KNCTEK GNSS positioning module

UGL-1010 Specification

(Small Size : 10.1x9.7x2.5mm ±0.3mm)

Version 1.0
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UGL-1010 Specification

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Revision History

1. 2017-06-07 : Initiated Version 1.0

UGL-1010 Operational Manual

INTRODUCTION

The **UGL-1010** is the newest generation of KNCTEK GNSS positioning module. The GNSS Module is powered by U-Blox & KNCTEK technology and easy to integrate and combine exceptional positioning performance with highly flexible power, design, and connectivity options. The miniature design is the best choice to be embedded in a portable device various Trackers, various Vehicle & personal Locaters & Trackers and etc. The excellent sensitivity of **UGL-1010** gets the great performance when going though the urban canyon and foliage environmental condition.

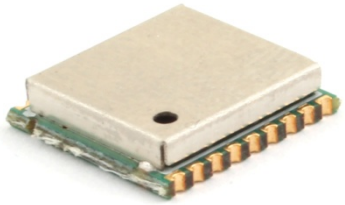
PRODUCT FEATURES

- ✧ GPS, GLONASS, Beidou, Galileo, QZSS, SBAS(WAAS, MSAS, EGNOS, GAGAN) supported(default : GPS, GLONASS including QZSS, SBAS)
- ✧ 72-channel u-blox M8 Engine
- ✧ Operable from 3.0V/ 43mA for Acquisition and 35mA for Tracking Mode
- ✧ Signal Detection better than -167dBm in Ultra High Tracking Sensitivity
- ✧ Enhanced Cold Acquisition Sensitivity at -148dBm and Reacquisition at -160dBm
- ✧ Fast TTFF 26 seconds for Cold start
- ✧ Advanced Multipath detection and suppression
- ✧ Jamming detection and mitigation
- ✧ AssistNow Autonomous 3days
- ✧ Excellent Sensitive for Urban Canyon and Foliage Environmental condition
- ✧ NMEA-0183 compliant protocol
- ✧ Automotive-grade Quality GPS/GLONASS solution
- ✧ Small form factor (10.1x9.7x2.5mm)
- ✧ ODM/OEM development is fully supported Application Engineering
- ✧ RoHS compliant

PRODUCT APPLICATION

- ✧ Automotive applications
- ✧ Speed camera detector
- ✧ Personal and Car navigation
- ✧ Marine navigation
- ✧ Timing application and the others

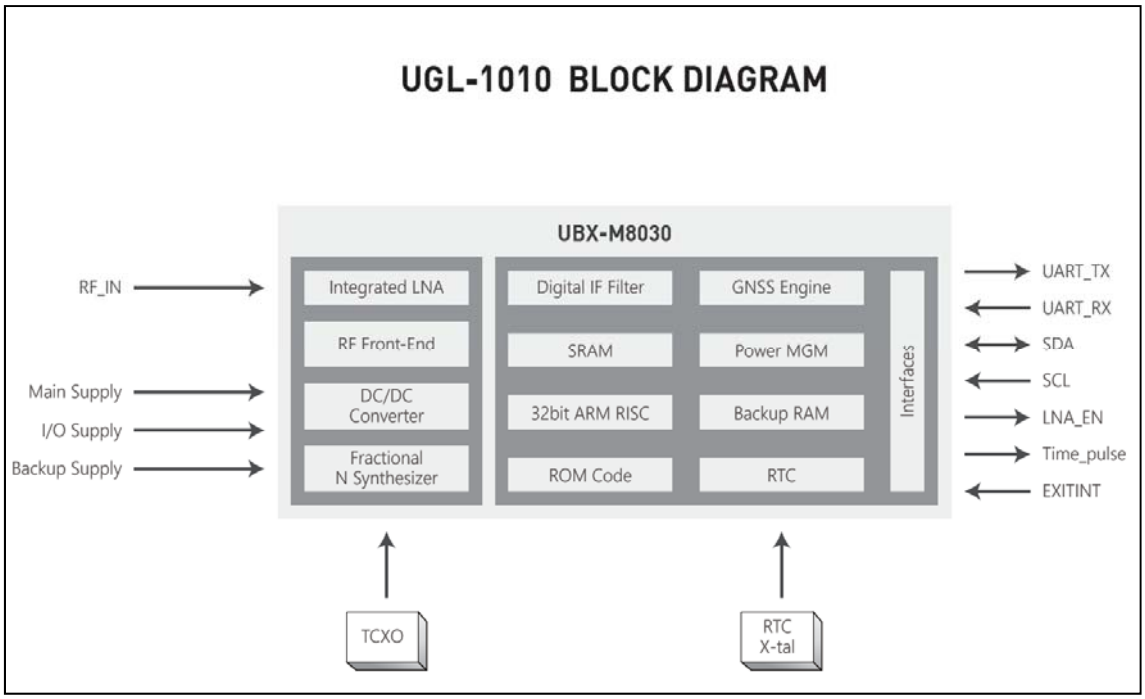
PRODUCT PICTURE



UGL-1010 SYSTEM BLOCK DIAGRAM

The UGL-1010 consists of U-Blox8 chipsets Technology.

The system is described as follows.



TECHNICAL SPECIFICATION

1. Electrical Characteristics

1.1 Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	VCC	-0.3	3.6	V
Input Pins				
Input Pin Voltage	Vin	-0.3	VCC_IO+0.5	V
Backup Battery	Vbat	1.4	3.6	V
Environment				
Operating Temperature	Topr	-30	85	℃
Storage Temperature	Tstg	-40	85	℃
Peak Reflow Soldering Temperature < 10S	Tpeak		260	℃
Humidity			95	%

Note : Absolute maximum ratings are stress ratings only, and functional operation at the maximums 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, please refer to the operating conditions tables as follow.

1.2 Operating Condition

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	VCC & IO		2.7	3.0	3.6	V
Power Supply voltage ripple	Vcc_PP	Vcc = 3.0V			50	mV
Acquisition current	IccA	Vcc = 3.0V		43		mA
Tracking current	IccT	Vcc = 3.0V		35		mA
Input high voltage	V_{IH}		0.7*Vcc_IO			V
Input low voltage	V_{IL}				0.2*Vcc_IO	V
Output high voltage	V_{OH}		Vcc_IO-0.4			V
Output low voltage	V_{OL}				0.4	V

2. General & Performance Specification

Parameter	Specification	
Receiver Type	GPS/GLONASS, 72 Channel u-blox M8 engine	
Sensitivity	Tracking	-167dBm
	Re-acquisition	-160dBm
	Cold Start	-148dBm
Accuracy	Position	2.5m CEP
	Velocity	0.05m/s
Acquisition Time	Cold Start	26 sec. typical (Open sky[1])
	Hot Start	1 sec. typical (Open sky)
	Reacquisition Time	1 sec(Open sky, re-appear after some seconds)
	AssistNow Autonomous	Self-aided ephemeris estimation : 15 ~ 20 sec. avg
Power Consumption	Tracking	35mA @ 3.0V
	Acquisition	43mA
	Back-up	15uA @ 3V
Navigation Data Update Rate	1Hz_Default	In case of using Binary input : Max 10Hz
Operational Limits	Velocity	Max 500 m/s
	Altitude	Max 50,000m
	Acceleration	Less than 4g(39.2m/sec²)
Mechanical data	Dimension	10.1 X 9.7 X 2.5mm (+/- 0.3mm)
	Weight	1.0grams ±5%
Protocol	NMEA-0183 V4.0	GNRMC 1Hz(one time per sec)
		GNVTG 1Hz
		GNGGA 1Hz
		GNGSA 1Hz
		GPGSV 1Hz
		GLGSV 1Hz
		GNGLL 1Hz

