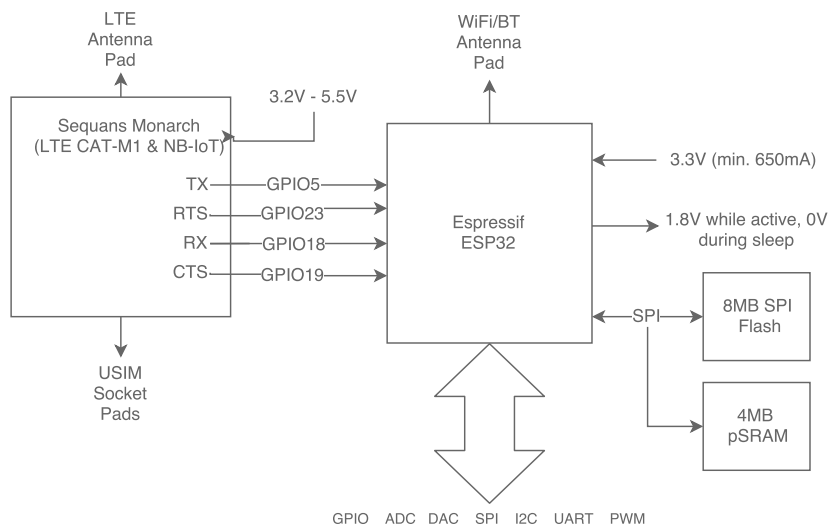


*Figure 1 – System block diagram*

# 5.0    Pinout

23/01/18



Only Input pins!
No pullup/pulldown
internal resistance

*Absolute MAX per pin 12mA
recommended 6mA*

*Outputs 1V8 while the module
is in active mode, and drops
to 0V during deep sleep*

*Supply with a stable 3V3 power source
capable of delivering at least 950mA*

**Boot modes and safe boot**

P12 + 3V3

1-3 sec  Safe boot, latest firmware is selected
4-6 sec  Safe boot, previous user update selected
7-9 sec  Safe boot, the factory firmware is selected

**Low Level Bootloader**

P2 + GND

LTE CAT M1 / NB1 Antenna

WiFi / Bluetooth
Antenna

PROGRAM
Port

Connected to
the LTE radio

Power
GND
Serial Pin
Analog Pin
Control
Physical Pin
Port Pin
Touch Pin
DAC Pin
PWM Pin

*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 | – | – | Ground | | | | |
| 2 | – | – | Ground | | | | |
| 3 | – | – | Ground | | | | |
| 4 | – | – | USIM Clock | | | | |
| 5 | – | – | USIM I/O | | | | |
| 6 | – | – | Ground | | | | |
| 7 | – | – | Ground | | | | |
| 8 | – | – | Ground | | | | |
| 9 | – | – | Reset | | | | Active Low |
| 10 | 3 | P0 | RX0 (Programming) | | • | | Used by the bootloader and to program the module |
| 11 | 1 | P1 | TX0 (Programming) | | • | | Used by the bootloader and to program the module |
| 12 | 0 | P2 | | 2* | • | • | If tied to GND during boot the device will enter bootloader mode |
| 13 | 4 | P3 | TX1 | 2* | • | • | |
| 14 | 15 | P4 | RX1 | 2* | • | • | JTAG TDO, SD card CMD |
| 15 | 5 | – | Sequans modem RX | | • | | Not recommended for external use |
| 16 | 27 | – | Sequans modem Interrupt | 2* | • | • | Not recommended for external use |
| 17 | 19 | – | Sequans modem CTS | | • | | Not recommended for external use |
| 18 | 2 | P8 | | 2* | • | • | SD card DAT0 |
| 19 | 12 | P9 | SDA | 2* | • | • | JTAG TDI |

