



**TM2500**

**GSM/GPRS/GNSS/BLUETOOTH module**

**USER MANUAL**

Version 0.2

FOR OEM OR INTEGRATORS ONLY: This module is limited to OEM installation only and must not be sold to end-users.

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OEM integrators must be instructed to ensure that the end-user has no manual instructions to remove or install the device.

The end-user can not remove or install this module to any other devices.

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## INTRODUCTION

### 1.1 Contact information, Support

The TM25 Hardware User Manual contains all information necessary for a successful integration of the GSM/GPRS module TM25 into the customer applications.

This document is intended for Teltonika customers to support application and engineering efforts that use the products designed by Teltonika. The document contains a description interfaces present on the module.

#### Contact information, Support

For general contact, technical support, to report documentation errors and manuals, contact Teltonika Technical Support Center at: [support@teltonika.lt](mailto:support@teltonika.lt)

### 1.2 Related Documents

At\_commands\_Manual

### 1.3 OVERVIEW

This document describes Teltonika GSM/GPRS/GPS/BLUETOOTH module: mechanical and electrical parameters, pin-outs descriptions, hardware commands, power supply parameters, I/O and port descriptions, mounting and packing information as well as the design rules of the module integration within user application.

The document contains some hardware solutions for developing a product with the Teltonika TM25 module, suggested hardware solutions can be taken as a base for developing the product with Teltonika TM25 module.

## 1.4 SCOPE OF THE PRODUCT

TM25 is a Quad-band GSM/GPS/BLUETOOTH module, with tiny profile of 17mm x 17mm x 2.5mm. Module works at 850MHz, 900MHz, 1800MHz, 1900MHz frequencies. TM25 contains GPRS multi-slot class 12 and supports the GPRS coding schemes CS-1, CS-2, CS-3, CS-4.

## 1.5 CERTIFICATION

TM25 GSM/GPRS/GPS/BLUETOOTH module is certified by CE approval report Radio & Telecommunications Terminal Equipment Directive (R&TTED) report.

Hereby, Teltonika declares that this GSM/GPRS/GPS/BLUETOOTH Data Module is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The directives that are followed for this data module are described below:

### **MODEM features**

#### Radio interface and baseband front-end

- Digital PM data path with baseband front-end
- High dynamic range delta-sigma ADC converts the downlink analog I and Q signal to digital baseband.
- 10-bit D/A converter for Automatic Power Control (APC).
- Programmable radio Rx filters with adaptive gain control.
- Dedicated Rx filter for FB acquisition.
- 6-pin Baseband Parallel Interface (BPI) with programmable driving strength
- Supports multi-band

#### Voice and modem CODEC

- Dial tone generation
- Voice memo
- Noise reduction
- Echo suppression
- Advanced sidetone oscillation reduction
- Digital sidetone generator with programmable gain
- Two programmable acoustic compensation filters

- Supports GSM/GPRS modem
- GSM quad vocoders for adaptive multirate (AMR), enhanced full rate (EFR), full rate (FR) and half rate (HF)
- GSM channel coding, equalization and A5/1, A5/2 and A5/3 ciphering
- GPRS GEA1, GEA2 and GEA ciphering
- GPRS packet switched data with CS1/CS2/CS3/CS4 coding schemes
- GPRS Class 12
- Supports SAIC (single antenna interface cancellation) technology
- Supports VAMOS (Voice services over Adaptive multi-user channels on One Slot).

#### Voice interface and voice front-end

- Microphone input has one low-noise amplifier with programmable gain Automatic Gain Control (AGC) mechanisms
- Voice power amplifier with programmable gain
- 2nd order Sigma-Delta A/D converter for voice uplink path
- Shares D/A converter with audio playback path
- Supports full-duplex hands-free operation
- Compliant with GSM 03.50

### **GSM/GPRS RF Features**

#### Receiver

- Dual single-ended LNAs support Quad band Quadrature RF mixer
- Fully integrated channel filter
- High dynamic range ADC
- -12dB PGA gain with 6dB gain step

#### Transmitter

- Transmitter outputs support quad bands.
- Highly precise and low noise RF transmitter for GSM/GPRS applications

### Frequency synthesizer

- Programmable fractional-N synthesizer
- Integrated wide range RFVCO
- Integrated loop filter
- Fast settling time suitable for multi-slot GPRS applications.

