

## General Description

The GT-1612-UB7X module series is a family of stand-alone GPS receivers featuring the high performance u-blox 7 positioning engine. These flexible and cost effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.6mm package. Their compact architecture and power and memory options make GT-1612-UB7X modules ideal for battery operated mobile devices with very strict cost and space constraints.

The 56-channel u-blox 7 positioning engine boasts a Time-To-First-Fix (TTFF) of under 1 second. The dedicated acquisition engine, with over 1 million correlators, is capable of massive parallel time/frequency space searches, enabling it to find satellites instantly. Innovative design and technology suppresses jamming sources and mitigates multipath effects, giving GT-1612-UB7X GPS receivers excellent navigation performance even in the most challenging environments.

GT-1612-UB7X modules are not designed for life saving or supporting devices or for aviation and should not be used in products that could in any way negatively impact the security or health of the user or third parties or that could cause damage to goods.



**Figure 1: GT-1612-UB7X Top View**

## Applications

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

## Features

- Build on high performance, low-power u-blox7xxxchipset
- Ultra high sensitivity: -165dBm
- Extremely fast TTFF at low signal level
- Built in high gain LNA
- Low power consumption: Max 20mA@3.0V
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage: 2.75V to 3.6V
- Operating temperature range: -40to85°C
- SMD type with stamp holes
- Small form factor: 16x12.2x2.6mm
- RoHS compliant (Lead-free)

## Performance Specification

Parameter	Specification	
Receiver Type	56-channel engineGPS & QZSS L1 C/A, GLONASS L1OF, Galileo* E1B/L1, Compass* ready SBAS: WAAS, EGNOS, MSAS	
Sensitivity	Tracking	-165dBm
	Acquisition	-160dBm
Accuracy	Position	5m CEP without SA
	Velocity	0.1m/s without SA
	Timing (PPS)	10ns RMS
Acquisition Time	Cold Start	29s
	Warm Start	28s
	Hot Start	1s
	Re-Acquisition	<1s
Power Consumption	Tracking	20mA @3V Vcc
	Acquisition	20mA
	Sleep/Standby	TBD
NavigationDataUpdate Rate	1Hz	
Operational Limits	Altitude	Max 18,000m
	Velocity	Max 515m/s
	Acceleration	Less than 4g

## Interfaces Configuration

### 1.1 Assisted GPS (A-GPS)

Supply of aiding information like ephemeris, almanac, rough last position and time and satellite status and an optional time synchronization signal will reduce time to first fix significantly and improve the acquisition sensitivity. GT-1612-UB7X modules support the u-blox AssistNow Online and AssistNow Offline A-GPS services<sup>8</sup> and are OMA SUPL compliant.

## 1.2 SuperSense Indoor GPS

GT-1612-UB7X modules come with SuperSense, providing ultra-fast acquisition/reacquisition and exceptional tracking sensitivity. SuperSense enables best-in-class tracking and navigation in difficult signal environments such as urban canyons or indoor locations.

## 1.3 KickStart / Oscillators

An available feature is KickStart. This functionality uses a TCXO to accelerate weak signal acquisition, enabling faster start and reacquisition times. KickStart is available with the GT-1612-UB7X.

## 1.4 Protocols and interfaces

Protocol	Type
NMEA	Input/output, ASCII, 0183, 2.3 (compatible to 3.0)
UBX	Input/output, binary, u-blox proprietary

**Table 2: Available protocols**

Both protocols are available on UART, DDC and SPI. For specification of the various protocols see the u-blox6 Receiver Description including Protocol Specification [2].

GT-1612-UB7X modules support a number of peripheral interfaces for serial communication. The embedded firmware uses these interfaces according to their respective protocol specifications. For specific applications, the firmware also supports the connection of peripheral devices, such as external memories, to some of the interfaces.

## 1.5 UART

GT-1612-UB7X modules include one configurable UART interface for serial communication (for information about configuration see section 1.11).

