

## General Description

The Gotop GT-1513-MTGN is a complete GPS/GNSS engine module that features super sensitivity, ultra low power and small form factor. The GPS/GNSS signal is applied to the antenna input of module, and a complete serial data message with position, velocity and time information is presented at the serial interface with NMEA protocol or custom protocol.

Its  $-165\text{dBm}$  tracking sensitivity extends positioning coverage into places like urban canyons and dense foliage environments where the GPS/GNSS was not possible before. The small form factor and low power consumption make the module easy to integrate into portable devices like PNDs, mobile phones, cameras and vehicle navigation systems.

## Applications

- LBS (Location Based Service)
- PND (Portable Navigation Device)
- Vehicle navigation system
- Mobile phone



**Figure 1: GT-1513-MTGN Top View**

## Features

- Built on high performance, low-power MT3333 chipset
- Ultra high sensitivity:  $-165\text{dBm}$
- Extremely fast TTFF at low signal level
- Built in high gain LNA
- Low power consumption: Max  $20\text{mA}@3.3\text{V}$
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage:  $2.8\text{V}$  to  $4.3\text{V}$
- Operating temperature range:  $-40$  to  $85^\circ\text{C}$
- SMD type with stamp holes
- Small form factor:  $15 \times 13 \times 2.4\text{mm}$
- RoHS compliant (Lead-free)