## 6.0  Pin Details

*Table 1 – Module pinout*

| Module Pin | ESP32 GPIO | Pin Name | Default Function | ADC | PWM | RTC† | Notes |
|---|---|---|---|---|---|---|---|
| 20 | 13 | P10 | SCL (I2C) / CLK (SPI) | 2* | ● | ● | JTAG TCK |
| 21 | 22 | P11 | MOSI | | ● | | |
| 22 | 21 | P12 | | | ● | | If tied to 3.3V during boot the device enters safe boot mode, JTAG MISO |
| 23 | – | – | Ground | | | | |
| 24 | – | – | Ground | | | | |
| 25 | – | – | WiFi/BT antenna | | | | 50 Ohm impedance required |
| 26 | – | – | Ground | | | | |
| 27 | – | – | Ground | | | | |
| 28 | – | – | Ground | | | | |
| 29 | 36 | P13 | | 1 | | ● | Input only |
| 30 | 37 | P14 | | 1 | | ● | Input only |
| 31 | 38 | P15 | | 1 | | ● | Input only |
| 32 | 39 | P16 | | 1 | | ● | Input only |
| 33 | 35 | P17 | | 1 | | ● | Input only |
| 34 | 34 | P18 | | 1 | | ● | Input only |
| 35 | 32 | P19 | | 1 | ● | ● | |
| 36 | 33 | P20 | | 1 | ● | ● | Connected to the on−board RGB LED |
| 37 | 26 | P21 | | 2* | ● | ● | DAC |
| 38 | 25 | P22 | | 2* | ● | ● | DAC |
| 39 | 14 | P23 | | 2* | ● | ● | JTAG TMS, SD card SCLK |

## 6.0    Pin Details

*Table 1 − Module pinout*

| Module Pin | ESP32 GPIO | Pin Name | Default Function | ADC | PWM | RTC† | Notes |
|---|---|---|---|---|---|---|---|
| 40 | – | – | 3.3V input | | | | This supply should be able to source 650mA |
| 41 | – | – | Ground | | | | |
| 42 | – | – | 1.8V Output | | | | Only when the device is active, during deep sleep this drops to 0V |
| 43 | – | – | Ground | | | | |
| 44 | – | – | Ground | | | | |
| 49 | – | – | 3.2−5.5V input | | | | Powers the Sequans cellular modem |
| 50 | – | – | Ground | | | | |
| 51 | – | – | LTE CAT−M1/NB−IoT antenna | | | | 699−960 and 1710−2170Mhz depending on local carrier bands, 50 Ohm impedance required |
| 52 | – | – | Ground | | | | |
| – | 23 | – | Sequans modem TX | | | | |
| – | 18 | – | Sequans modem RTS | | | | |

† 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.<br>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.<br>Note: P13–18 can only be mapped to MISO since they are input only. |
| CAN* | 1 | Remappable to any GPIO.<br>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)
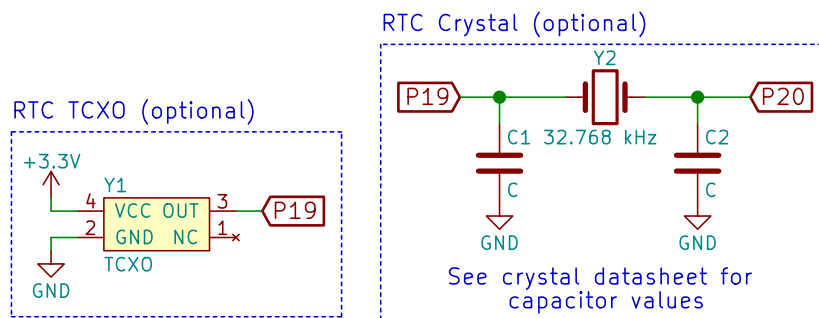


*Figure 3 – External RTC crystal circuits*

## 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. 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 G01 also acts as a Wi−Fi access point
SSID: gpy−wlan−XXXX
Password: www.pycom.io
Once connected to the G01'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 G01 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 G01 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 module requires a regulated 3V3 power supply (for WiFi, Bluetooth and the core processor), and a non-regulated 3.2 to 5.5V supply for the LTE sub-system. The 1V8 pin is only an output which is enabled whenever the module is in active mode. During deepsleep the 1V8 signal goes low. Do not supply power to the 1V8 pin, and never use this pin as a power supply, only as a control signal.