## 1.6 Display Data Channel (DDC)

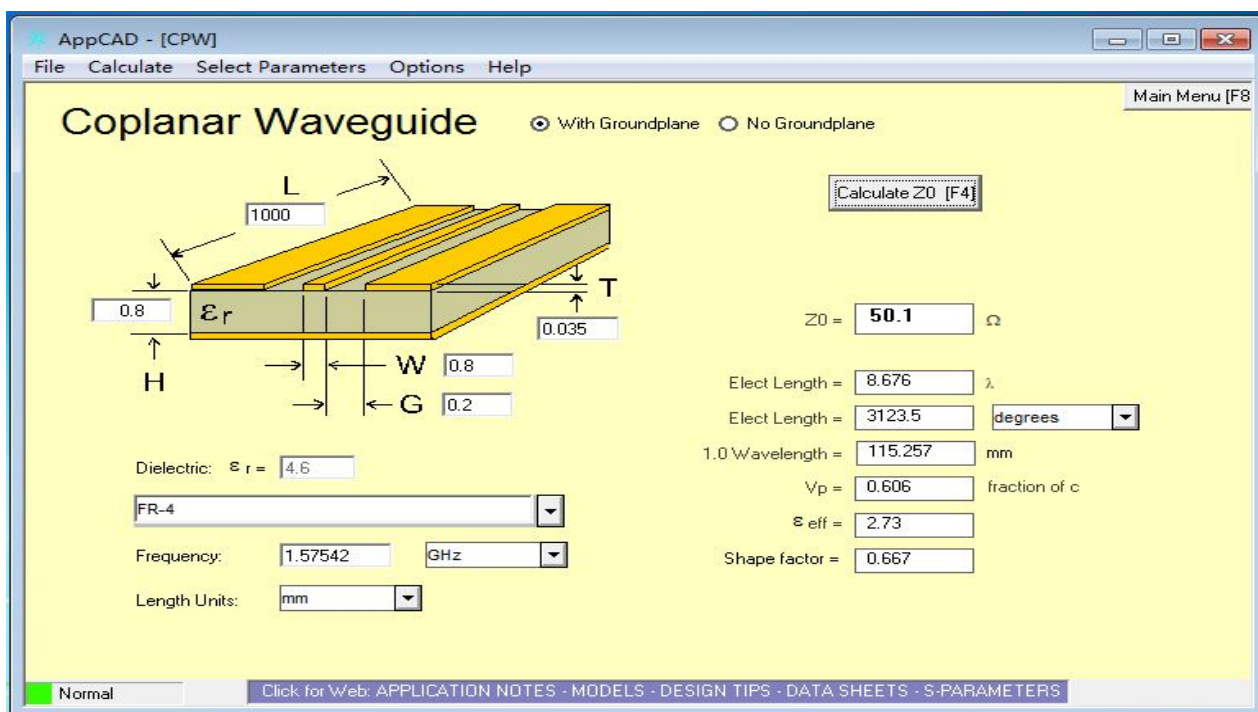
The I2C compatible DDC interface can be used either to access external devices with a serial interface (e.g. EEPROM or A/D converters) or to interface with a host CPU. It is capable of master and slave operation and communicates at a rate of <100kbit/s. GPS.

## 1.7 Antenna

GT-1612-UB7X modules are designed for use with passive and active 9 antennas.

Parameter		Specification
Antenna Type		Passive and active antenna
Active Antenna Recommendations	Minimum gain	15 - 20 dB (to compensate signal loss in RF cable)
	Maximum noise figure	1.5 dB
	Maximum gain	50 dB

The maximum noise figure should be no more than 1.5dB and output impedance is at 50 Ohm.



**Table 3: Antenna Specifications for all GT-1612-UB7X modules**

### 1.8 Operating modes

GT-1612-UB7X modules have 2 continuous operating modes (Maximum Performance and Eco). Maximum Performance mode freely uses the acquisition engine, resulting in the best possible TTFF, while Eco mode optimizes the use of the acquisition engine to deliver lower current consumption. At medium to strong signals, there is almost no difference for acquisition and tracking performance in these modes.