### Digitally-Controlled Crystal Oscillator (DCXO)

- Two-pin 25MHz crystal oscillator
- On-chip programmable capacitor array for coarse-tuning
- On-chip programmable capacitor array for fine-tuning
- Low power mode supports 32K crystal removal

## **Bluetooth features**

### Radio feature

- Fully compliant with Bluetooth specification 3.0
- Low out-of-band spurious emissions support simultaneous operation with GPS and GSM\SM/GPRS worldwide radio systems
- Low-IF architecture with high degree of linearity and high order channel filter
- Fully integrated PA provides 7.5 dBm output power
- -95 dBm sensitivity with excellent interference rejection performance
- Hardware AGC dynamically adjusts receiver performance in changing environments

### Baseband features

- Up to 4 simultaneous active ACL links
- Up to 1 simultaneous SCO or eSCO link with CVSD coding
- Supports eSCO
- Scatternet support: Up to piconets simultaneously with background inquiry/page scan
- Supports sniff mode
- AFH and PTA collaborative support for WLAN/BT coexistence
- Idle mode and sleep mode enables ultra-low power consumption

- Supports PCM interface and built-in programmable transcoders for linear voice with re-transmission
- Built-in hardware modem engine for access code correction, header error correction, forward error correction, CRC, whitening and encryption
- Channel quality driven data rate adaptation
- Channel assessment for AFH

#### Platform features

- Embedded processor for Bluetooth protocol stack with build-in memory system
- Fully verified ROM based system with code patch for feature enhancement

#### **FM Features**

- 65-108 MHz worldwide FM bands with 50KHz tuning step
- Supports RDS/RBDS radio data system
- Digital stereo demodulator
- Adaptive FM demodulator for both high- and low-quality scenarios
- Low sensitivity level with superior interference rejection
- Programmable de-emphasis (bypass/50 S/75 S)
- Stereophonic multiplex signal (MPX) signal detection and demodulation
- Superior stereo noise reduction and soft mute volume control
- Mono/stereo blending
- Audio sensitivity 3dBu Vemf (SINAD=26dB)
- Audio SINAD  $\geq 60$ dB
- Supports Anti-jamming algorithm
- Supports short antenna

#### **GPS features**

- GPS/GLONASS/GALILEO/BEIDOU receiver
- Supports multi-GNSS, QZSS, SBAS ranging
- Supports WAAS,EGNOS,MSAS,GAGAN
- 12 multi-tone active interference cancellers



- RTCM ready
- Indoor and outdoor multi-path detection and compensation
- Supports FCC E911 compliance and A-GPS
- Max. fixed update rate up to 10 Hz

## Application Functions

TM2500 is an SMD type module with 129 LGA pads. From 129 pads, 28 are GROUND pads, 14 General purpose (GPIO) pads and other purpose pins.

### 1.6 Application Modes Introduction

TM2500 module is integrated with GSM, GNSS and BLUETOOTH engines which can work as a whole unit (all-in-one solution) or work independently (stand-alone solution) according to customer demands.

## POWER SUPPLY

### 1.7 Power Supply Requirements

The external power must be connected to modem power pads.

**Table 1** TM2500 Power supply range

POWER SUPPLY	
Nominal Supply Voltage	+4.0 V
Normal Operating Voltage range	+3.4 – 4.2 v

### 1.8 Power Features of GSM Part

The power supply of the GSM part is one of the main issues in TM2500 module, because GSM modem could provide short current bursts consumption up to maximum 2A during transmissions. The operating Voltage Range must never be exceeded. Power supply range of GSM part is from 3.3V to 4.6V. Special care must be taken when designing the applications power supply section to avoid having an excessive voltage drop. If the voltage drop is exceeding the limits it could cause a Power Off of the module.

