

KNCTEK GPS/GLONASS Mouse
UGM-1533GL Specification

Version 1.0
2019/12/27

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UGM-1533GL Specification

REVISION HISTORY	3
INTRODUCTION	4
PRODUCT FEATURES	4
PRODUCT APPLICATIONS	4
PRODUCT PICTURE	5
UGM-1533GL SYSTEM BLOCK DIAGRAM	5
TECHNICAL SPECIFICATION	6
ORDERING INFORMATION.....	8
I/O INTERFACE	9
CABLE DRAWING.....	10
PACKING SPECIFICATION	11
GPS/GLONASS RECEIVER USER'S TIP	12
CONTACT INFORMATION SECTION	13
NMEA PROTOCOL	14

Revision History

1. 2019-12-27 : Initiated Version 1.0

UGM-1533GL Operational Manual

INTRODUCTION

The **UGM-1533GL** is the newest generation of KNCTEK GPS/GLONASS Mouse. The GPS/GLONASS Mouse is powered by U-blox technology and KNCTEK's proprietary navigation algorithm that provide you more stable navigation data.

The miniature design is the best choice to be embedded in the portable devices, various Trackers, Vehicle & Personal Locaters and etc. The excellent sensitivity of **UGM-1533GL** gets the great performance when going through the urban canyon and foliage environmental condition.

PRODUCT FEATURES

- ✧ GPS, GLONASS, QZSS, SBAS(WAAS, MSAS, EGNOS, GAGAN) supported
- ✧ 72-channel u-blox M8 Engine
- ✧ Operable from 3.3V to 5.5V / 60mA for Acquisition and 50mA 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 with case(22 x 45.6 x 9.9mm)
- ✧ ODM/OEM development is fully supported Application Engineering
- ✧ RoHS compliant

PRODUCT APPLICATION

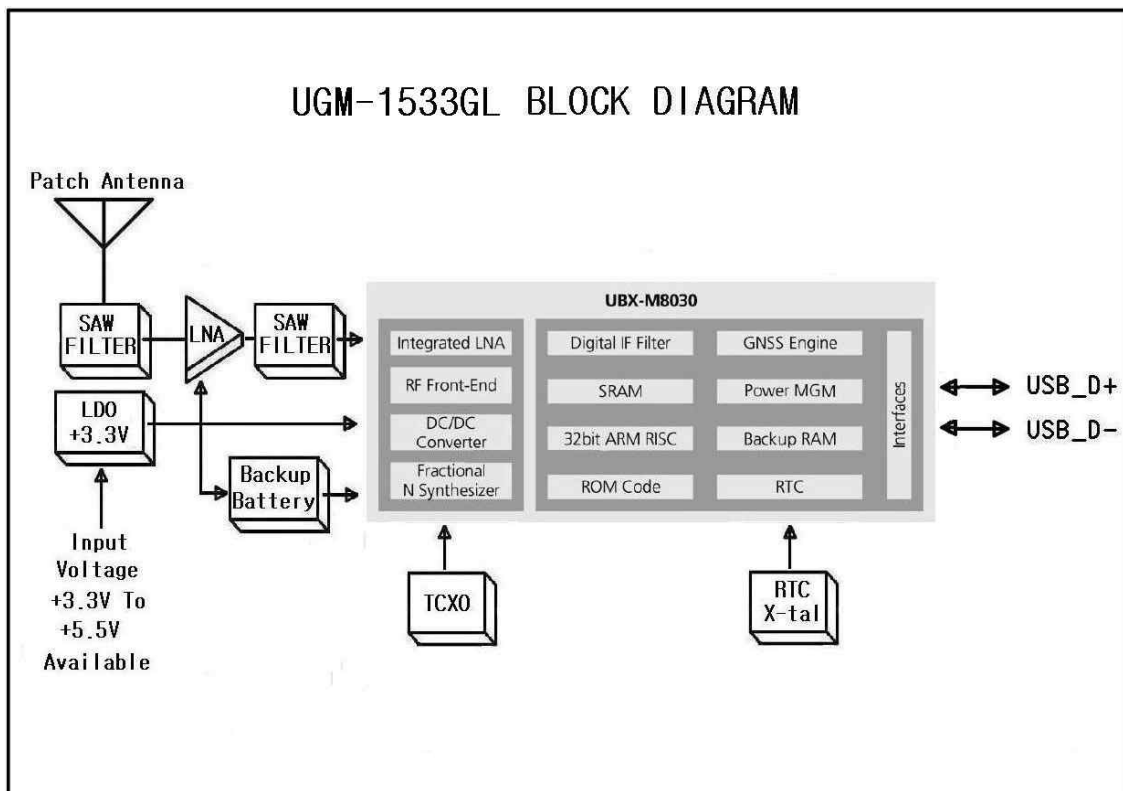
- ✧ Automotive applications
- ✧ Speed camera detector
- ✧ Personal and Car navigation
- ✧ Marine navigation
- ✧ Timing application and the others