### 1.9 Maximum Performance mode

In Maximum Performance mode, u-blox 7 receivers use the acquisition engine at full performance to search for all possible satellites until the Almanac is completely downloaded.

As a consequence, tracking current consumption level will be achieved when:

A valid GPS position is fixed

Almanac is entirely downloaded

Ephemeris for all satellites in view are valid

GT-1612-UB7X modules allow an optional external serial EEPROM to be connected to the DDC interface.

This feature is only supported by modules with ROM 7.0 and above.

## 2.0 USB

GT-1612-UB7X modules provide a USB version 2.0 FS (Full Speed, 12Mbit/s) interface as an alternative to the UART. The pull-up resistor on USB\_DP is integrated to signal a full-speed device to the host. The VDD\_USB pin supplies the USB interface, independently from the VDD\_IO pin.

u-blox provides a Microsoft® certified USB driver for Windows XP and Windows Vista operating systems. Windows 7 will also be supported following certification

**Table 4: Operating systems supported by USB driver**

Operating System	Support level
Windows XP	Certified
Windows Vista	Certified
Windows 7	Certified

**Pin Description**

Pin No.	Pin name	I/O	Description
1	SAFEBOOT	I	Leave Open if not used
2	NC	I	Leave Open if not used
3	TIMEPULSE	O	Time pulse (1PPS)
4	EXTINT0	I	External Interrupt Pin
5	USB_DM	I/O	USB Data
6	USB_DP	I/O	USB Data
7	VDD_USB	I	USB Supply
8	NC	I	Leave Open if not used
9	VCC_RF	O	Output Voltage RF section
10	GND	G	Ground
11	RF_IN	I	GPS Signal Input
12	GND	G	Ground
13	GND	G	Ground
14	ANT_OK	I/O	Antenna status of antenna supervisor
15	ANT_OFF	I/O	Antenna power control of antenna supervisor
16	RESET_N	I/O	Leave Open if not used
17	EXTINT1	I	External Interrupt Pin
18	SDA	I/O	DDC Data
19	SCL	I/O	DDC Clock
20	TXD	O	UART Serial Data Output Pull up (75KΩ) if not used
21	RXD	I	UART Serial Data Input Pull up (75KΩ) if not used
22	V_BAT	P	Backup battery supply voltage
23	VCC	P	DC supply voltage
24	GND	G	Ground