The VBAT trace should be wide enough to ensure that there is not too much voltage drop during burst transmission. The width of trace should be no less than 2mm; and in principle, the longer the VBAT trace, the wider it will be.

### 1.8.1 Reference Design for Power Supply

It is suggested to control the module's main power supply (VBAT) via LDO enable pin to restart the module when the module becomes abnormal. Power switch circuit like P-channel MOSFET switch circuit can also be used to control VBAT.

### 1.8.2 Power Features of GNSS Part

Power supply range of GNSS part is from 2.8 to maximum 4.3V.

### 1.8.3 Monitor power supply

The AT command AT+CBC can be used to monitor the supply voltage of the GSM part. The unit of the displayed voltage is mV. For details, please refer to AT commands manual.

### 1.8.4 Minimum Functionality Mode

Minimum functionality mode reduces the functionality of the GSM part to a minimum level. The consumption of the current can be minimized when the slow clocking mode is activated at the same time.

The mode is set via the **AT+CFUN** command which provides the choice of the functionality levels <fun>=0, 1, 4

- 0: minimum functionality
- 1: full functionality (default)
- 4: disable from both transmitting and receiving RF signals

If the GSM part is set to minimum functionality by **AT+CFUN=0**, the RF function and SIM card function

would be disabled. In this case, the UART port is still accessible, but all AT commands related with RF function or SIM card function will be unavailable.

If the GSM part is set by the command **AT+CFUN=4**, the RF function will be disabled, but the UART port

is still active. In this case, all AT commands related with RF function will be unavailable.

After the GSM part is set by **AT+CFUN=0** or **AT+CFUN=4**, it can return to full functionality mode by **AT+CFUN=1**.

For more detailed information about AT+CFUN, please refer to AT commands manual document.

## 1.9 SLEEP Mode

SLEEP mode is disabled by default. It can be enabled by **AT+ESLP=1** and the premise is that the GNSS is powered off. The default setting is **AT+ESLP=0**, and in this mode, the GSM part cannot enter SLEEP mode.

When the GSM part is set by the command **AT+ESLP=1**, you can control the part to enter into or exit from the SLEEP mode through pin DTR. When DTR is set to high level, and there is no on-air or hardware interrupt such as GPIO interrupt or data on UART port, the GSM part will enter into SLEEP

mode automatically. In this mode, the GSM part can still receive voice, SMS or GPRS paging from network, but the UART port does not work.

### 1.10 Operating Modes of GNSS Part

Full on mode includes tracking mode and acquisition mode. Acquisition mode is defined as that the GNSS part starts to search satellites, and to determine the visible satellites, coarse carrier frequency & code phase of satellite signals. When the acquisition is completed, it switches to tracking mode automatically. Tracking mode is defined as that the GNSS part tracks satellites and demodulates the navigation data from specific satellites. When the GNSS\_VCC is valid, the GNSS part will enter into full on mode automatically.

### 1.11 Power consumption

TM2500 module power consumptions:

**Table 2** Power consumption table

Mode	Average Current Consumption	Note
Power OFF Mode	1.01 mA	Module supplied but Switched off
2G (GSM) Talk Mode @ 850/900 MHz, PCL=5 (P=33dBm)	251.7 mA	
2G (GSM) Talk Mode @ 1800/1900 MHz, PCL=0 (P=30dBm)	181.5 mA	
2.5G (GPRS 2+1) TBF mode @850/900 MHz, PCL = 5 (P=33dBm)	252.7 mA	
2.5G (GPRS 2+2) TBF mode @850/900 MHz, PCL = 5 (P=33dBm)	365.5 mA	
2.5G (GPRS 2+1) TBF mode @1800/1900 MHz, PCL = 0 (P=30dBm)	175.5 mA	
2.5G (GPRS 2+2) TBF mode @1800/1900 MHz, PCL = 0 (P=30dBm)	256.2 mA	

The listed current consumption values are referred to the average current consumption of the whole module, when the module supply voltage is 4V and signal power is -75dBm.