PRODUCT PICTURE



UGM-1533GL SYSTEM BLOCK DIAGRAM

The UGM-1533GL consists of u-blox M8 chipsets Technology, KNCTEK LNA and proprietary software. 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	6	V
Input Pins				
Input Pin Voltage I/O	RX	-0.3	3.6	V
Backup Battery	Vbat	1.6	3.6	V
Environment				
Operating Temperature	Topr	-30	85	°C
Storage Temperature	Tstg	-40	85	°C
Backup Battery operating temperature ¹	Tbat	-20	60	°C
Humidity			95	%

** 1 Backup Battery operating temperature depends on Battery characteristics

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		3.3	5.0	5.5	V
Power Supply voltage ripple	Vcc_PP	Vcc = 3.3 ~ 5.5V			50	mV
Acquisition current	IccA	Vcc = 3.3 ~ 5.5V		60		mA
Tracking current	IccT	Vcc = 3.3 ~ 5.5V		50		mA
Input high voltage	V _{IH}		2.0			V
Input low voltage	V _{IL}		0		0.8	V
Output high voltage	V _{OH}		2.8			V

Output low voltage	V_{OL}				0.3	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	50mA @ 3.3 ~ 5.5V	
	Acquisition	60mA @ 3.3 ~ 5.5V	
	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/sec ²)	
Mechanical data	Dimension	22X45.6X9.9mm	
	Weight	27.5grams \pm 5%(1m Cable)	
Protocol	NMEA-0183 V4.0	GNRMC	1Hz(one time per sec)
		GNVTG	1Hz
		GNGGA	1Hz
		GNGSA	1Hz
		GPGSV	1Hz
		GLGSV	1Hz
		GNGLL	1Hz

** ¹Open Sky means no obstructions in the sky

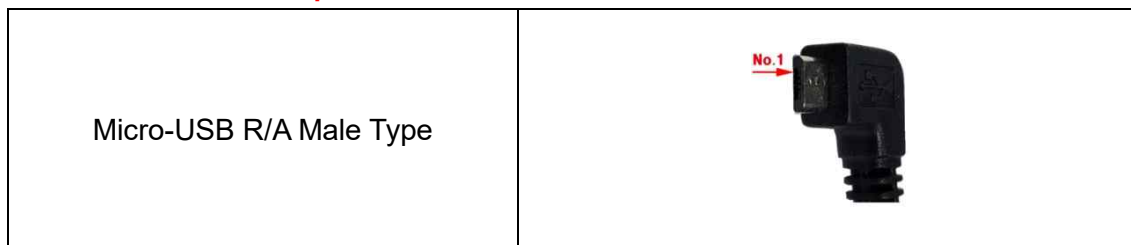
ORDERING INFORMATION [Example]



ITEM	DESCRIPTION	NOTE
GPS Data Output Level	USB Data	
Baudrate	9600bps	
Connector Type	Micro USB R/A male type	
Pin Map	VCC, DM, DP, Detection, GND	
Cable Length	1m	meter
3M Tape Type	3M5952	Black
3M Tape Attachment Location	Bottom Side	
GPS Antenna Position	Bottom Side	

(Customer :)