## Pin Assignment

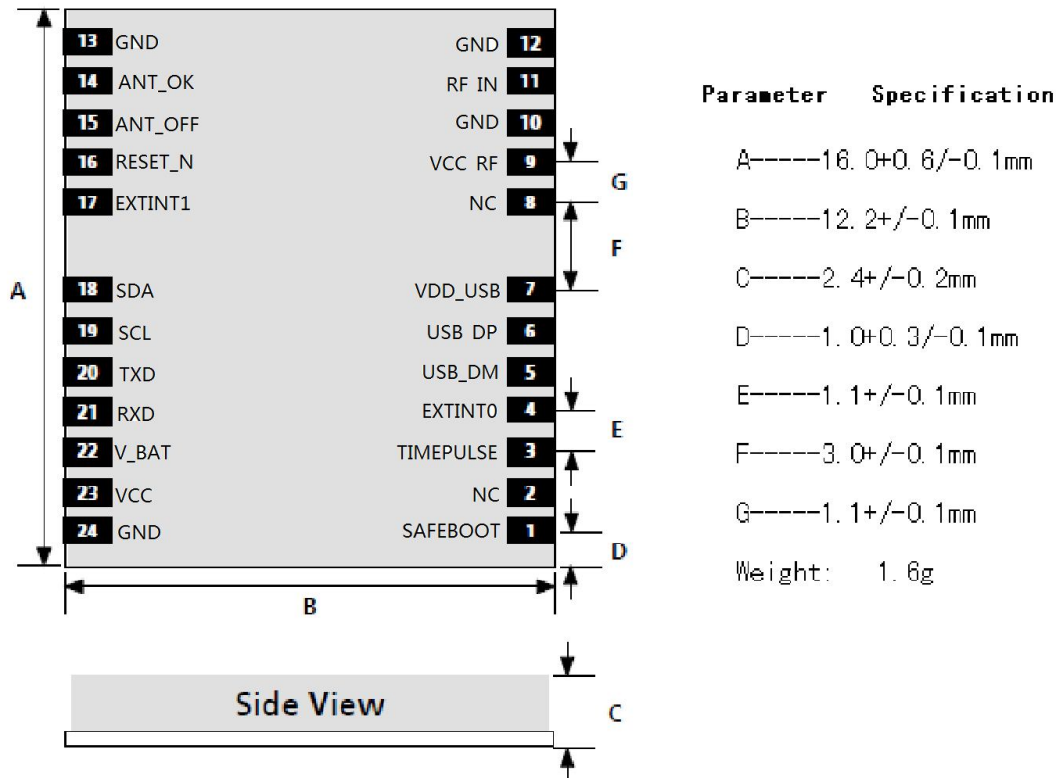


Figure 2: GT-1612-UB7X Pin Packag

## Electrical Characteristics

### Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	Vcc	2.75	3.6	V
Input Pins				
Input Pin Voltage I/O	RXD/TXD	-0.3	3.6	V
Backup Battery	V_BAT	1.4	3.6	V
Environment				

Storage Temperature	Tstg	-40	125	°C
PeakReflow Soldering Temperature <10s	Tpeak		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	Vcc		2.75	3.3	3.6	V
Powersupplyvoltageripple	Vcc_PP	Vcc=3.0V			20	mV
Consumption current	Icc	Vcc=3.0V		20	20	mA
Input high voltage	V <sub>IH</sub>		0.7xVcc		Vcc+1.0	V
Input low voltage	V <sub>IL</sub>		-0.3		0.3xVcc	V
Output high voltage	V <sub>OH</sub>		0.8xVcc		Vcc	V
Output low voltage	V <sub>OL</sub>		0		0.2xVcc	V
Operating temperature	Topr		-40		85	°C

### 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 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-1612-UB7X supports the following NMEA-0183 messages: GGA, GLL, GSA, GSV, RMC and VTG

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

NMEA Record	DESCRIPTION
GGA	Global positioning system fixed data
GLL	Geographic position—latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed

### GGA-Global Positioning System Fixed Data

Table 2 contains the values of the following example:

\$GPGGA, 161229.487,3723.24751,N, 12158.34160,W, 1,07,1.0,9.0,M,0000\*18

**Table 2: GGA Data Format**

Name	Example	Units	Description
Message ID	\$GPGGA		GGA protocol header
UTC Position	161229.487		hhmmss.sss
Latitude	3723.24751		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	12158.34160		dddmm.mmmmm
E/W Indicator	W		E=east or W=west
PositionFix Indicator	1		See Table 2-1
Satellites Used	07		Range 0 to 12

HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude	9.0	meters	
Units	M	meters	
Geoids Separation		meters	
Units	M	meters	
Age of Diff.Corr.		second	Null fields when DGPS is not Used
Diff.Ref.Station ID	0000		
Checksum	*18		
<CR> <LF>			End of message termination

**Table 2-1: Position Fix Indicators**

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid

### GLL-Geographic Position – Latitude/Longitude

Table 3 contains the values of the following example:

\$GPGLL , 3723.24755, N,12158.34161, W,161229.487, A\*2C.

**Table 3: GLL Data Format**

Name	Example	Units	Description
Message ID	\$GPGLL		GLL protocol header
Latitude	3723.24755		ddmm.mmmmm

N/S Indicator	N		N=north or S=south
Longitude	12158.34161		dddmm.mmmmm
E/W Indicator	W		E=east or W=west
UTC Position	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Checksum	*2C		
<CR> <LF>			End of message termination

### GSA-GNSS 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 12
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

## GSV-GNSS Satellites in View

Table 5 contains the values of the following example:

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

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

**Table 5: GGA Data Format**

Name	Example	Units	Description
Message ID	\$GPGSV		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 32)
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 32)
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 GSV data may be required.