The RF transmission is not continuous in the GSM system, the transmission is packed into bursts at a base frequency of about 216 Hz, and the relative current peaks can be as high as about 2.5 A.

Therefore the power supply has to be designed in order to withstand with these current peaks without big voltage drops.

### 1.11.1 Power down

The following procedures can be used to turn off the module:

- Normal power down procedure: Turn off module using the PWRKEY pin.
- Over-voltage or under-voltage automatic shutdown: Take effect when over-voltage or under-voltage is detected.

## 1.12 Power Saving

Based on system requirements, there are several actions to drive the module to enter low current consumption status. For example, „AT+CFUN“ can be used to set module into minimum functionality mode and DTR hardware interface signal can be used to lead system to SLEEP mode.

### 1.13 Minimum functionality mode

Minimum functionality mode reduces the functionality of the module to a minimum level. The consumption of the current can be minimized when the slow clocking mode is activated at the same time. The mode is set with the “AT+CFUN” command which provides the choice of the functionality levels <AT+CFUN>=0, 1, 4.

- 0: minimal functionality, turn off radio and SIM power.
- 1: can enter normal mode, full functionality.
- 4: can enter flight mode.

#### 1.13.1 SLEEP mode

SLEEP mode is disabled by default. It can be enabled by AT+ESLP=1. The default setting is AT+ESLP=0, and in this mode GSM part cannot enter SLEEP mode.

When the GSM part is set by the command AT+QSCLK=1, you can control the part to enter into or exit from the SLEEP mode through pin DTR. When DTR is set to high level, and there is no on-air or hardware interrupt such as GPIO interrupt or data on UART port, the GSM part will enter into SLEEP mode automatically. In this mode, the GSM part can still receive voice, SMS or GPRS paging from network, but the UART port does not work.

## 1.14 Bluetooth antenna description

TM2500 module provides a Bluetooth antenna pad named BT\_ANT, pin definition listed below.

**Table 3** BT\_ANT pin definition

Pin name	Pin number	Description
BT_ANT	A7	BT antenna pad
GND	A6,A8,B7	Ground

It is necessary to add additional Band Pass filter in to the circuit, we recommend Murata Electronics filter, part. No: LFB182G45SG9A293. For additional information please see TM2500\_Block diagram p.g 10;

For SMT Bluetooth antenna we recommend to use ceramic antenna ANT3216A063R2400A.

**Table 4** Antenna description

Description	Value
Center Frequency	2.45 GHz
Bandwidth	230 MHz(Typ.)
Return Loos	10 dB min
Polarization	Linear
Azimuth Beam width	Omni-directional
Peak Gain	≤1.69 dBi(Typ.)
Impedance	50Ω
Operating Temperature	- 40~105°C
Maximum Power	1 W
Termination	Ni/Sn (Environmentally-Friendly Leadless)
Resistance to Soldering Heats	260°C, 10sec.

On our developed EVB for TM2500, we used coplanar waveguide transmission line. RF transmission line width is 0.5mm, thickness between transmission line and ground is 0.125mm. For examples how to calculate RF line impedance see reference in TM2500 technical operation descriptions, p.g 27-29;

### 1.15 RF Output Power

**Table 5** RF Output power

Frequency	Max.	Min.
GSM850	33dBm	5dBm±
EGSM900	33dBm	5dBm±
DCS1800	30dBm	0dBm±
PCS1900	30dBm	0dBm±

## 1.16 RF Receiving Sensitivity

**Table 6** Receiving Sensitivity

Frequency	Receive Sensitivity
GSM850	<- 110dBm
EGSM900	<- 110dBm
DCS1800	<- 110dBm
PCS1900	<- 110dBm