** [1]Open Sky means no obstructions in the sky

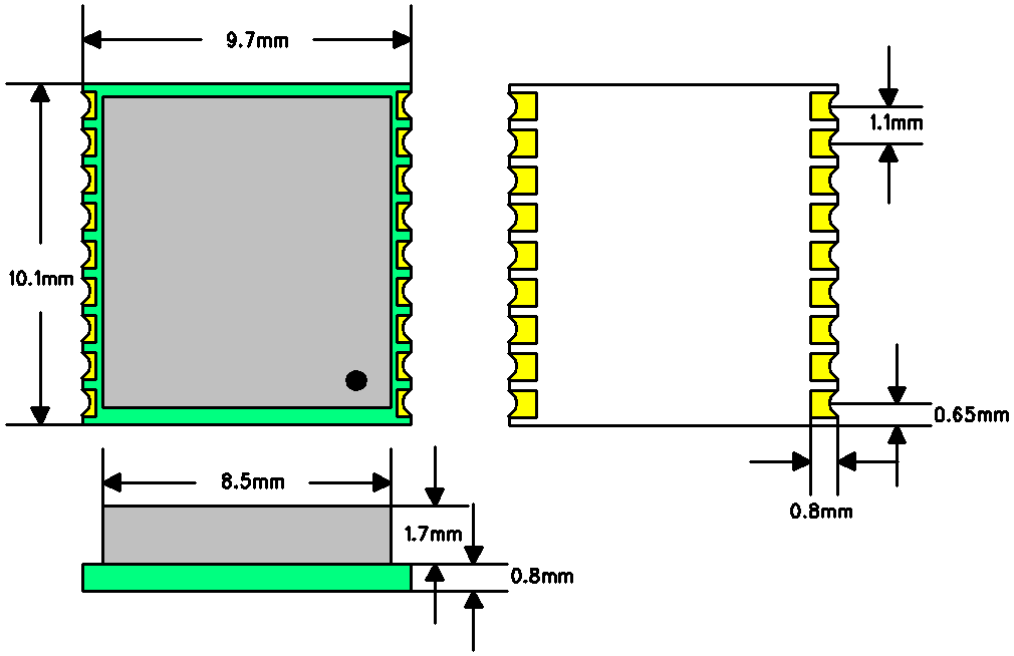
RECOMMENDED GPS/GLONASS ACTIVE EXTERNAL ANTENNA

It's recommended to use a GPS/GLONASS active external antenna with supply voltage of 3.3VDC and a current draw of 15mA maximum. The quality of the GPS/GLONASS active external antenna chosen is of paramount importance for the overall sensitivity of the GPS/GLONASS system. A GPS/GLONASS active external antenna should have a typical gain 20dB and a noise figure ≤ 1.5dB, which applies to more than 90% of the antennas available in the market.

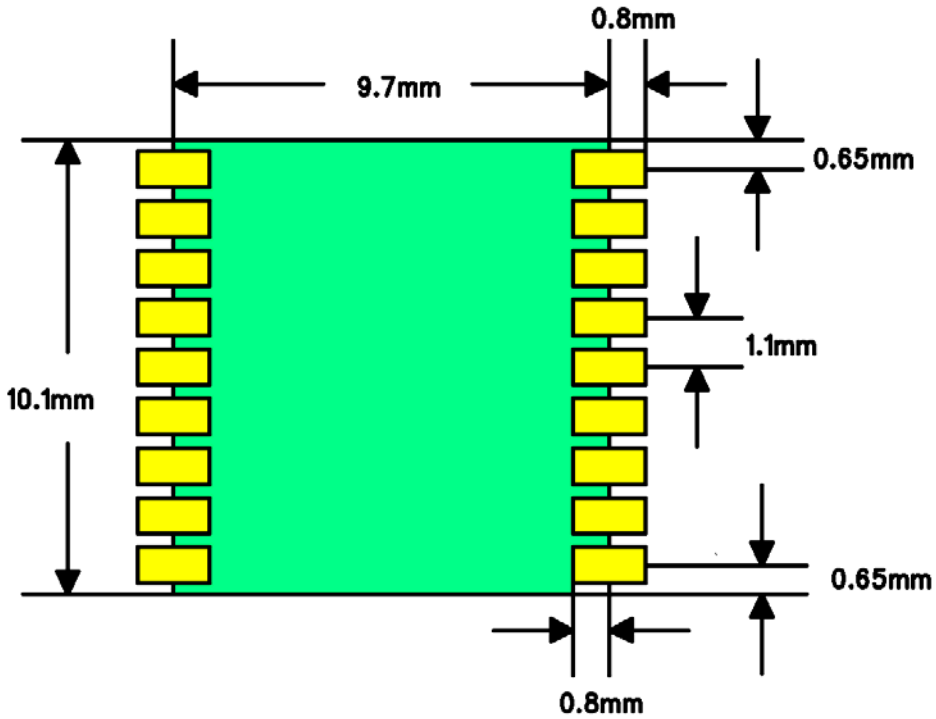
3.3V GPS/GLONASS Active External Antenna Specification

Characteristics	Specification
Center Frequency	GPS : 1575.42 1.023MHz, GLONASS : 1602 4MHz
Band Width(-10dB return loss)	10MHz @ each Band
Gain at Zenith	5.0dBi Typical
VSWR	2.0 : 1 Max
Polarization	R.H.C.P
Axial Ratio	3.0dB max
Gain	Typical 25dB (minimum 20dB)
Noise Figure	Less than 1.5dB
Out Band Attenuation	20dB min for 50MHz
Voltage	3.0 VDC or 2.7 ~ 3.3 VDC
Current	< 15 mA