## 10.1   Current consumption by power modes/features running at 3.7V

*Table 4 – Power consumption by feature*

| Mode | Min | Avg. | Max | Units |
|---|---|---|---|---|
| Idle (no radios) | – | 37 | – | mA |
| LTE Transmit | – | 173 | 285 | mA |
| LTE Attached | – | 75 | – | mA |
| WiFi AP | – | 117 | – | mA |
| WiFi client | – | 130 | – | mA |
| Bluetooth | – | 113 | – | mA |
| Deep sleep | – | 13.5 | – | mA |

## 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 |
| File system (2) | 4MB file system on devices with 8MB flash | 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 LTE CAT–M1/NB–IoT

## 14.1 Supported features

- 12 bands supported from 699Mhz to 2690Mhz (Total worldwide support)
- 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

*Table 15 – LTE modem performance*

| 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 |

## 14.2.1 Supported LTE bands

*Table 16 – Supported LTE bands*

| Bands | TX Frequencies | RX Frequencies |
|---|---|---|
| Low Bands 5, 8, 12, 13, 18, 19, 20, 28 | 699 to 915 MHz | 729 to 960 MHz |
| Mid Bands 1, 2, 3, 4 | 1710 to 1980 MHz | 1805 to 2170 MHz |

## 14.3 SIM Card requirements

*Table 17 – SIM card specificiations*

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

## 14.4 Certified carriers

*Table 18 – Certified carriers*

| Carrier | Country | Network |
|---|---|---|
| Verizon US | United States | LTE CAT–M1 |