## 1.17 Operating Frequencies

**Table 7** Operating Frequencies

Frequencies	Receive	Transmit	ARFCH
GSM850	869~894MHz	824~849MHz	128~251
EGSM900	925~960MHz	880~915MHz	0~124, 975~1023
DCS1800	1805~1880MHz	1710~1785MHz	512~885
PCS1900	1930~1990MHz	1850~1910MHz	512~810

## DIGITAL LEVEL SPECIFICATIONS

The following tables show the digital levels specifications used in the TM25 interface circuits:

### 1.18 DC characteristics

Absolute maximum ratings

**Table 8** maximum ratings

Absolute Maximum Rating (Not Functional):
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Description	Input level limit values	
	Min	Max
Generic digital interfaces GPIO	-0.30 V	3.6 V
I2C interface	-0.30 V	3.6 V
UART interface	-0.30 V	3.6 V
SIM interface	-0.30 V	3.6 V
PWR_ON	-0.30 V	3.6 V
EXTRSTn signal	-0.30 V	3.6 V

## Communicate with Module

0. Connect the main port of EVB or the module to PC's USB port with the USB to UART converter cable.
2. Open the COM Port Terminal on PC. Set appropriate Baud Rate (such as 115200 bps) and COM Port number related to module.
3. Attach GSM, GPS and if needed BLUETOOTH ntena to EVB.
4. Insert SIM card into the SIM card socket (main sim card socket is closer to PCB).
5. Power ON EVB.
6. After ntenaf, in COM Port terminal will appear text, with meaning that module boot started. Wait 2-3 seconds, and module will be ready to accept AT commands, ntena to AT commands manual.

The module is set to autobauding mode in default configuration. This operation is to synchronize the baud rate between the computer and the module.

**Table 9** Terms and Abbreviations

Abbreviation	Description
3GPP	3rd Generation Partnership Project
8-PSK	Eight-Phase Shift Keying
AC	Alternating Current
ADC	Analog to Digital Converter
AFC	Automatic Frequency Correction

Abbreviation	Description
ASC	Asynchronous Serial Interface Controller
AT	AT Command Interpreter Software Subsystem, or attention
B2B	Board-to-Board
BABT	British Approvals Board for Telecommunications
CBCH	Cell Broadcast Channel
CBS	Cell Broadcast Services
CGU	Clock Generation Unit
CS	Coding Scheme or Chip Select
CSD	Circuit Switched Data
CTS	Clear To Send
DAI	Digital Audio Interface
DC	Direct Current
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DCS	Digital Cellular System
DL	Down Link (Reception)
DSP	Digital Signal Processing
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTM	Dual Transfer Mode
DTMF	Dual Tone Multi Frequency
DTR	Data Terminal Ready
EDGE	Enhanced Data rates for GSM Evolution
EEPROM	Electrically Erasable and Programmable ROM
E-GPRS	Enhanced GPRS
EGSM	Extended GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FDD	Frequency Division Duplex
FEM	Front End Module



Abbreviation	Description
FFS	Flash File System
GND	Ground
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HDLC	High Level Data Link Control
HSDPA	High Speed Downlink Packet Access
HW	Hardware
JTAG	ntena Test Action Group
I2C	Inter-Integrated Circuit
I2S	Inter IC Sound
IIR	Infinite Impulse Response
IMEI	International Mobile Equipment Identity
I/O	Input / Output
IP	Internet Protocol
IPC	Inter Processor Communication
ISO	International Organization for Standardization
ITU	International Telecommunication Union
LDO	Low-Dropout
LVD	Low ntenaf Directive
M2M	ntena to Machine
MCP	Multi-Chip-Package
MCS	Modulation Coding Scheme
ME	Mobile Equipment
MICTOR	Matched ntenaf Connector
MIDI	Musical Instrument Digital Interface
MS	Mobile Station
MSC	Mobile Switching Centre
MUX	Multiplexer or Multiplexed
NOM	Network Operating Mode

