General Description

The GT-1612-UB8X module series is a family of stand-alone GPS& BeiDou receivers featuring the high performance u-blox 8 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-UB8X modules ideal for battery operated mobile devices with very strict cost and space constraints.

The 56-channel u-blox 8 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-UB8X GPS&BeiDou receivers excellent navigation performance even in the most challenging environments.

GT-1612-UB8Xmodules 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-UB8X Top View

Applications

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

Features

- Build on high performance, low-power u-blox8xxxchipset
- Ultra high sensitivity: -167dBm
- Extremely fast TTFFat 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℃
- 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 L1O F,Galileo E1B/L1, BeiDou ready SBAS: WAAS, EGNOS, MSAS
Sensitivity	Tracking -167dBm Acquisition -165dBm
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

1.1Assisted 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-UB8X modules support the u-blox AssistNow Online and AssistNow Offline A-GPS services8 and are OMA SUPL compliant.

1.2 SuperSense Indoor GPS

GT-1612-UB7XmodulescomewithSuperSense,providingultra-fastacquisition/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 wit h 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-UB8Xmodules support a number of peripheral interfaces for serial communic ation. The embedded firmware uses these interfaces according to their respective proto col specifications. For specific applications, the firmware also supports the connection of peripheral devices, such as external memories, to some of the interfaces.

1.5UART

GT-1612-UB8XmodulesincludeoneconfigurableUARTinterfaceforserial 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.

1.7Antenna

GT-1612-UB8X modules are designed for use with passive and active9 antennas.