### RMC-Recommended Minimum Specific GNSS Data

**Table 6 contains the values of the following example:**

\$GPRMC, 161229.487, A, 3723.24751, N, 12158.34161, 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	3723.24751		ddmm.mmmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.34161		dddmm.mmmmm
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

### VTG-Course Over Ground and Ground Speed

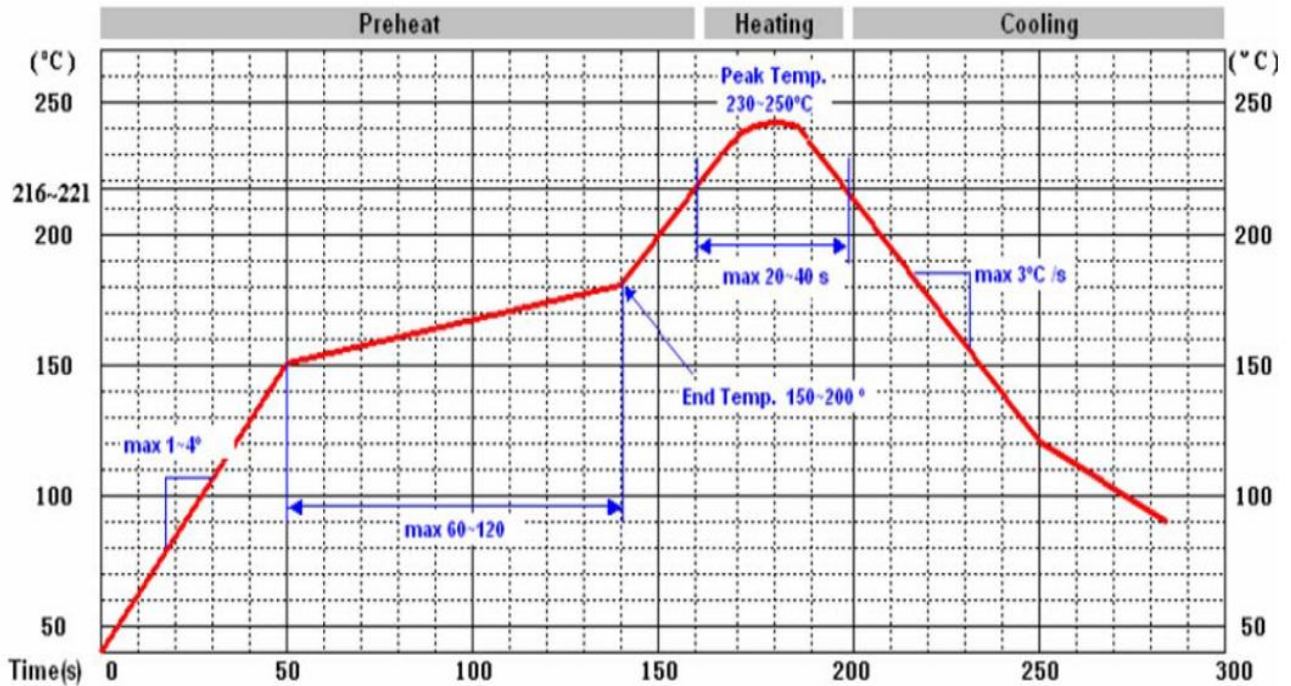
**Table 7 contains the values of the following example:**