Abbreviation	Description
NTC	ntenaf Temperature Coefficient
PA	Power Amplifier
PBCCH	Packet Broadcast Control Channel
PC	Personal Computer
PCB	Printed Circuit Board
PCCCH	Packet Common Control Channel
PCS	Personal Communications Service
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation Extra ntenafkon for Testing
PLMN	Public Land Mobile Network
PMU	Power Management Unit
PPS	Protocol and ntenaf Selection
PSD	Packet Switch Data
PSRAM	Pseudo Static Random Access Memory
RF	Radio Frequency
RI	Ring Indicator
ROM	Read Only Memory
RTC	Real Time Clock
RTS	Ready To Send
RX	Receiver
R&TTED	Radio and Tele Terminal Equipment Directive
SAW	Surface Acoustic Wave
SCCU	Standby Clock Control Unit
SIM	Subscriber Identification Module
SMA	SubMiniature version A connector
SMPTE	Society of Motion Picture and Television Engineers
SMS	Short Message Service
SPI	Serial Peripheral Interface
SSC	Synchronous Serial Interface Controller

Abbreviation	Description
SW	Software
TCH	Traffic Channel
TCP	Transmission Control Protocol
TS	Technical Specification
TX	Transmitter
UART	Universal Asynchronous Receiver-Transmitter
UDI	Unrestricted Digital Information
UE	User Equipment
UEA	UMTS Encryption Algorithm
UL	Up Link (Transmission)
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIF	Universal Serial interfaces
VC-TCXO	ntena Controlled – Temperature Controlled Crystal Oscillator
WCDMA	Wideband CODE Division Multiple Access

## FCC RF EXPOSURE REQUIREMENTS

### Standards and Regulatory Compliance

#### Standards and certification

The EUT conforms to the following standards and certification requirements:

GSM850/1900, Bluetooth

FCC

47 CFR Part 1 – RF radiation exposure limits

47 CFR Part 2 – Equipment authorization

47 CFR Part C – Bluetooth

### **FCC certification requirements.**

According to the definition of mobile and fixed antenna is described in Part 2.1091(b), this antenna is a mobile antenna.

And the following conditions must be met:

1. The EUT is a mobile antenna; maintain at least a 20 cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.
2. The antenna is only for fixed operation mode. (A Class II Change would be required for near-body Host applications.)
3. A label with the following statements must be attached to the host end product: This antenna contains Tx FCC ID:2AJLOTM2500TLT
4. To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed:
  - GSM850/1900 band < 2 dBi
  - Bluetooth <1.69 dBi
5. This module must not transmit simultaneously with any other antenna or transmitter
6. The host end product must include a user manual that clearly defines operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

For portable devices, in addition to the conditions 3 through 6 described above, a separate approval is required to satisfy the SAR requirements of FCC Part 2.1093

If the device is used for other equipment that separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

For this device, OEM integrators must be provided with labeling instructions of finished products. Please refer to KDB784748 D01 v07, section 8. Page 6/7 last two paragraphs:

A certified modular has the option to use a permanently affixed label, or an electronic label. For a permanently affixed label, the module must be labelled with an FCC ID - Section 2.926 (see 2.2 Certification (labelling requirements) above). The OEM manual must provide clear instructions explaining to the OEM the labelling requirements, options and OEM user manual instructions that are required (see next paragraph).

For a host using a certified modular with a standard fixed label, if (1) the module's FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module FCC ID:2AJLOTM2500TLT" or "Contains FCC ID:2AJLOTM2500TLT" must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

The user manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution: Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

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.

### **FCC RF exposure requirements**

1. Radiated transmit power must be equal to or lower than that specified in the FCC Grant of Equipment Authorization for FCC ID:2AJLOTM2500TLT.
2. To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed:
  - GSM850/1900 band <2 dBi
  - Bluetooth <1.69 dBi
3. This module must not transmit simultaneously with any other antenna or transmitter.
4. 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.

## Change Log

Nr.	Date	Version	Comments
1	2016-08-25	0.1	Preliminary draft release.
2	2016-10-24	0.2	Added BT antenna information and reference.