MECHANICAL LAYOUT

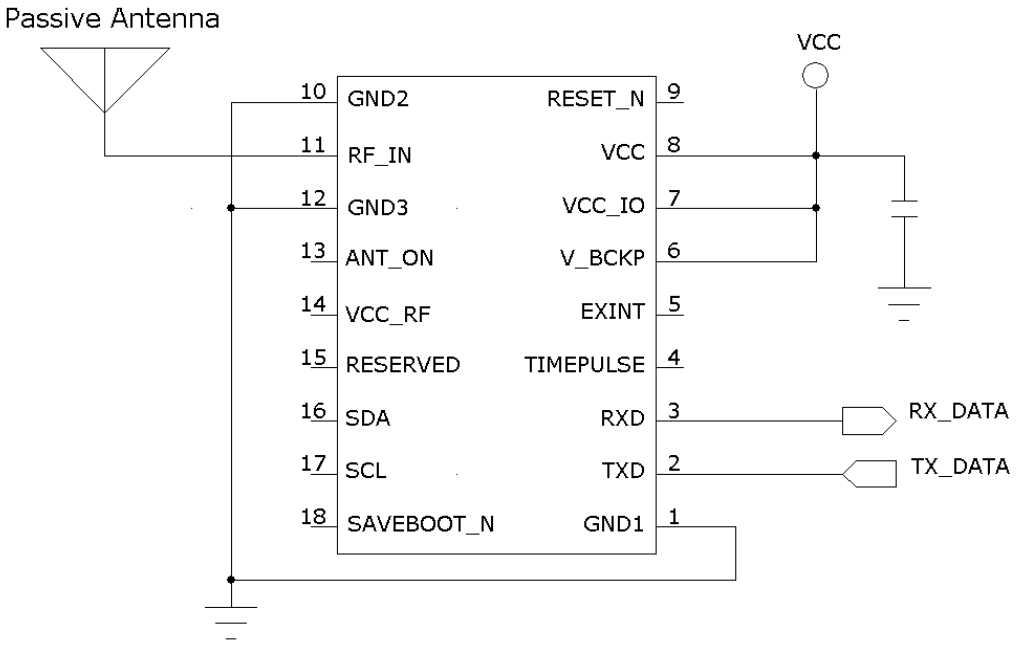


RECOMMENDED LAND PATTERN DIMENSION

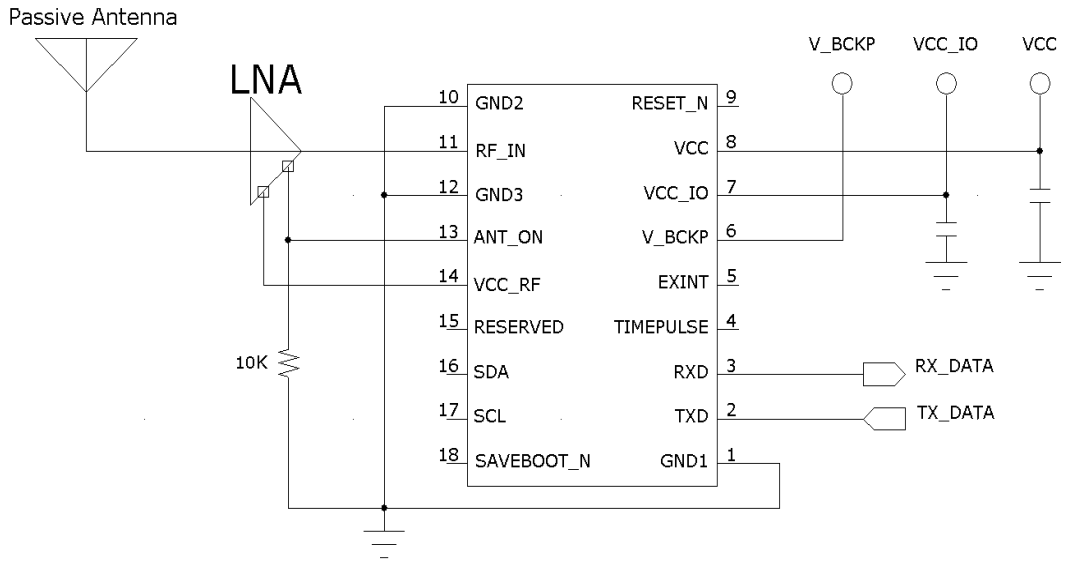


HARDWARE INTERFACE

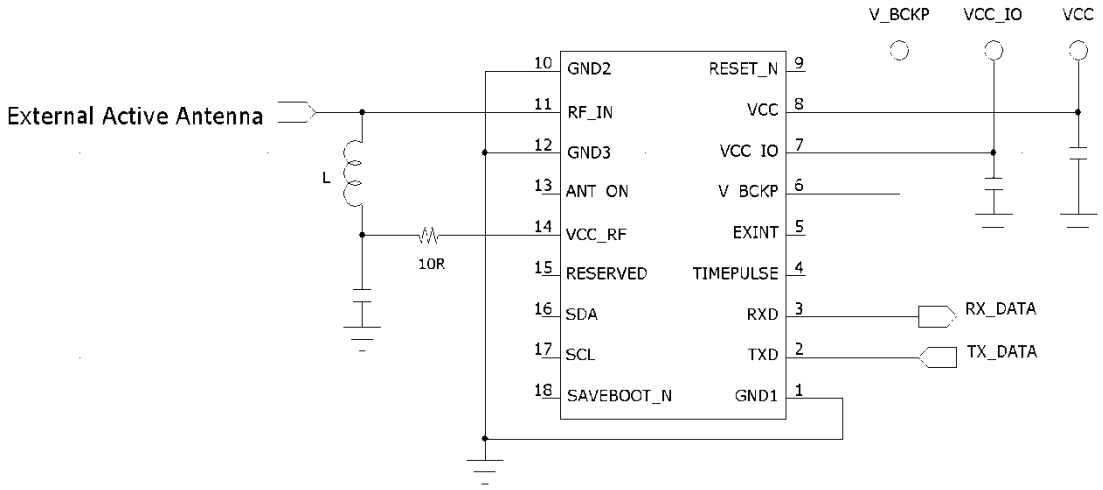
1. Example 1 for GPS/GLONASS Passive Antenna(minimal setup)



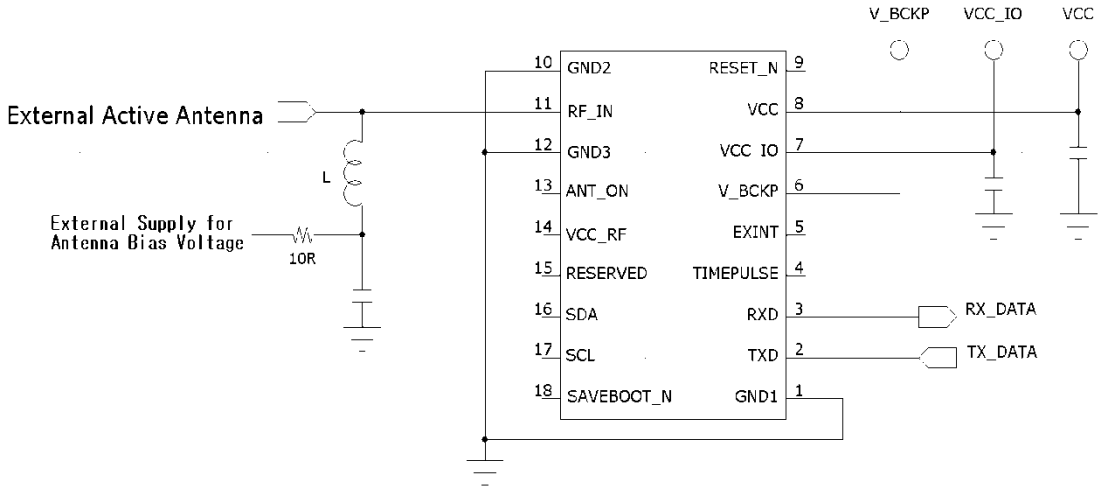
2. Example 2 for GPS/GLONASS Passive Antenna and External LNA



3. Example 3 for GPS/GLONASS external Active Antenna using Supply from VCC_RF



4. Example 4 for GPS/GLONASS external Active Antenna using Supply from External Supply



DEFINITION OF PIN ASSIGNDMENT

PIN	SIGNAL NAME	I/O	DESCRIPTION	CHARACTER
1	GND	GND	Ground	
2	TXD	O	UART TX	UART Serial Data Output, 3.0V LVTTL
3	RXD	I	UART RX	UART Serial Data Input, 3.0V LVTTL
4	TIMEPULSE	O	1 Pulse per Second	Leave open if not used, Voltage level referred VCC_IO.
5	EXTINT	I	External Interrupt	Leave open if not used, Voltage level referred VCC_IO.
6	V_BCKP	I	Backup Battery supply, **must not be unconnected**	DC +1.4 ~ +3.6V
7	VCC_IO	I	IO Supply Voltage	Usually connect to VCC Pin 8
8	VCC	I	DC Power Supply Voltage input	DC +3.0V(2.7 ~ 3.6V)
9	RESET_N	I	RESET(Active LOW)	Active LOW
10	GND	GND	Ground	
11	RF_IN	I	GPS/GLONASS SIGNAL INPUT	50Ω Impedance Line @ GPS/GLONASS
12	GND	GND	Ground	
13	ANT_ON	O	ANT_ON	Active antenna or ext. LNA Control in power save mode.
14	VCC_RF	O	Voltage output of VCC_RF	Output voltage for Active Antenna
15	Reserved	-	Reserved	Leave open
16	SDA	I/O	DDC Pins	DDC Data. Leave open, if not used
17	SCL	I	DDC Pins	DDC Clock. Leave open, if not used
18	SAFEBOOT	I	SAFEBOOT_N	For future service, updates and reconfiguration, leave OPEN

VCC : Main DC Power Input

This is the main power supply for the Engine board. The power range is **DC 3.0V(2.7 ~ 3.6V)** Suitable decoupling must be provided by external decoupling circuitry.