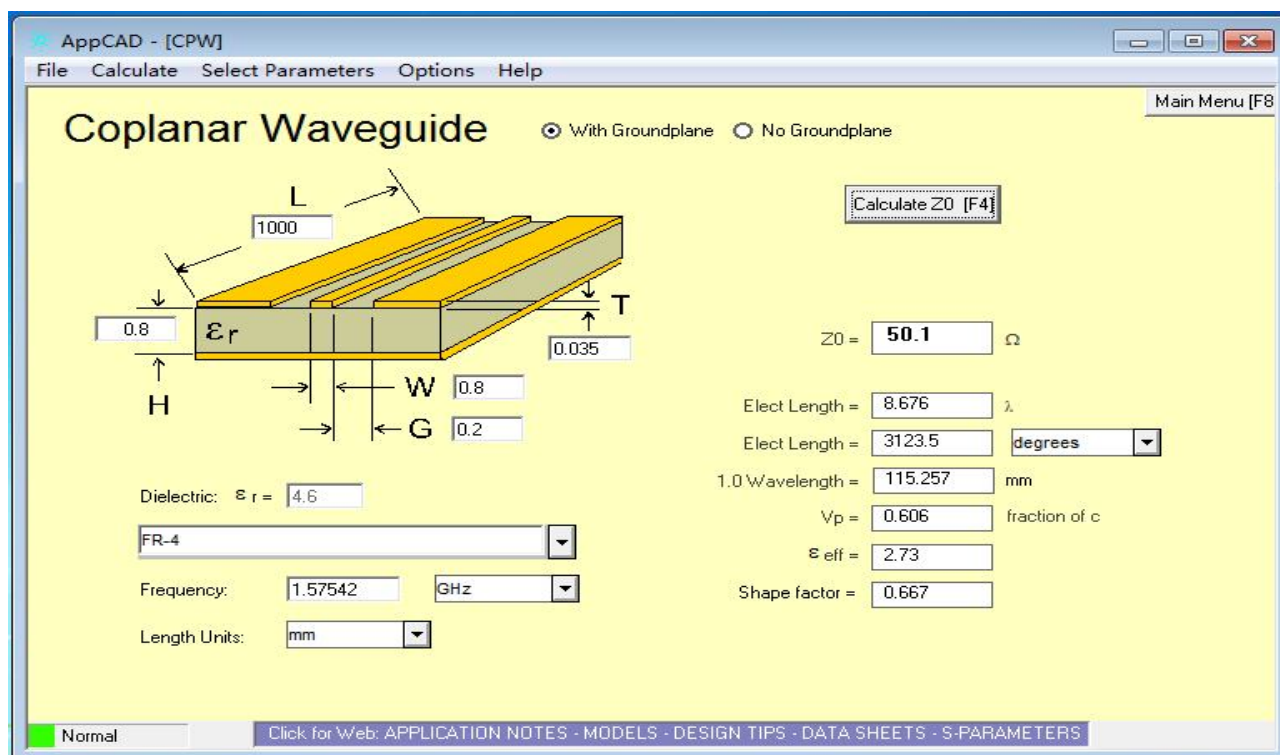
## Performance Specification

Parameter	Specification
Receiver Type	Gps/Glonass/Galileo/Beidou(afterICDreleased)receiver Supports multi-GNSS incl.QZSS,SBAS ranging Supports:WAAS/EGNOS/MSAS/GAGAN
Sensitivity	Tracking -165dBm Acquisition -163dBm(hot) -148dBm(cold)
Accuracy	Position 5m CEP without SA Velocity 0.1m/s without SA Timing (PPS) 1mS RMS
Acquisition Time	Cold Start 30s Warm Start 25s Hot Start 1s Re-Acquisition <1s
Power Consumption	Tracking 20mA @3.3V Vcc Acquisition 18mA Sleep/Standby TBD
NavigationDataUpdate Rate	1Hz
Operational Limits	Altitude Max 18,000m Velocity Max 515m/s Acceleration Less than 4g

## Interfaces Configuration

**Power Supply:** Regulated power for the GT-1513-MTGN is required. The input voltage Vcc should be 3.3V  $\pm$ 10%, maximum, current is no less than 20mA. Suitable decoupling must be provided by external decoupling circuitry.

**Antenna:** The GT-1513-MTGN GPS/GNSS receiver is designed for supporting the active antenna or passive antenna connected with pin RF\_IN. The gain of active antenna should be no less than 15dB. The maximum noise figure should be no more than 2.5dB and output impedance is at 50 Ohm



**UART Ports:** The module supports two full duplex serial channels UART . All serial connections are at 3V CMOS logic levels, if need different voltage levels, use appropriate level shifters. The baud rate of both serial ports are fully programmable, the data format is however fixed: X, N, 8, 1, i.e. X baud rate, no parity, eight data bits and one stop bit, no other data formats are supported, LSB is sent first. The modules default baud rate is set up 9600bps, however, the user can change the default baud rate to any value from 4800 bps to 115kbps. UART is used e.g. for booting and NMEA interface.

**Backup Battery Power:** In case of a power failure on pin Vcc, real-time clock and backup RAM are supplied through pin VBAT. This enables the GT-1513-MTGN GPS /GNSS Receiver to recover from power failure with either a hot start or a warm start (depending on the duration of Vcc outage). If no Backup Battery is connected, the receiver performs a cold start upon powered up.

**Pin Description**

Pin No.	Pin name	I/O	Description	Remark
1	RXB/SCK	I	2.8V,LVTTL I/O PPU,PPD,SMT2mA~16mA PDR,Serial input for UART2,Default:75Kpull-up	Default: 8mA driving
2	TXB/TXIND	O	2.8V,LVTTL I/O PPU,PPD,SMT2mA~16mA PDR,Serial input for UART2,Default:75Kpull-up	Default:8mA driving
3	P1PPS	O	Time Pulse(1PPS)	Leave Open in not used
4	TXA/I2C_DA/SO	O	2.8V,LVTTL I/O PPU,PPD,SMT2mA~16mA PDR,Serial input for UART1,Default:75Kpull-up	Default:8mA driving
5	RXA/I2C_CK/SI	I	2.8V,LVTTL I/O PPU,PPD,SMT2mA~16mA PDR,Serial input for UART1,Default:75Kpull-up	Default:8mA driving
6	GPIO11/SCS	I/O	2.8V,LVTTL I/O PPU,PPD,SMT2mA~16mA PDR JTAG interface clock	Default:75Kpull-down Default:8mA driving
7	GPIO9	I/O	Strap pin host_sel[0]Host_sel[1:0]	Interfac
8	GPIO10	I/O	Strap pin host_sel[0]Host_sel[1:0]	Interfac
9	NC		No connection	
10	NC		No connection	
11	V_BAT	P	Backup battery supply voltage	
12	VCC	P	DC supply voltage	
13	GPIO8	I/O	2.8V,LVTTL I/O PPU,PPD,SMT2mA~16mA PDR JTAG interface clock	Default:75Kpull-down Default:8mA driving
14	GPIO1	I/O	2.8V,LVTTL I/O PPU,PPD,SMT2mA~16mA PDR JTAG interface clock	Default:75Kpull-down Default:8mA driving
15	GPIO2	I/O	2.8V,LVTTL I/O PPU,PPD,SMT2mA~16mA PDR JTAG interface clock	Default:75Kpull-down Default:8mA driving
16	NC		No connection	
17	VCC_RF	P	Linear regulator power output, 3.0V (Do not use this as power source of backup battery)	
18	GND	G	Ground	
19	RF_IN	I	GPS&GNSS Signal Input	
20	GND	G	Ground	
21	GND	G	Ground	
22	GND	G	Ground	