I/O INTERFACE [Example]



Micro-USB R/A Male Pin Description

PIN	SIGNAL NAME	I/O	DESCRIPTION	CHARACTER
1	VCC	P	DC Power Supply Voltage input from USB power	DC 3.3V to 5.5V Acceptable
2	USB_DM	I/O	I/O Differential USB D-	USB Data-
3	USB_DP	I/O	I/O Differential USB D+	USB Data+
4	Detection	O	Used for USB detecting, 1K resistor pull-downed	Leave open If not used
5	GND	P	Digital Reference Ground	Digital Reference Ground

VCC DC Power Input

This is the main power supply for the Engine board. The power range is **DC 3.3V to 5.5V Acceptable**. Suitable decoupling must be provided by external decoupling circuitry.

GND

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

USB_DM

Data minus for USB communication.

USB_DP

Data plus for USB communication.

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, GNLL.

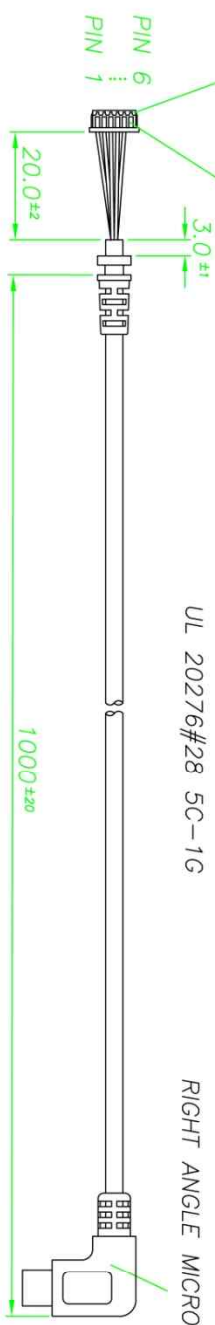
Detection

Used for USB Detecting. Leave open if not used

REVISION	LOCATION	DESCRIPTION OF CHANGE	DATE	APPROVAL

HOUSING
12505 YS-06

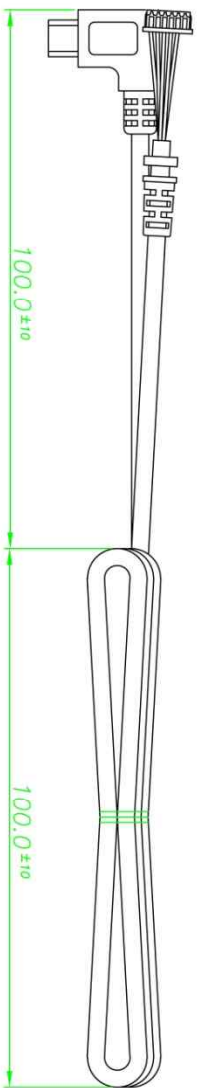
PIN
12505 TS



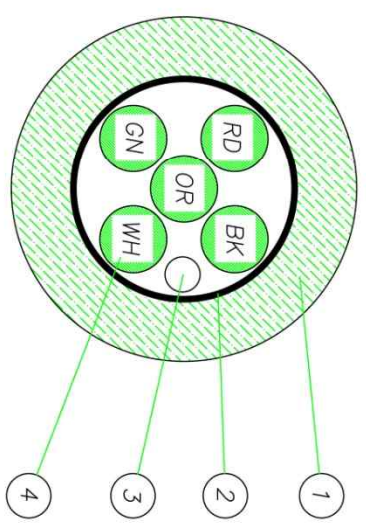
UL 20276#28 5C-1G

RIGHT ANGLE MICRO USB 5PIN

NO	HOUSING	MICRO USB
1	ORANGE	VCC RED
2	RED	RX WHITE
3	GREEN	TX GREEN
4	WHITE	DT ORANGE
5	BLACK	GND BLACK/DRAIN
6		



AWM 20276
CABLE SPEC.