VCC_IO : IO Supply Voltage

VCC_IO from the host system supplies the digital I/Os. The wide range of VCC_IO allows seamless interfacing to standard logic voltage levels independent of the VCC voltage level. In many applications, VCC_IO is simply connected to the main supply voltage.

GND

GND provides the ground for the Engine board. Connect all grounds.

UART_TXD

UART Interface TX for serial communication to a host CPU. This is the main transmit channel and used to output standard NMEA_0183 sentence or response to input binary command. The default setup is NMEA Output, 9600bps, 8 data bits, no parity, 1 stop bit. The default sentences are GNRMC, GNVTG, GNGGA, GNGSA, GPGSV, GLGSV, GNGLL.

UART_RXD

UART Interface RX for serial communication to a host CPU. This is the main receiving channel and is used to input binary commands to the Engine board from host CPU.

ANT_ON

This pin can be used to turn on and off an external LNA or an Active Antenna. This reduces power consumption in Power Save Mode(Backup mode).

TIMEPULSE

The TIMEPULSE output generates pulse trains synchronized with a GNSS or UTC time grid, with intervals configurable over a wide frequency range. Thus it may be used as a low frequency time synchronization pulse or as a high frequency reference signal.
By default the time pulse signal is configured to 1 pulse per second.

RESET_N

Driving RESET_N low activates a hardware reset of the system. Use this pin only to reset the module. Do not use RESET to turn the module on and off, since the reset state increases power consumption. RESET is an input only and no additional capacitance should be added on reset pin to GND.

EXTINT

EXTINT is external interrupt pin with fixed input voltage thresholds with respect to VCC_IO. It can be used for wake-up functions in Power Save Mode and for aiding. Leave open if unused; the functions are disabled by default.

VCC_RF

This is pin for supplying voltage of external Active Antenna or LNA.

RF_IN

The Module supports passive & active antennas. The line on the PCB from the antenna(or antenna connector)has to be a controlled line (Micro strip at 50Ω @ GPS/GLONASS signal).

V_BCKP

This is the battery backup supply that powers the SRAM and RTC when main power is removed. Without an external backup battery or on board battery, engine board will execute a cold start after every turn on. To achieve the faster start-up offered by a hot or warm start, either a backup battery must be connected or battery installed on board. **This pin must be connected by power(normal Input power)for operating, must not be unconnected.**

SAFEBOOT

If the SAFEBOOT pin is “low” at start up, UGL-1010 module starts in Safe Boot Mode and doesn’t begin GNSS operation. The Safe Boot Mode can be used recover from situations where the Flash has become corrupted.

SCL

This pin is clock for DDC data.(internal pull-up resistors)

An I²C compatible Display Data Channel(DDC) interface is available for serial communication with an external host CPU. The interface only supports operation in slave mode(master mode is not supported). The DDC protocol and electrical interface are fully compatible with the Fast – Mode of the I²C industry standard.

SDA

This pin is Data for DDC data.(internal pull-up resistors)

Packing Information

1. **Packing Method**

   TBD : To be determined

GPS/GLONASS Receiver User's Tip

1. GPS/GLONASS signal will be affected by weather and environment conditions, thus suggest to use the GPS/GLONSS receiver under less shielding environments to ensure GPS/GLONASS receiver has better receiving performance.
2. When GPS/GLONASS receiver is moving, it will prolong the time to fix the position, so suggest to wait for the satellite signals to be locked at a fixed point when first power-on the GPS/GLONASS receiver to ensure to lock the GPS/GLONASS signal at the shortest time.
3. The following situation will affect the GPS/GLONASS receiving performance:
   a. Solar control filmed windows.
   b. Metal shielded, such as umbrella, or in vehicle.
   c. Among high buildings.
   d. Under bridges or tunnels.
   e. Under high voltage cables or near by radio wave sources, such as mobile phone base stations.
   f. Bad or heavy cloudy weather.
4. If the satellite signals can not be locked or encounter receiving problem (while in the urban area), the following steps are suggested:
   a. Move to another open space or reposition GPS/GLONASS receiver toward the direction with fewer blockages.
   b. Move the GPS/GLONASS receiver away from the interference resources.
   c. Wait until the weather condition is improved.

While a GPS/GLONASS with a backup battery, the GPS/GLONASS receiver can fix a position immediately at next power-on if the build-in backup battery is full-recharged.

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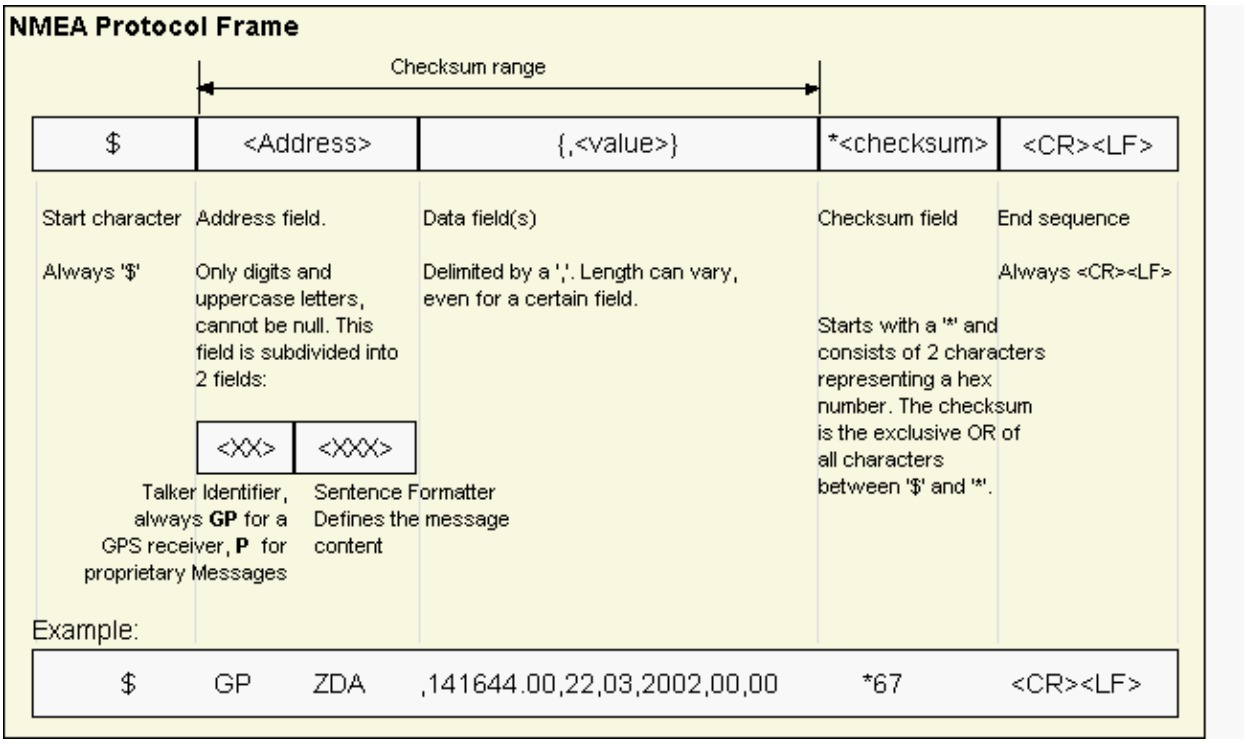
NMEA Protocol

19 Protocol Overview

19.1 Message Format

NMEA messages sent by the GNSS receiver are based on NMEA 0183 Version 4.0. The following picture shows the structure of a NMEA protocol message.