\$GPVTG, 309.62, T, M, 0.13, N, 0.2, K\*6E

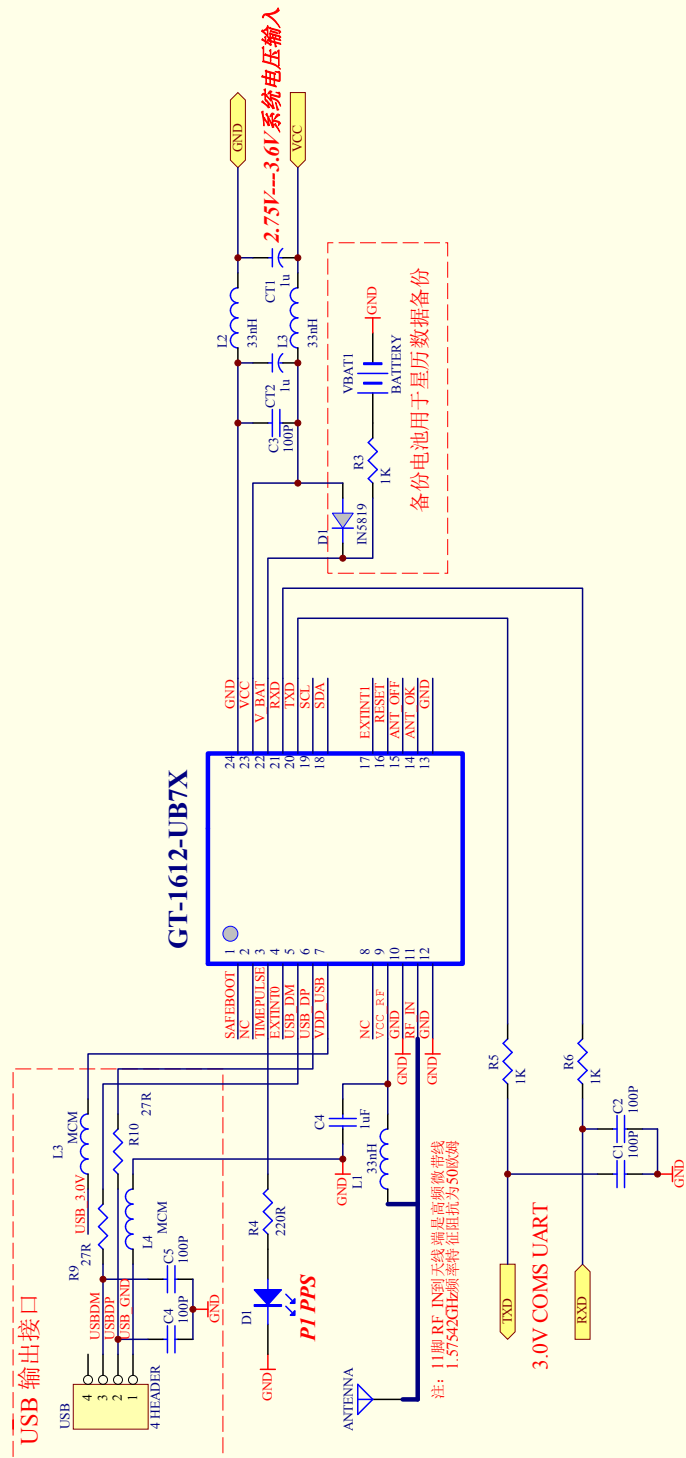
**Table 7: VTG Data Format**

Name	Example	Units	Description
Message ID	\$GPVTG		VTG protocol header
Course	309.62	Degrees	Measured heading
Reference	T		True
Course		Degrees	Measured heading
Reference	M		Magnetic
Speed	0.13	Knots	Measured horizontal speed
Units	N		Knots
Speed	0.2	Km/hr	Measured horizontal speed
Units	K		Kilometer per hour
Checksum	*6E		
<CR> <LF>			End of message termination

### 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.



USB 输出接口

注：11脚 RF IN 到天线是高频微带线  
1.57542GHz 频率特征阻抗为 50 欧姆

Title		<b>GOTOP TECHNOLOGYCO.,LTD</b>	
Size	Number	Revision	
A4	<b>GT-1612-UB7X</b>	<b>应用电路</b>	<b>V2.0</b>
Date:	14-Nov-2014		
File:	D:\公司技术资料\公司技术资料\GOTOP\GOTOP最新技术资料\技术文件\产品PCB文件\G		



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