## 15.0  Electrical Characteristics

### 15.1  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 | – | – |

### 15.2  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 |

## 16.0    Minimum Recommended Circuit
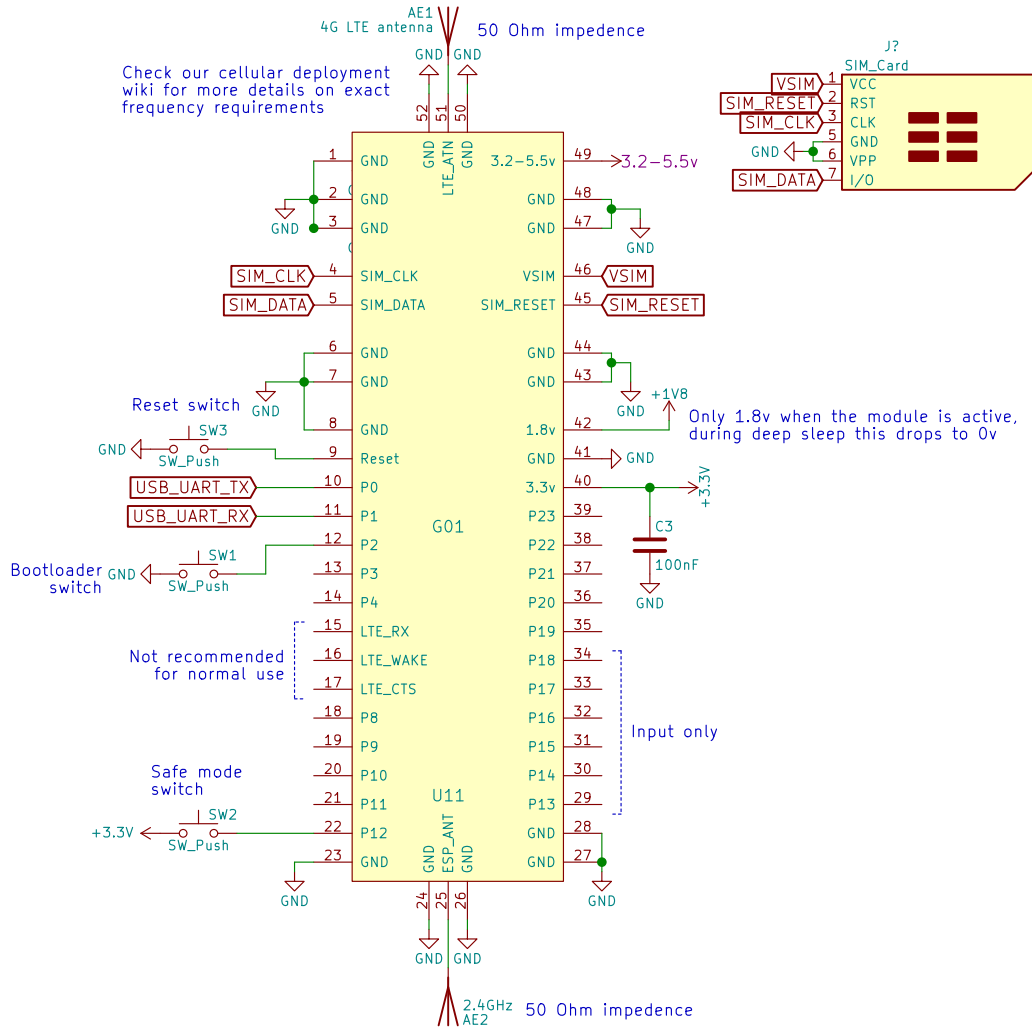


*Figure 4 – Minimum required circuit*

## 17.0    Mechanical Specifications
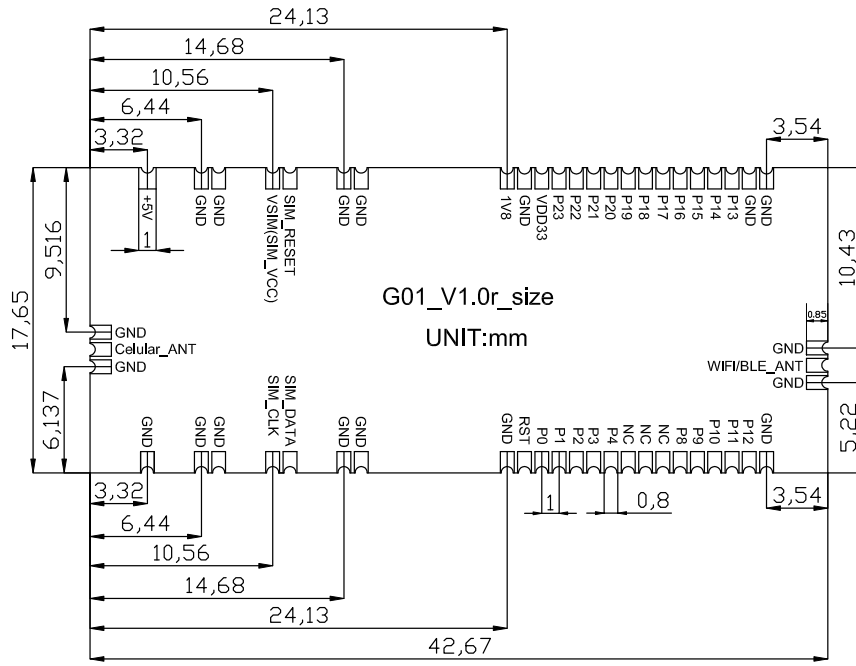


*Figure 5 – Mechanical drawing (top down view)*

## 18.0    Recommended Land Patterns
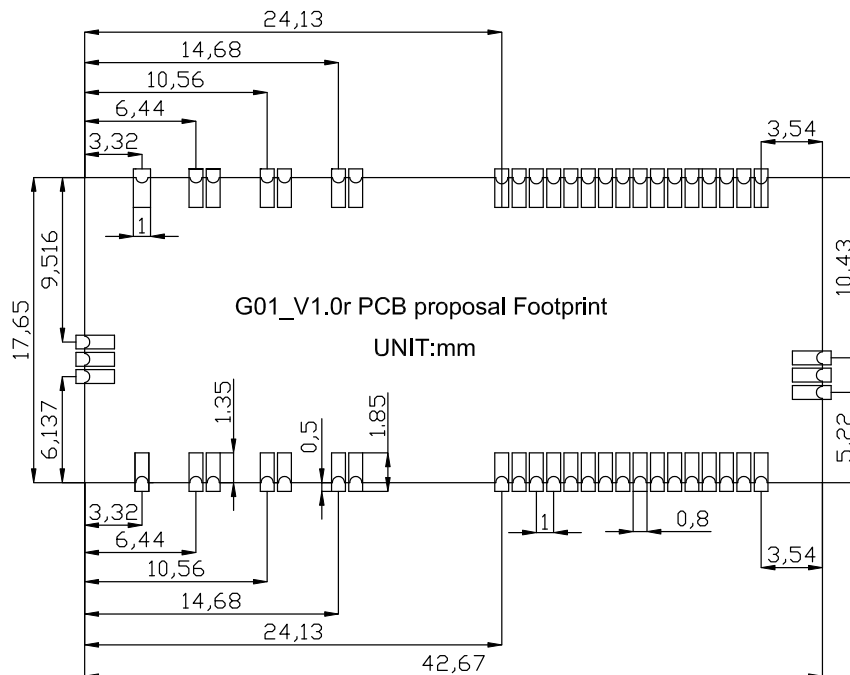


*Figure 6 – Recommended land pattern*

## 19.0  Design Considerations

### 19.1  Antenna Impedance

Our OEM modules are intended to be used with a 50−ohm antenna. They are also required to be connected to the antenna by a 50−ohm grounded co−planar waveguide (as shown in the reference design below with the yellow lines) or a microstrip.