For further information on the NMEA Standard, refer to *NMEA 0183 Standard For Interfacing Marine Electronic Devices*, Version 4.00, November 1, 2008. See http://www.nmea.org/ for ordering instructions.

The NMEA standard allows for proprietary, manufacturer-specific messages to be added. These shall be marked with a manufacturer mnemonic. The mnemonic assigned to u-blox is UBX and is used for all non-standard messages. These proprietary NMEA messages therefore have the address field set to PUBX. The first data field in a PUBX message identifies the message number with two digits.

19.2 Talker ID

One of the ways the NMEA standard differentiates between GNSS is by using a two-letter message identifier, the 'Talker ID'. The specific Talker ID used by a u-blox receiver will depend on the device model and system configuration. The table below shows the Talker ID that will be used for various GNSS configurations.

NMEA Talker IDs

Configured GNSS	*Talker ID*
GPS, SBAS, QZSS	GP
GLONASS	GL
Galileo	GA
BeiDou	GB
Any combination of GNSS	GN

19.3 Protocol Configuration

The NMEA protocol on u-blox receivers can be configured to the need of customer applications using CFG-NMEA. For backwards compatibility various versions of this message are supported, however, any new users should use the version that is not marked as deprecated.

There are four NMEA standards supported. The default NMEA version is 4.0. Alternatively versions 4.1, 2.3, and 2.1 can be enabled (for details on how this affects the output refer to section Position Fix Flags in NMEA Mode).

NMEA defines satellite numbering systems for some, but not all GNSS (this is partly dependent on the NMEA version). Satellite numbers for unsupported GNSS can be configured using CFG-NMEA. Unknown satellite numbers are always reported as a null NMEA field (i.e. an empty string)

The NMEA specification indicates that the GGA message is GPS specific. However, u-blox receivers support the output of a GGA message for each of the Talker IDs.

NMEA filtering flags

Parameter	*Description*
Position filtering	Enable to permit positions from failed or invalid fixes to be reported (with the "V" status flag to indicate that the data is not valid).
Valid position filtering	Enable to permit positions from invalid fixes to be reported (with the "V" status flag to indicate that the data is not valid).
Time filtering	Enable to permit the receiver's best knowledge of time to be output, even though it might be wrong.
Date filtering	Enable to permit the receiver's best knowledge of date to be output, even though it might be wrong.
GPS-only filtering	Enable to restrict output to only report GPS satellites.
Track filtering	Enable to permit course over ground (COG) to be reported even when it would otherwise be frozen.

NMEA flags

Parameter	*Description*
Compatibility Mode	Some older NMEA applications expect the NMEA output to be formatted in a specific way, for example, they will only work if the latitude and longitude have exactly four digits behind the decimal point. u-blox receivers offer a compatibility mode to support these legacy applications.
Consideration Mode	u-blox receivers use a sophisticated signal quality detection scheme, in order to produce the best possible position output. This algorithm considers all SV measurements, and may eventually decide to only use a subset thereof, if it improves the overall position accuracy. If Consideration mode is enabled, all satellites, which were considered for navigation, are communicated as being used for the position determination. If Consideration Mode is disabled, only those satellites which after the consideration step remained in the position output are marked as being used.
Limit82 Mode	Enabling this mode will limit the NMEA sentance length to a maximum of 82 characters.

Extended configuration

Option	*Description*
GNSS to filter	Filters satellites based on their GNSS
Satellite numbering	This field configures the display of satellites that do not have an NMEA-defined value. Note: this does not apply to satellites with an unknown ID.

Extended configuration continued

Option	*Description*
Main Talker ID	By default the main Talker ID (i.e. the Talker ID used for all messages other than GSV) is determined by the GNSS assignment of the receiver's channels (see UBX-CFG-GNSS). This field enables the main Talker ID to be overridden.
GSV Talker ID	By default the Talker ID for GSV messages is GNSS specific (as defined by NMEA). This field enables the GSV Talker ID to be overridden.
BDS Talker ID	By default the Talker ID for BeiDou is 'GB'. This field enableds the BeiDou Talker ID to be overridden.

19.4 Satellite Numbering

The NMEA protocol (V4.0) identifies satellites with a two digit number, reserving the numbers 1 to 32 for GPS, 33-64 for SBAS and 65-96 for GLONASS. So, for example, GLONASS SV4 is reported using number 68. u-blox receivers support this method in their NMEA output when "strict" SV numbering is selected. In most cases this is the default setting, but can be checked or set using UBX-CFG-NMEA.

Unfortunately there is currently no standard way of identifying satellites from any other GNSS within the NMEA protocol. In order to support QZSS within current receivers and prepare for support of other systems (e.g. Galileo) in future receivers, an "extended" SV numbering scheme can be enabled (using UBX-CFG-NMEA). This uses the NMEA-defined numbers where possible, but adds other number ranges to support other GNSS. Note however that these non-standard extensions require 3 digit numbers, which may not be supported by some NMEA parsing software. For example QZSS satellites are reported using numbers in the range 193 to 197.

See Satellite Numbering Summary for a complete list of satellite numbers.

GLONASS satellites can be tracked before they have been identified. In NMEA output, such unknown satellite numbers are always reported as a null field (i.e. an empty string).

19.5 Latitude and Longitude Format

According to the NMEA Standard, Latitude and Longitude are output in the format Degrees, Minutes and (Decimal) Fractions of Minutes. To convert to Degrees and Fractions of Degrees, or Degrees, Minutes, Seconds and Fractions of seconds, the 'Minutes' and 'Fractional Minutes' parts need to be converted. In other words: If the GPS Receiver reports a Latitude of 4717.112671 North and Longitude of 00833.914843 East, this is

Latitude 47 Degrees, 17.112671 Minutes

Longitude 8 Degrees, 33.914843 Minutes

or

Latitude 47 Degrees, 17 Minutes, 6.76026 Seconds

Longitude 8 Degrees, 33 Minutes, 54.89058 Seconds

or

Latitude 47.28521118 Degrees

Longitude 8.56524738 Degrees

19.6 Position Fix Flags

This section shows how u-blox implements the NMEA protocol and the conditions determining how flags are set.