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

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

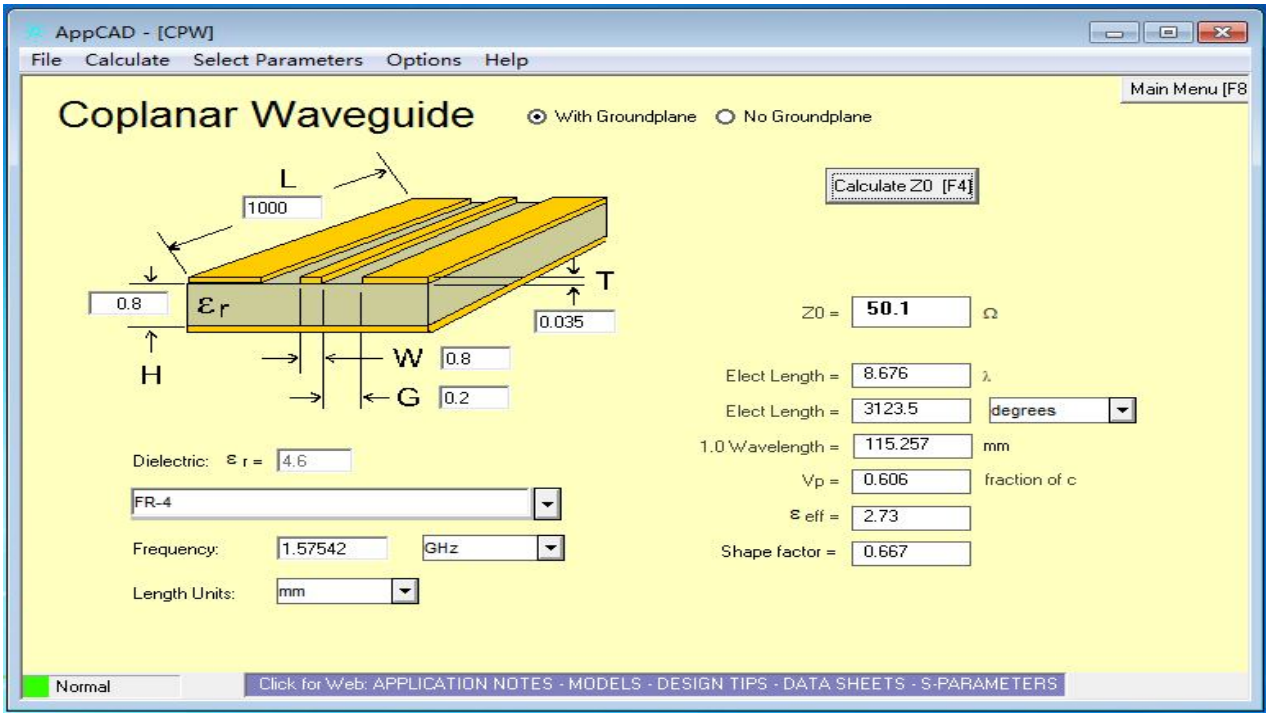


Table 3: Antenna Specifications for all GT-1612-UB8X modules

1.8Operating modes

GT-1612-UB8X 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.

1.9Maximum Performance mode

In Maximum Performance mode, u-blox 8 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-UB8Xmodules 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.

2.0USB

GT-1612-UB8Xmodules 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 providesaMicrosoft®certifiedUSBdriver for Windows XP and WindowsVista operating systems. Windows 7 will also be supported following certification

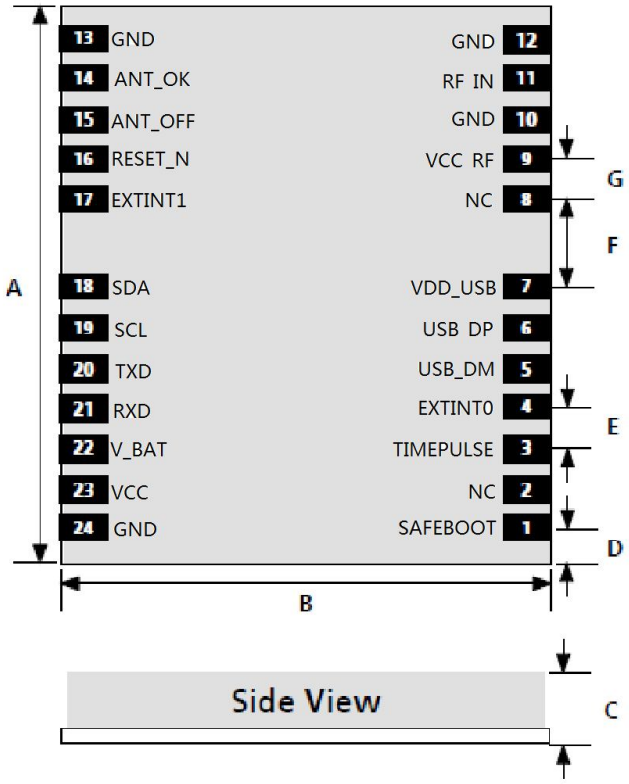
Table 4: Operating systems supported by USB driver

. 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 suppiy voltage
24	GND	G	Ground

Pin Assignment



Parameter	Specification
A	16.0±0.6/−0.1mm
B	12.2+/−0.1mm
C	2.4+/−0.2mm
D	1.0±0.3/−0.1mm
E	1.1+/−0.1mm
F	3.0+/−0.1mm
G	1.1+/−0.1mm
Weight:	1.6g

Figure 2: GT-1612-UB8X 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_{IH}		0.7xVcc		Vcc+1.0	V
Input low voltage	V_{IL}		-0.3		0.3xVcc	V
Output high voltage	V_{OH}		0.8xVcc		Vcc	V
Output low voltage	V_{OL}		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&BeiDou specific messages all start with $GBxxx whereGNxxx 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-UB8Xsupports the following NMEA-0183 messages: GGA, GLL, GSA, GSV, RMC and VTG

Table 1: NMEA-0183 Output Messages

NMEA Record	DESCRIPTION
BD only mode NMEAOutPut:**GBRMC.GBGGA.GBGSV.GBGSA.GBGLL.GBVTG**	
GPS only mode NMEAOutPut:**GPRMC.GPGGA.GPGSV.GPGSA.GPGLL.GPVTG**	
Galileo only mode NMEAOutPut:**GARMC.GAGGA.GAGSV.GAGSA.GAGLL.GAVTG**	
Glonass only mode NMEAOutPut:**GLRMC.GLGGA.GLGSV.GLGSA.GLGLL.GLVTG**	
GPS+BDonlymode NMEAOutPut:**GNRMC.GNGGA.GNGSV.GNGSA.GNGLL.GNVTG**	
xxGLL	Geographic position—latitude/longitude
xxGGA	Global positioning system fixed data
xxGSA	GNSS DOP and active satellites
xxGSV	GNSS satellites in view
xxRMC	Recommended minimum specific GNSS data
xxVTG	Course over ground and ground speed