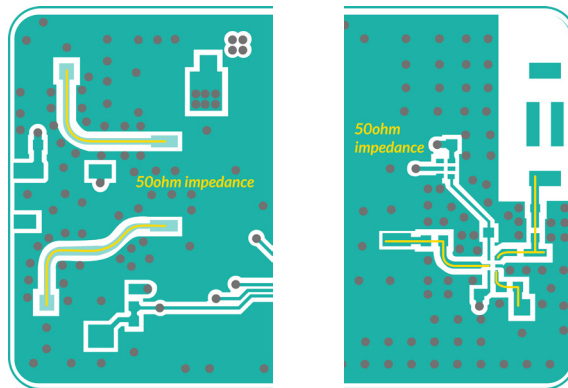


*Figure 7 – 50−ohm impedance antenna connections*

### 19.2  Deep sleep power

When selecting a voltage regulator for your application ensure that it has a low power mode, and that this is enabled when the device enters deep sleep. We also recommend cutting off power to all non−essential components such as LEDs, logic gates, sensors etc. when the device is in deep sleep. This can be done using the circuit shown right:

This circuit uses the 1.8V output of the module to cut off supply to non−essential circuitry. The 1.8V output is only active when the module is running, when it goes to deep sleep it drops to 0V. The non−essential circuitry is then powered from the "ACTIVE_POWER" bus
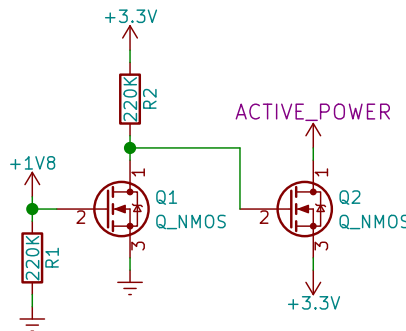