Flags in NMEA 2.3 and above

Flags in NMEA 2.3 and above continued

NMEA Message: Field	*No position fix (at power-up, after losing satellite lock)*	*GNSS fix, but user limits exceeded*	*Dead reckoning fix, but user limits exceeded*	*Dead reckoning fix (ADR with external sensors, linear extrapolation, or map matching)*	*2D GNSS fix*	*3D GNSS fix*	*Combined GNSS/dead reckoning fix (ADR with external sensors)*
NMEA Message: Field	*No position fix (at power-up, after losing satellite lock)*	*GNSS fix, but user limits exceeded*	*Dead reckoning fix, but user limits exceeded*	*Dead reckoning fix (ADR with external sensors, linear extrapolation, or map matching)*	*2D GNSS fix*	*3D GNSS fix*	*Combined GNSS/dead reckoning fix (ADR with external sensors)*
GLL, RMC: status	V	V	V	A	A	A	A
	V=Data Invalid, A=Data Valid						
GGA: quality	0	0	6	6	1 / 2	1 / 2	1 / 2
	0=No Fix, 1=Autonomous GNSS Fix, 2=Differential GNSS Fix, 6=Estimated/Dead Reckoning Fix						
GSA: navMode	1	1	2	2	2	3	3
	1=No Fix, 2=2D Fix, 3=3D Fix						
GLL, RMC, VTG, GNS: posMode	N	N	E	E	A / D	A / D	A / D
	N=No Fix, E=Estimated/Dead Reckoning Fix, A=Autonomous GNSS Fix, D=Differential GNSS Fix						

Flags in NMEA 2.1 and below

The flags in NMEA 2.1 and below are the same as NMEA 2.3 and above but with the following differences:

- The posMode field is not output for GLL, RMC and VTG messages (each message has one field less).
- The GGA quality field is set to 1 (instead of 6) For both types of dead reckoning fix.

Extra fields in NMEA 4.1 and above

Message	*Extra fields*
GBS	systemId, signalId
GNS	navStatus
GRS	systemId, signalId
GSA	systemId
GSV	signalId
RMC	navStatus

19.7 Multi-GNSS considerations

Many applications which process NMEA messages assume that only a single GNSS is active. However, when multiple GNSS are configured, the NMEA specification requires the output to change in the following ways:

NMEA output for Multi-GNSS

Change	*Description*
Main Talker ID	The main Talker ID will be 'GN' (e.g. instead of 'GP' for a GPS receiver)
GSV Talker IDs	The GSV message reports the signal strength of the visible satellites. However, the Talker ID it uses is specific to the GNSS it is reporting information for, so for a multi-GNSS receiver it will not be the same as the main Talker ID. (e.g. other messages will be using the 'GN' Talker ID but the GSV message will use GNSS-sepcific Talker IDs)

NMEA output for Multi-GNSS continued

Change	*Description*
Multiple GSA and GRS Messages	Multiple GSA and GRS messages are output for each fix, one for each GNSS. This may confuse applications which assume they are output only once per position fix (as is the case for a single GNSS receiver).

19.8 Output of Invalid/Unknown Data

By default the receiver will not output invalid data. In such cases, it will output empty fields.

A valid position fix is reported as follows:

```
$GPGLL,4717.11634,N,00833.91297,E,124923.00,A,A*6E
```

An invalid position fix (but time valid) is reported as follows:

```
$GPGLL,,,,,124924.00,V,N*42
```

If Time is unknown (e.g. during a cold-start):

```
$GPGLL,,,,,,V,N*64
```

Note:

An exception from the above default are dead reckoning fixes, which are also output when invalid (user limits exceeded).

Output of invalid data marked with the 'Invalid/Valid' Flags can be enabled using the UBX protocol message CFG-NMEA.

Differing from the NMEA standard, u-blox reports valid dead reckoning fixes with user limits met (not exceeded) as valid (A) instead of invalid (V).

19.9 Messages Overview

When configuring NMEA messages using the UBX protocol message CFG-MSG, the Class/Ids shown in the table shall be used.

Page	*Mnemonic*	*Cls/ID*	*Description*
NMEA Standard Messages			**Standard Messages**
65	**DTM**	0xF0 0x0A	Datum Reference
66	**GBQ**	0xF0 0x44	Poll a standard message (if the current Talker ID is GB)
66	**GBS**	0xF0 0x09	GNSS Satellite Fault Detection
67	**GGA**	0xF0 0x00	Global positioning system fix data
68	**GLL**	0xF0 0x01	Latitude and longitude, with time of position fix and status
69	**GLQ**	0xF0 0x43	Poll a standard message (if the current Talker ID is GL)
70	**GNQ**	0xF0 0x42	Poll a standard message (if the current Talker ID is GN)
70	**GNS**	0xF0 0x0D	GNSS fix data
71	**GPQ**	0xF0 0x40	Poll a standard message (if the current Talker ID is GP)
72	**GRS**	0xF0 0x06	GNSS Range Residuals
73	**GSA**	0xF0 0x02	GNSS DOP and Active Satellites
74	**GST**	0xF0 0x07	GNSS Pseudo Range Error Statistics
75	**GSV**	0xF0 0x03	GNSS Satellites in View
76	**RMC**	0xF0 0x04	Recommended Minimum data
77	**TXT**	0xF0 0x41	Text Transmission

NMEA Messages Overview continued

Page	*Mnemonic*	*Cls/ID*	*Description*
78	**VLW**	0xF0 0x0F	Dual ground/water distance
78	**VTG**	0xF0 0x05	Course over ground and Ground speed
79	**ZDA**	0xF0 0x08	Time and Date
NMEA PUBX Messages			**Proprietary Messages**
81	**CONFIG**	0xF1 0x41	Set Protocols and Baudrate
82	**POSITION**	0xF1 0x00	Lat/Long Position Data
83	**SVSTATUS**	0xF1 0x03	Satellite Status
84	**TIME**	0xF1 0x04	Time of Day and Clock Information

Example:

```
$GPGBS,235503.00,1.6,1.4,3.2,,,,,*40
$GPGBS,235458.00,1.4,1.3,3.1,03,,-21.4,3.8,1,0*5B
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxGBS	-	string	$GPGBS	GBS Message ID (xx = current Talker ID)
1	time	-	hhmmss.ss	235503.00	UTC time to which this RAIM sentence belongs, see note on UTC representation
2	errLat	m	numeric	1.6	Expected error in latitude
3	errLon	m	numeric	1.4	Expected error in longitude
4	errAlt	m	numeric	3.2	Expected error in altitude
5	svid	-	numeric	03	Satellite ID of most likely failed satellite
6	prob	-	numeric	-	Probability of missed detection, not supported (empty)
7	bias	m	numeric	-21.4	Estimate on most likely failed satellite (a priori residual)
8	stddev	m	numeric	3.8	Standard deviation of estimated bias
9	systemId	-	numeric	1	NMEA defined GNSS System ID **NMEA v4.1 and above only**
10	signalId	-	numeric	0	NMEA defined GNSS Signal ID (0 = All signals) **NMEA v4.1 and above only**
11	cs	-	hexadecimal	*5B	Checksum
12	<CR><LF>	-	character	-	Carriage return and line feed

20.4 GGA

20.4.1 Global positioning system fix data

Message	**GGA**		
Description	**Global positioning system fix data**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	**The output of this message is dependent on the currently selected datum (default: WGS84). The NMEA specification indicates that the GGA message is GPS specific. However, when the receiver is configured for multi-GNSS, the GGA message contents will be generated from the multi-GNSS solution. For multi-GNSS use, it is recommended that the NMEA-GNS message is used instead.** Time and position, together with GPS fixing related data (number of satellites in use, and the resulting HDOP, age of differential data if in use, etc.).		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x00	17	

Message Structure:

```
$xxGGA,time,lat,NS,long,EW,quality,numSV,HDOP,alt,M,sep,M,diffAge,diffStation*cs<CR><LF>
```

Example:

```
$GPGGA,092725.00,4717.11399,N,00833.91590,E,1,08,1.01,499.6,M,48.0,M,,*5B
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*