GGA-Global Positioning System Fixed Data

Table 2 contains the values of the following example:
$xxGGA, 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	$xxGGA		GGA protocol header
UTC Position	161229.487		hhmmss.sss

Latitude	3723.24571		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:
$xxGLL , 3723.24755, N,12158.34161, W,161229.487, A*2C.
Table 3: GLL Data Format

Name	Example	Units	Description
Message ID	$xxGLL		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 temination

GSA-GNSS DOP and Active Satellites

Table 4 contains the values of the following example:
$xxGSA , 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	$xxGSA		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:
$xxGSV , 2, 1, 07, 07, 79,048, 42, 02, 51,062, 43, 26, 36,256, 42, 27, 27, 138,42*71
$xxGSV, 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	$xxGSV		GSV protocol header
Number of Message	2		Range 1 to 3

Message Number	1		Range 1 to 4
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:
$xxRMC, 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	$xxRMC		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

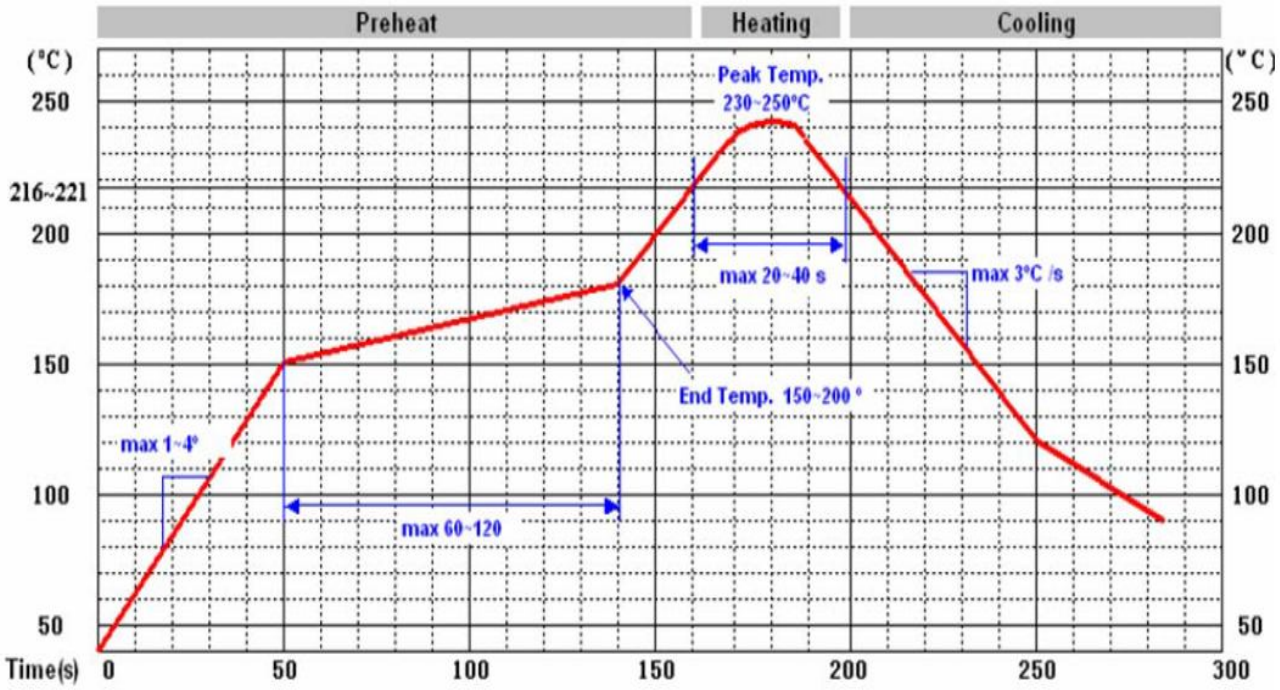
VTG-Course Over Ground and Ground Speed

Table 7 contains the values of the following example:
$xxVTG, 309.62, T, M, 0.13, N, 0.2, K*6E
Table 7: VTG Data Format