NO	DESCRIPTION	SPECIFICATION
1	JACKET	Non-Toxic PVC O/D: $\phi 3.2 \pm 0.2$
2	TAPE	JKT COLOR: BLACK AL/PS Tape
3	DRAIN WIRE	7/0.127TA(28AWG) O/D: $\phi 0.38$
4	CONDUCTOR	7/0.127TA(28AWG) O/D: $\phi 0.38$
	INSULATION	SR-PVC O/D: $\phi 0.68 \pm 0.05$
	MARKING	INK PRINTING ONE THE SURFACE OF CABLE

TOLERANCE TABLE ±mm

CLASSIFICATION	CLASS			
	1	2	3	4 (S)
0	~ 16	0.06	0.1	0.1
17	~ 63	0.06	0.1	0.2
64	~ 250	0.1	0.2	0.3
251	~ 1000	0.2	0.3	0.4

APPLICATION MODEL	Q'TY	SPECIFICATION	REMARK
DO NOT SCALE			
DRAW	CHECK	APPO	

APPLICATION MODEL	Q'TY	SPECIFICATION	REMARK
DO NOT SCALE			
DRAW	CHECK	APPO	
DATE	MAR. 3. 2020	TITLE: MICRO USB CABLE	FILE NAME
		DRAWING NO.	
			REVISION A1

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 using the GPS/GLONASS 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 nearby radio wave sources, such as mobile phone base stations.
 - f. Bad or heavy cloudy weather.
4. If the satellite signals cannot 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.

Contact Information Section

Contact : knc3@knctek.co.kr

Web Site : www.knctek.co.kr

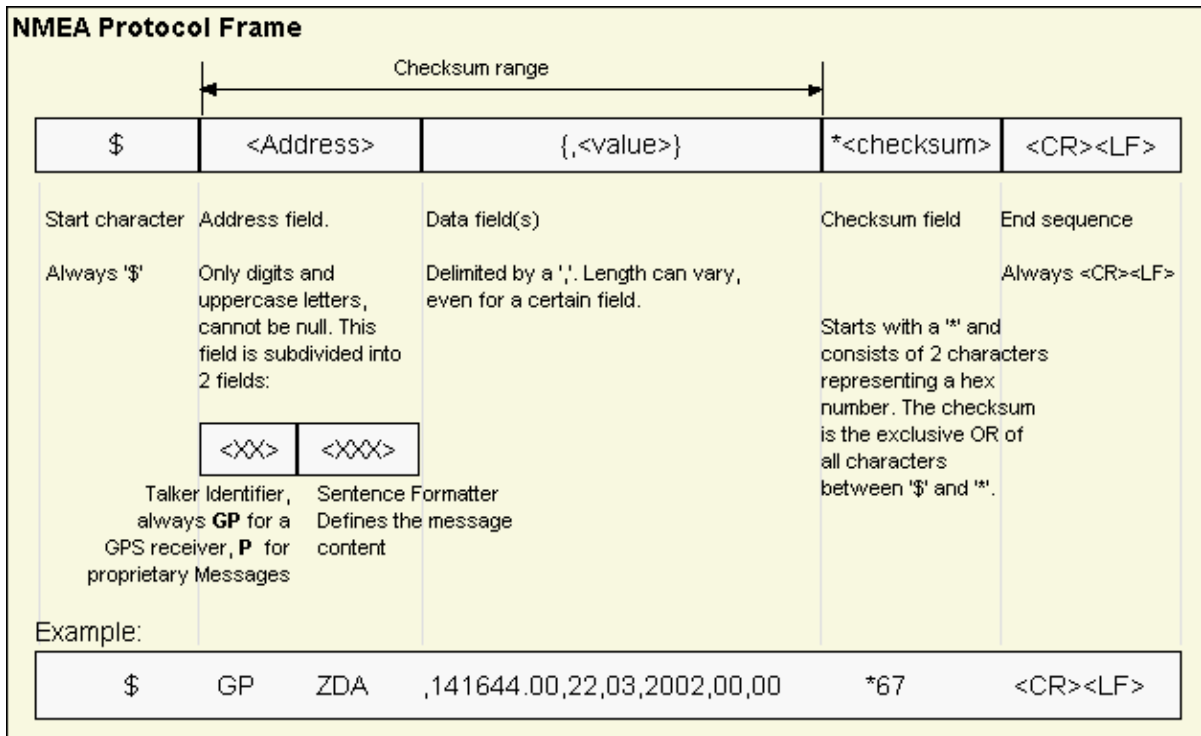
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FAX: 82-2-830-5703**

NMEA Protocol

17 Protocol Overview

NMEA messages sent by the GNSS receiver are based on NMEA 0183 Version 2.3. The following picture shows the structure of a NMEA protocol message.