*Figure 8 – Power switch for deep sleep mode*

### 19.3 Reference layout

Below you will find the designs for our universal reference board that fits all of our OEM modules. The design files can be downloaded from our website.
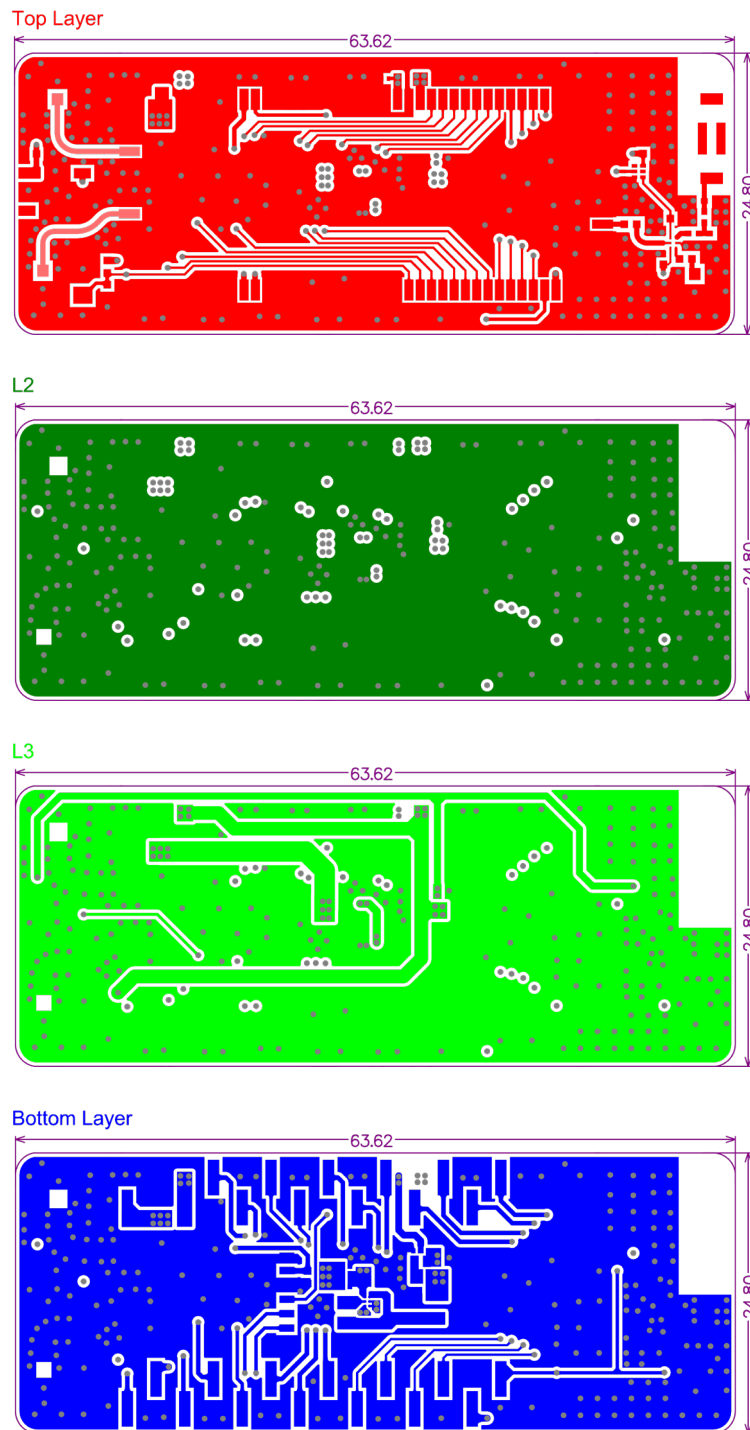
Top Layer

L2

L3

Bottom Layer

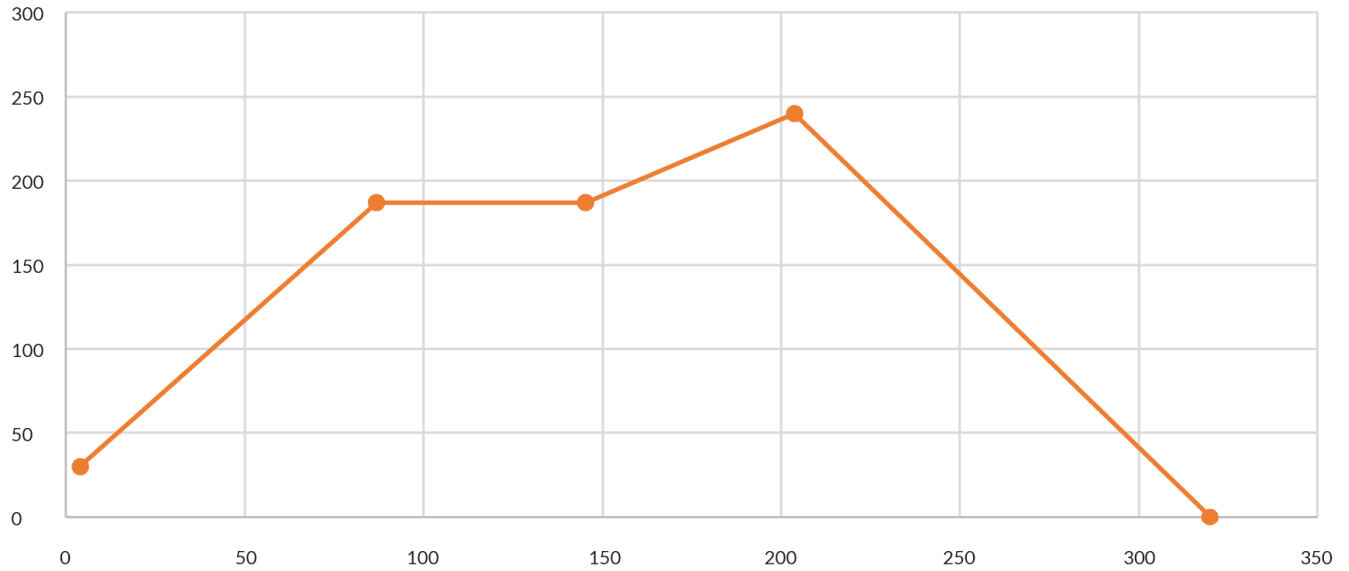*Figure 9 – PCB layers for reference design – Units: mm*