GGA continued

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxGGA	-	string	$GPGGA	GGA Message ID (xx = current Talker ID)
1	time	-	hhmmss.ss	092725.00	UTC time, see note on UTC representation
2	lat	-	ddmm.mmmmm	4717.11399	Latitude (degrees & minutes), see format description
3	NS	-	character	N	North/South indicator
4	long	-	dddmm.mmmmm	00833.91590	Longitude (degrees & minutes), see format description
5	EW	-	character	E	East/West indicator
6	quality	-	digit	1	Quality indicator for position fix, see table below and position fix flags description
7	numSV	-	numeric	08	Number of satellites used (range: 0-12)
8	HDOP	-	numeric	1.01	Horizontal Dilution of Precision
9	alt	m	numeric	499.6	Altitude above mean sea level
10	uAlt	-	character	M	Altitude units: meters (fixed field)
11	sep	m	numeric	48.0	Geoid separation: difference between geoid and mean sea level
12	uSep	-	character	M	Separation units: meters (fixed field)
13	diffAge	s	numeric	-	Age of differential corrections (blank when DGPS is not used)
14	diffStation	-	numeric	-	ID of station providing differential corrections (blank when DGPS is not used)
15	cs	-	hexadecimal	*5B	Checksum
16	<CR><LF>	-	character	-	Carriage return and line feed

Table Quality Indicator

Quality Indicator	*Description, see also position fix flags description*
0	No Fix / Invalid
1	Standard GPS (2D/3D)
2	Differential GPS
6	Estimated (DR) Fix

20.5 GLL

20.5.1 Latitude and longitude, with time of position fix and status

Message	**GLL**		
Description	**Latitude and longitude, with time of position fix and status**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	**The output of this message is dependent on the currently selected datum (default: WGS84)** -		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x01	10	

Message Structure:

```
$xxGLL,lat,NS,long,EW,time,status,posMode*cs<CR><LF>
```

Example:

```
$GPGLL,4717.11364,N,00833.91565,E,092321.00,A,A*60
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxGLL	-	string	$GPGLL	GLL Message ID (xx = current Talker ID)
1	lat	-	ddmm.mmmmm	4717.11364	Latitude (degrees & minutes), see format description
2	NS	-	character	N	North/South indicator
3	long	-	dddmm.mmmmm	00833.91565	Longitude (degrees & minutes), see format description
4	EW	-	character	E	East/West indicator
5	time	-	hhmmss.ss	092321.00	UTC time, see note on UTC representation
6	status	-	character	A	V = Data invalid or receiver warning, A = Data valid. See position fix flags description.
7	posMode	-	character	A	Positioning mode, see position fix flags description. **NMEA v2.3 and above only**
8	cs	-	hexadecimal	*60	Checksum
9	<CR><LF>	-	character	-	Carriage return and line feed

20.6 GLQ

20.6.1 Poll a standard message (if the current Talker ID is GL)

Message	**GLQ**		
Description	**Poll a standard message (if the current Talker ID is GL)**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Input Message		
Comment	Polls a standard NMEA message if the current Talker ID is GL		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x43	4	

Message Structure:

```
$xxGLQ,msgId*cs<CR><LF>
```

Example:

```
$EIGLQ,RMC*3A
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxGLQ	-	string	$EIGLQ	GLQ Message ID (xx = Talker ID of the device requesting the poll)
1	msgId	-	string	RMC	Message ID of the message to be polled
2	cs	-	hexadecimal	*3A	Checksum
3	<CR><LF>	-	character	-	Carriage return and line feed

Table Mode

Mode	*Description*
0	Residuals were used to calculate the position given in the matching GGA sentence.
1	Residuals were recomputed after the GGA position was computed.

20.11 GSA

20.11.1 GNSS DOP and Active Satellites

Message	**GSA**		
Description	**GNSS DOP and Active Satellites**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	The GPS receiver operating mode, satellites used for navigation, and DOP values. • If less than 12 SVs are used for navigation, the remaining fields are left empty. If more than 12 SVs are used for navigation, only the IDs of the first 12 are output. • The SV numbers (fields 'sv') are in the range of 1 to 32 for GPS satellites, and 33 to 64 for SBAS satellites (33 = SBAS PRN 120, 34 = SBAS PRN 121, and so on) **In a multi-GNSS system this message will be output multiple times, once for each GNSS.**		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x02	21	

Message Structure:

```
$xxGSA,opMode,navMode{,sv},PDOP,HDOP,VDOP,systemId*cs<CR><LF>
```

Example:

```
$GPGSA,A,3,23,29,07,08,09,18,26,28,,,,,1.94,1.18,1.54,1*0D
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxGSA	-	string	$GPGSA	GSA Message ID (xx = current Talker ID)
1	opMode	-	character	A	Operation mode, see first table below
2	navMode	-	digit	3	Navigation mode, see second table below and position fix flags description
Start of repeated block (12 times)					
3 + 1*N	sv	-	numeric	29	Satellite number
End of repeated block					
15	PDOP	-	numeric	1.94	Position dilution of precision
16	HDOP	-	numeric	1.18	Horizontal dilution of precision
17	VDOP	-	numeric	1.54	Vertical dilution of precision
18	systemId	-	numeric	1	NMEA defined GNSS System ID **NMEA v4.1 and above only**
19	cs	-	hexadecimal	*0D	Checksum
20	<CR><LF>	-	character	-	Carriage return and line feed

Table Operation Mode

Operation Mode	*Description*
M	Manually set to operate in 2D or 3D mode
A	Automatically switching between 2D or 3D mode

Table Navigation Mode

Navigation Mode	*Description, see also position fix flags description*
1	Fix not available
2	2D Fix
3	3D Fix

20.12 GST

20.12.1 GNSS Pseudo Range Error Statistics

Message	**GST**		
Description	**GNSS Pseudo Range Error Statistics**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	This message reports statisical information on the quality of the position solution.		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x07	11	

Message Structure:

```
$xxGST,time,rangeRms,stdMajor,stdMinor,orient,stdLat,stdLong,stdAlt*cs<CR><LF>
```

Example:

```
$GPGST,082356.00,1.8,,,,1.7,1.3,2.2*7E
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	`xxGST`	-	string	$GPGST	GST Message ID (xx = current Talker ID)
1	`time`	-	hhmmss.ss	082356.00	UTC time of associated position fix, see note on UTC representation
2	`rangeRms`	m	numeric	1.8	RMS value of the standard deviation of the ranges
3	`stdMajor`	m	numeric	-	Standard deviation of semi-major axis (blank - not supported)
4	`stdMinor`	m	numeric	-	Standard deviation of semi-minor axis (blank - not supported)
5	`orient`	deg	numeric	-	Orientation of semi-major axis (blank - not supported)
6	`stdLat`	m	numeric	1.7	Standard deviation of latitude error
7	`stdLong`	m	numeric	1.3	Standard deviation of longitude error
8	`stdAlt`	m	numeric	2.2	Standard deviation of altitude error
9	`cs`	-	hexadecimal	*7E	Checksum
10	`<CR><LF>`	-	character	-	Carriage return and line feed

20.13 GSV

20.13.1 GNSS Satellites in View

Message	**GSV**		
Description	**GNSS Satellites in View**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	The number of satellites in view, together with each SV ID, elevation azimuth, and signal strength (C/No) value. Only four satellite details are transmitted in one message. **In a multi-GNSS system sets of GSV messages will be output multiple times, one set for each GNSS.**		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x03	8..16	

Message Structure:

```
$xxGSV,numMsg,msgNum,numSV,{,sv,elv,az,cno},signalId*cs<CR><LF>
```