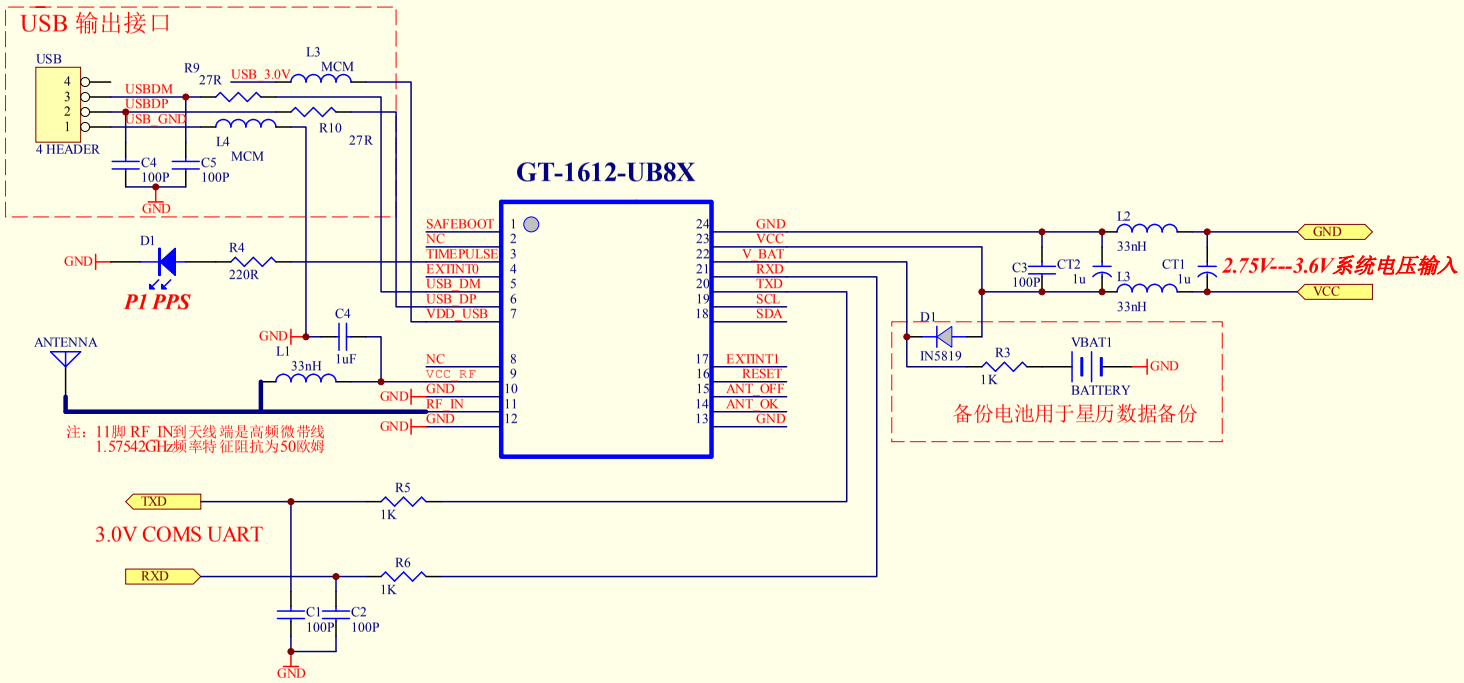
Name	Example	Units	Description
Message ID	$xxVTG		VTG protocol header
Course	309.62	Degrees	Measured heading
Reference	T		True
Course		Degrees	Measured heading
Reference	M		Magnetic
Speed	0.13	Knots	Measured horizontal speed

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 ofsoldering 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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