## 20.0   Soldering Profile



*Figure 10 – Reflow soldering temperature profile*

*Table 21– 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.
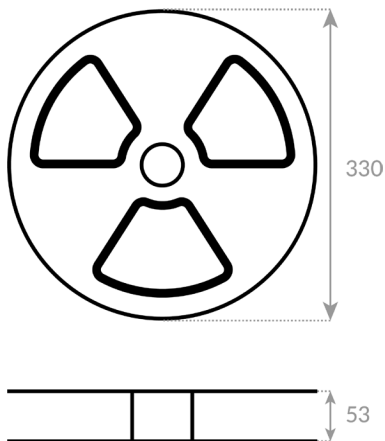
## 21.0 Ordering Information

*Table 22 – Ordering information*

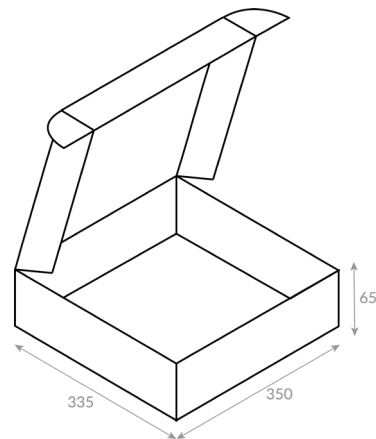| Product EAN | Description |
|---|---|
| 0700461341598 | G01 – OEM version of GPy 1.0 |
| 0700461908845 | Reel of 250 G01 OEM modules |
| 0700461908968 | Reel of 500 G01 OEM modules |

## 22.0 Packaging

### 22.1 Reel

*Figure 11 – Mechanical drawing of reel – Units: mm*
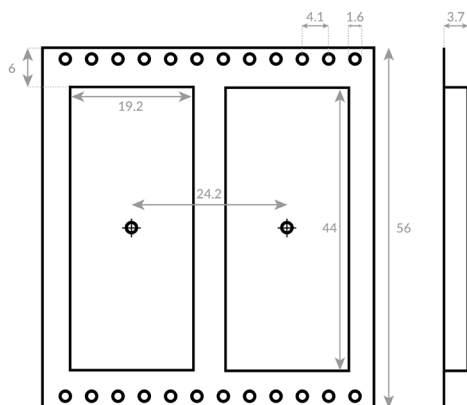


### 22.3 Box

*Figure 13 – Mechanical drawing of reel box – Units: mm*



### 22.2 Tape

*Figure 12 – Mechanical drawing of reel tape – Units: mm*

## 23.0  Certification

FCC    2AJMTG01R
IC      22263–G01R
CE      0700
Copies of the certificates can be found on our website.

## 24.0  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: 2AJMTG01R". 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 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 −40~+85C

Receiver category 3

## 25.0   Revision History

*Table 23 − Document revision history*

| Version 1.0 | Initial Release |
|---|---|