Example:

```
$GPGSV,3,1,10,23,38,230,44,29,71,156,47,07,29,116,41,08,09,081,36,0*7F
$GPGSV,3,2,10,10,07,189,,05,05,220,,09,34,274,42,18,25,309,44,0*72
$GPGSV,3,3,10,26,82,187,47,28,43,056,46,0*77
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxGSV	-	string	$GPGSV	GSV Message ID (xx = GSV Talker ID)
1	numMsg	-	digit	3	Number of messages, total number of GSV messages being output
2	msgNum	-	digit	1	Number of this message
3	numSV	-	numeric	10	Number of satellites in view
Start of repeated block (1..4 times)					
4 + 4*N	sv	-	numeric	23	Satellite ID
5 + 4*N	elv	deg	numeric	38	Elevation (range 0-90)
6 + 4*N	az	deg	numeric	230	Azimuth, (range 0-359)
7 + 4*N	cno	dBHz	numeric	44	Signal strength (C/N0, range 0-99), blank when not tracking
End of repeated block					
5..16	signalId	-	numeric	0	NMEA defined GNSS Signal ID (0 = All signals) **NMEA v4.1 and above only**
6..16	cs	-	hexadecimal	*7F	Checksum
7..16	<CR><LF>	-	character	-	Carriage return and line feed

20.14 RMC

20.14.1 Recommended Minimum data

Message	**RMC**		
Description	**Recommended Minimum data**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	**The output of this message is dependent on the currently selected datum (default: WGS84)** The recommended minimum sentence defined by NMEA for GNSS system data.		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x04	16	

Message Structure:

```
$xxRMC,time,status,lat,NS,long,EW,spd,cog,date,mv,mvEW,posMode,navStatus*cs<CR><LF>
```

Example:

```
$GPRMC,083559.00,A,4717.11437,N,00833.91522,E,0.004,77.52,091202,,,A,V*57
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxRMC	-	string	$GPRMC	RMC Message ID (xx = current Talker ID)
1	time	-	hhmmss.ss	083559.00	UTC time, see note on UTC representation
2	status	-	character	A	Status, V = Navigation receiver warning, A = Data valid, see position fix flags description
3	lat	-	ddmm.mmmmm	4717.11437	Latitude (degrees & minutes), see format description
4	NS	-	character	N	North/South indicator
5	long	-	dddmm.mmmmm	00833.91522	Longitude (degrees & minutes), see format description
6	EW	-	character	E	East/West indicator
7	spd	knots	numeric	0.004	Speed over ground
8	cog	degrees	numeric	77.52	Course over ground
9	date	-	ddmmyy	091202	Date in day, month, year format, see note on UTC representation
10	mv	degrees	numeric	-	Magnetic variation value (blank - not supported)
11	mvEW	-	character	-	Magnetic variation E/W indicator (blank - not supported)
12	posMode	-	character	-	Mode Indicator, see position fix flags description **NMEA v2.3 and above only**
13	navStatus	-	character	V	Navigational status indicator (V = Equipment is not providing navigational status information) **NMEA v4.1 and above only**
14	cs	-	hexadecimal	*57	Checksum
15	<CR><LF>	-	character	-	Carriage return and line feed

20.15 TXT

20.15.1 Text Transmission

Message	**TXT**		
Description	**Text Transmission**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	**This message is not configured through UBX-CFG-MSG, but instead through UBX-CFG-INF.** This message outputs various information on the receiver, such as power-up screen, software version etc. This message can be configured using UBX Protocol message UBX-CFG-INF.		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x41	7	

Message Structure:

```
$xxTXT,numMsg,msgNum,msgType,text*cs<CR><LF>
```

Example:

```
$GPTXT,01,01,02,u-blox ag - www.u-blox.com*50
$GPTXT,01,01,02,ANTARIS ATR0620 HW 00000040*67
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxTXT	-	string	$GPTXT	TXT Message ID (xx = current Talker ID)
1	numMsg	-	numeric	01	Total number of messages in this transmission, 01..99
2	msgNum	-	numeric	01	Message number in this transmission, range 01..xx
3	msgType	-	numeric	02	Text identifier, u-blox GPS receivers specify the type of the message with this number. 00: Error 01: Warning 02: Notice 07: User
4	text	-	string	www.u-blox.com	Any ASCII text
5	cs	-	hexadecimal	*67	Checksum
6	<CR><LF>	-	character	-	Carriage return and line feed

20.16 VLW

20.16.1 Dual ground/water distance

Message	**VLW**		
Description	**Dual ground/water distance**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	The distance traveled, relative to the water and over the ground.		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x0F	11	

Message Structure:

```
$xxVLW,twd,twdUnit,wd,wdUnit,tgd,tgdUnit,gd,gdUnit*cs<CR><LF>
```

Example:

```
$GPVLW,,N,,N,15.8,N,1.2,N*06
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxVLW	-	string	$GPVLW	VLW Message ID (xx = current Talker ID)
1	twd	nm	numeric	-	Total cumulative water distance, not output
2	twdUnit	-	character	N	Fixed field: nautical miles
3	wd	nm	numeric	-	Water distance since reset, not output
4	wdUnit	-	character	N	Fixed field: nautical miles
5	tgd	nm	numeric	15.8	Total cumulative ground distance
6	tgdUnit	-	character	N	Fixed field: nautical miles
7	gd	nm	numeric	1.2	Ground distance since reset
8	gdUnit	-	character	N	Fixed field: nautical miles
9	cs	-	hexadecimal	*06	Checksum
10	<CR><LF>	-	character	-	Carriage return and line feed

20.17 VTG

20.17.1 Course over ground and Ground speed

Message	**VTG**		
Description	**Course over ground and Ground speed**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	Velocity is given as Course over Ground (COG) and Speed over Ground (SOG).		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x05	12	

Message Structure:

```
$xxVTG,cogt,T,cogm,M,knots,N,kph,K,posMode*cs<CR><LF>
```

Example:

```
$GPVTG,77.52,T,,M,0.004,N,0.008,K,A*06
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*

VTG continued

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxVTG	-	string	$GPVTG	VTG Message ID (xx = current Talker ID)
1	cogt	degrees	numeric	77.52	Course over ground (true)
2	T	-	character	T	Fixed field: true
3	cogm	degrees	numeric	-	Course over ground (magnetic), not output
4	M	-	character	M	Fixed field: magnetic
5	knots	knots	numeric	0.004	Speed over ground
6	N	-	character	N	Fixed field: knots
7	kph	km/h	numeric	0.008	Speed over ground
8	K	-	character	K	Fixed field: kilometers per hour
9	posMode	-	character	A	Mode Indicator, see position fix flags description **NMEA v2.3 and above only**
10	cs	-	hexadecimal	*06	Checksum
11	<CR><LF>	-	character	-	Carriage return and line feed

20.18 ZDA

20.18.1 Time and Date

Message	**ZDA**		
Description	**Time and Date**		
Firmware	Supported on: • u-blox M8 firmware version 2.00		
Type	Output Message		
Comment	-		
Message Info	*ID for CFG-MSG*	*Number of fields*	
	0xF0 0x08	9	

Message Structure:

```
$xxZDA,hhmmss.ss,day,month,year,ltzh,ltzn*cs<CR><LF>
```

Example:

```
$GPZDA,082710.00,16,09,2002,00,00*64
```

Field No.	*Name*	*Unit*	*Format*	*Example*	*Description*
0	xxZDA	-	string	$GPZDA	ZDA Message ID (xx = current Talker ID)
1	time	-	hhmmss.ss	082710.00	UTC Time, see note on UTC representation
2	day	day	dd	16	UTC day (range: 1-31)
3	month	month	mm	09	UTC month (range: 1-12)
4	year	year	yyyy	2002	UTC year
5	ltzh	-	-xx	00	Local time zone hours (fixed to 00)
6	ltzn	-	zz	00	Local time zone minutes (fixed to 00)
7	cs	-	hexadecimal	*64	Checksum