**Pin Assignment**

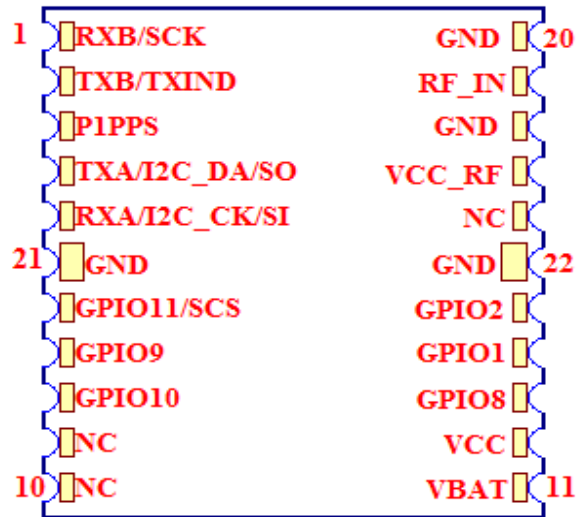


Figure 2: GT-1513-MTGN Pin Package

**Mechanical Specification**

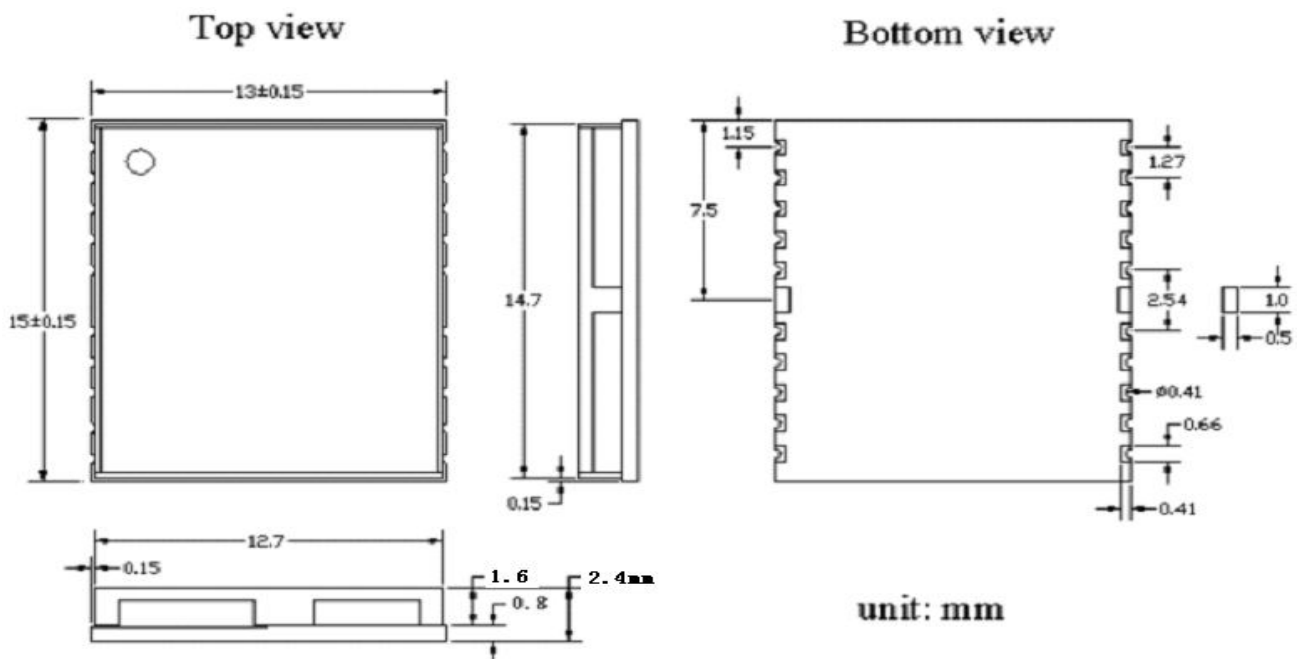


Figure 3: GT-1513-MTGN Dimensions

## Electrical Characteristics

### Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	V <sub>CC</sub>	2.8	4.3	V
Input Pins				
Input Pin Voltage I/O	RXA/TXA	-0.3	3.6	V
Backup Battery	VBAT	2.0	3.6	V
Environment				
Storage Temperature	T <sub>stg</sub>	-40	125	°C
PeakReflow Soldering Temperature	T <sub>peak</sub>		260	°C
Humidity			95	%

Note: Absolute maximum ratings are stress ratings only, and functional operation at the maxims is not guaranteed. Stress beyond the limits specified in this table may affect device reliability or cause permanent damage to the device. For functional operating conditions, refer to the operating conditions tables as follow.

### Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	V <sub>CC</sub>		2.8	3.3	4.3	V
Powersupplyvoltagegeripple	V <sub>CC_PP</sub>	V <sub>CC</sub> =3.0V			30	mV
Consumption current	I <sub>CC</sub>	V <sub>CC</sub> =3.0V		20	18	mA
Input high voltage	V <sub>IH</sub>		0.7xV <sub>CC</sub>		V <sub>CC</sub> +1.0	V
Input low voltage	V <sub>IL</sub>		-0.3		0.3xV <sub>CC</sub>	V

Output high voltage	$V_{OH}$		$0.8 \times V_{CC}$		$V_{CC}$	V
Output low voltage	$V_{OL}$		0		$0.2 \times V_{CC}$	V
Operating temperature	$T_{opr}$		-40		85	°C

## Software Protocol

### NMEA 0183 Protocol

The NMEA protocol is an ASCII-based protocol, Records start with a \$ and with carriage return/line feed. GPS specific messages all start with \$GPxxx/GNxxx where xxx is a three-letter identifier of the message data that follows. NMEA messages have a checksum, which allows detection of corrupted data transfers.

The Gotop GT-1513-MTGN supports the following NMEA-0183 messages: GPGSA, GPRMC, GNGSA, GNRMC, GLGSV

**Table 1: NMEA-0183 Output Messages**

NMEA Record	DESCRIPTION
GPGSA	GPS DOP and active satellites
GPRMC	Recommended minimum specific GPS data
GNGSA	GNSS DOP and active satellites
GNRMC	Recommended minimum specific GNSS data
GLGSV	GPS/GNSS satellites in view

### GPGSA-GPS DOP and Active Satellites

Table 4 contains the values of the following example:

\$GPGSA, A, 3, 07, 02, 26,27, 09, 04,15, , , , , , 1.8,1.0,1.5\*33.

**Table 4: GSA Data Format**

Name	Example	Units	Description
Message	\$GPGSA		GSA protocol header
Mode 1	A		See Table 4-2

Mode 2	3		See Table 4-1
Satellite Used	07		Sv on Channel 1
Satellite Used	02		Sv on Channel 2
...	...		...
Satellite Used			Sv on Channel 66
PDOP	1.8		Position Dilution of Precision
HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR> <LF>			End of message termination

**Table 4-1: Mode 1**

Value	Description
1	Fix not available
2	2D
3	3D

**Table 4-2: Mode 2**

Value	Description
M	Manual-forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

### GPRMC-Recommended Minimum Specific GPS Data

Table 6 contains the values of the following example:

\$GPRMC, 161229.487, A, 3723.2475, N, 12158.3416, W, 0.13,309.62, 120598,, \*10

**Table 6: RMC Data Format**

Name	Example	Units	Description
Message ID	\$GPRMC		RMC protocol header
UTS Position	161229.487		hhmmss.sss



Status	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	Knots	
Course Over	309.62	Degrees	True
Ground			
Date	120598		Dummy
Magnetic variation		Degrees	E=east or W=west
Checksum	*10		
<CR> <LF>			End of message termination

### GNSSA-GNSS DOP and Active Satellites

Table 4 contains the values of the following example:

\$GNSSA , A, 3, 07, 02, 26,27, 09, 04,15, , , , , , 1.8,1.0,1.5\*33.

**Table 4: GSA Data Format**

Name	Example	Units	Description
Message	\$GNSSA		GSA protocol header
Mode 1	A		See Table 4-2
Mode 2	3		See Table 4-1
Satellite Used	07		Sv on Channel 1
Satellite Used	02		Sv on Channel 2
...	...		...
Satellite Used			Sv on Channel 66
PDOP	1.8		Position Dilution of Precision

HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR> <LF>			End of message termination

**Table 4-1: Mode 1**

Value	Description
1	Fix not available
2	2D
3	3D

**Table 4-2: Mode 2**

Value	Description
M	Manual-forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

### GPRMC-Recommended Minimum Specific GNSS Data

Table 6 contains the values of the following example:

\$GNRMC, 161229.487, A, 3723.2475, N, 12158.3416, W, 0.13,309.62, 120598,, \*10

**Table 6: RMC Data Format**

Name	Example	Units	Description
Message ID	\$GNRMC		RMC protocol header
UTS Position	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	Knots	

Course Over	309.62	Degrees	True
Ground			
Date	120598		Dummy
Magnetic variation		Degrees	E=east or W=west
Checksum	*10		
<CR> <LF>			End of message termination

### GLGSV-GPS/GNSS Satellites in View

**Table 5 contains the values of the following example:**

\$GLGSV , 2, 1, 07, 07, 79,048, 42, 02, 51,062, 43, 26, 36,256, 42, 27, 27, 138,42\*71

\$GLGSV, 2, 2, 07, 09, 23,313, 42, 04, 19, 159, 41, 15,12,041, 42\*41.

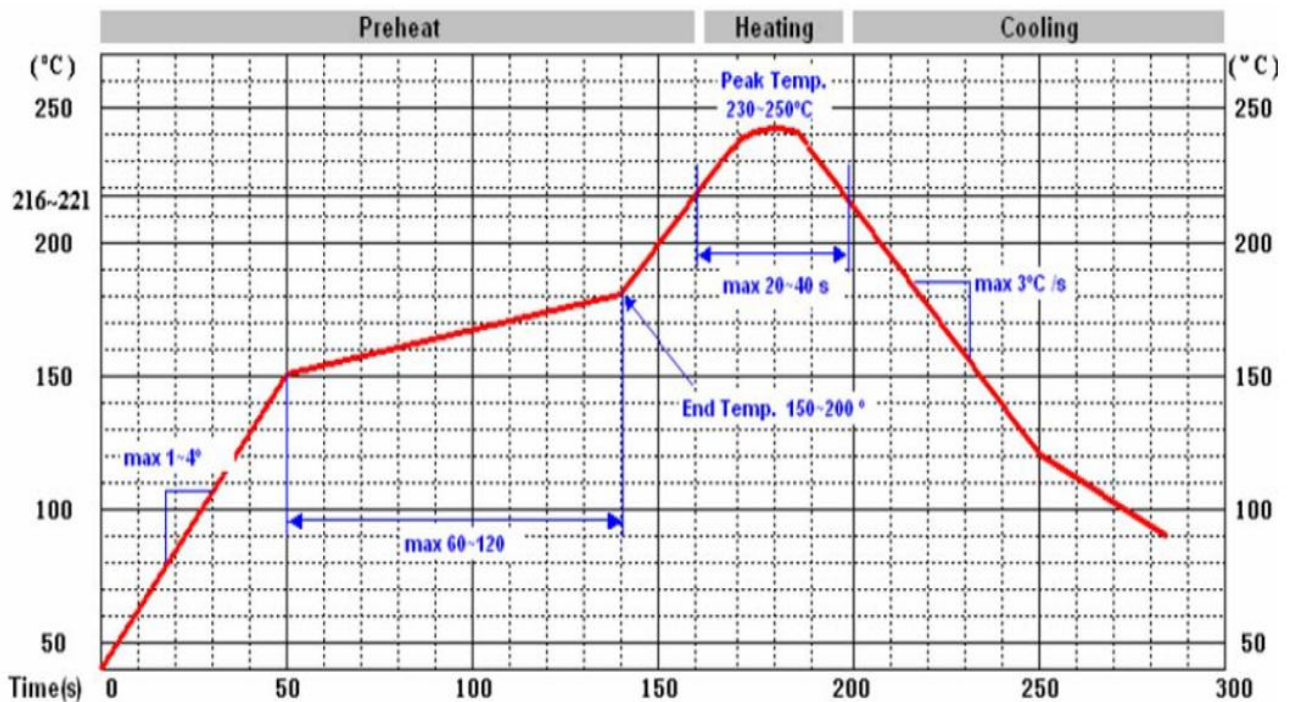
**Table 5: GLGGA Data Format**

Name	Example	Units	Description
Message ID	\$GLGSV		GSV protocol header
Number of Message	2		Range 1 to 3
Message Number	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1(Range 1 to 96)
Elevation	79	degrees	Channel 1(Maximum 90)
Azinmuth	048	degrees	Channel 1(True, Range 0 to 359)
SNR(C/NO)	42	dBHz	Range 0 to 99,null when not tracking
...			...
Satellite ID	27		Channel 4(Range 1 to 96)
Elevation	27	degrees	Channel 4(Maximum 90)
Azimuth	138	degrees	Channel 4(True, Range 0 to 359)
SNR(C/NO)	42	dBHz	Range 0 to 99, null when not tracking

Checksum	*71		
<CR> <LF>			End of message termination

Depending on the number of satellites tracked multiple messages of GLGSV data may be required. The range of GPS SVID is 1~32, GNSS SVID is 65~96.

### Manufacturing Process Recommendations



Note: The final soldering temperature chosen at the factory depends on additional external factors like choice of soldering paste, size, thickness and properties of the baseboard, etc. Exceeding the maximum soldering temperature in the recommended soldering profile may permanently damage the module.

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