For further information on the NMEA Standard please refer to *NMEA 0183 Standard For Interfacing Marine Electronic Devices*, Version 2.30, March 1, 1998. 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.

18 NMEA Protocol Configuration

The [NMEA protocol](#) on u-blox receivers can be configured to the need of customer applications using [CFG-NMEA](#).

There are two NMEA standards supported. The default NMEA version is 2.3. Alternatively version 2.1 can be enabled (for details on how this affects the output refer to section [Position Fix Flags in NMEA Mode](#)).

The NMEA standard differentiates between GPS, GLONASS, and combined GNSS receivers using a two-letter message identifier, the 'Talker ID'. Depending upon device model and system configuration, the u-blox receiver could output messages using any one of these Talker IDs.

By default, receivers configured to support GPS, SBAS and QZSS use the 'GP' Talker ID, receivers configured to support GLONASS use the 'GL' Talker ID, and receivers configured for any other GNSS or any other combinations of GNSS use the 'GN' Talker ID

NMEA defines a satellite numbering system for GPS, SBAS, and GLONASS. Satellite numbers for other 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.

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.
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.

19 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

20 Position Fix Flags in NMEA

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

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.

21 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
```

Please 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).

22 NMEA 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	
52	DTM	0xF0 0x0A	Datum Reference
53	GBS	0xF0 0x09	GNSS Satellite Fault Detection
54	GGA	0xF0 0x00	Global positioning system fix data
55	GLL	0xF0 0x01	Latitude and longitude, with time of position fix and status
56	GLQ	0xF0 0x43	Poll a standard message (if the current Talker ID is GL)
56	GNQ	0xF0 0x42	Poll a standard message (if the current Talker ID is GN)
57	GNS	0xF0 0x0D	GNSS fix data
58	GPQ	0xF0 0x40	Poll a standard message (if the current Talker ID is GP)
58	GRS	0xF0 0x06	GNSS Range Residuals
59	GSA	0xF0 0x02	GNSS DOP and Active Satellites
60	GST	0xF0 0x07	GNSS Pseudo Range Error Statistics
61	GSV	0xF0 0x03	GNSS Satellites in View
62	RMC	0xF0 0x04	Recommended Minimum data
63	TXT	0xF0 0x41	Text Transmission
64	VTG	0xF0 0x05	Course over ground and Ground speed
65	ZDA	0xF0 0x08	Time and Date
NMEA PUBX Messages		Proprietary Messages	
66	CONFIG	0xF1 0x41	Set Protocols and Baudrate
67	POSITION	0xF1 0x00	Poll a PUBX,00 message
67	POSITION	0xF1 0x00	Lat/Long Position Data
69	RATE	0xF1 0x40	Set NMEA message output rate
70	SVSTATUS	0xF1 0x03	Poll a PUBX,03 message
70	SVSTATUS	0xF1 0x03	Satellite Status
71	TIME	0xF1 0x04	Poll a PUBX,04 message
72	TIME	0xF1 0x04	Time of Day and Clock Information

23.13 RMC

23.13.1 Recommended Minimum data

Message	RMC		
Description	Recommended Minimum data		
Firmware	Supported on: <ul style="list-style-type: none"> • u-blox 7 firmware version 1.00 		
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	15	

Message Structure:

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

Example:

```
$GPRMC,083559.00,A,4717.11437,N,00833.91522,E,0.004,77.52,091202,,A*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. mmmm	4717.11437	Latitude (degrees & minutes), see format description
4	NS	-	character	N	North/South indicator
5	long	-	dddmm. mmmm	00833.91522	Longitude (degrees & minutes), see format description
6	EW	-	character	E	East/West indicator
7	spd	knot s	numeric	0.004	Speed over ground
8	cog	degr ees	numeric	77.52	Course over ground
9	date	-	ddmmyy	091202	Date in day, month, year format, see note on UTC representation
10	mv	degr ees	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
13	cs	-	hexadecimal	*57	Checksum
14	<CR><LF>	-	character	-	Carriage return and line feed

23.14 TXT

23.14.1 Text Transmission

Message	TXT		
Description	Text Transmission		
Firmware	Supported on: <ul style="list-style-type: none"> u-blox 7 firmware version 1.00 		
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

23.15 VTG

23.15.1 Course over ground and Ground speed

Message	VTG		
Description	Course over ground and Ground speed		
Firmware	Supported on: <ul style="list-style-type: none"> u-blox 7 firmware version 1.00 		
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
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
10	cs	-	hexadecimal	*06	Checksum
11	<CR><LF>	-	character	-	Carriage return and line feed

23.3 GGA

23.3.1 Global positioning system fix data

Message	GGA		
Description	Global positioning system fix data		
Firmware	Supported on: <ul style="list-style-type: none"> u-blox 7 firmware version 1.00 		
Type	Output Message		
Comment	The output of this message is dependent on the currently selected datum (default: WGS84) 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
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. mmmm	4717.11399	Latitude (degrees & minutes), see format description
3	NS	-	character	N	North/South indicator
4	long	-	dddmm. mmmm	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

23.4 GLL

23.4.1 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: <ul style="list-style-type: none"> u-blox 7 firmware version 1.00 		
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	(9) or (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 .
<i>Start of optional block</i>					
7	posMode	-	character	A	Positioning mode, see position fix flags description
<i>End of optional block</i>					
7	cs	-	hexadecimal	*60	Checksum
8	<CR><LF>	-	character	-	Carriage return and line feed

GRS continued

Field No.	Name	Unit	Format	Example	Description
2	mode	-	digit	1	Mode (see table below), u-blox receivers will always output Mode 1 residuals
Start of repeated block (12 times)					
3 + 1*N	residual	m	numeric	0.54	Range residuals for SVs used in navigation. The SV order matches the order from the GSA sentence.
End of repeated block					
15	cs	-	hexadecimal	*70	Checksum
16	<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.

23.10 GSA

23.10.1 GNSS DOP and Active Satellites

Message	GSA		
Description	GNSS DOP and Active Satellites		
Firmware	Supported on: <ul style="list-style-type: none"> u-blox 7 firmware version 1.00 		
Type	Output Message		
Comment	The GPS receiver operating mode, satellites used for navigation, and DOP values. <ul style="list-style-type: none"> 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) 		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x02	20	

Message Structure:

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

Example:

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

GSA continued

Field No.	Name	Unit	Format	Example	Description
16	HDOP	-	numeric	1.18	Horizontal dilution of precision
17	VDOP	-	numeric	1.54	Vertical dilution of precision
18	cs	-	hexadecimal	*0D	Checksum
19	<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

23.11 GST

23.11.1 GNSS Pseudo Range Error Statistics

Message	GST		
Description	GNSS Pseudo Range Error Statistics		
Firmware	Supported on: <ul style="list-style-type: none"> u-blox 7 firmware version 1.00 		
Type	Output Message		
Comment	This message reports statistical 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

GST continued

Field No.	Name	Unit	Format	Example	Description
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

23.12 GSV

23.12.1 GNSS Satellites in View

Message	GSV		
Description	GNSS Satellites in View		
Firmware	Supported on: • u-blox 7 firmware version 1.00		
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.		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x03	7..16	

Message Structure:

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

Example:

```
$GPGSV,3,1,10,23,38,230,44,29,71,156,47,07,29,116,41,08,09,081,36*7F
```

```
$GPGSV,3,2,10,10,07,189,,05,05,220,,09,34,274,42,18,25,309,44*72
```

```
$GPGSV,3,3,10,26,82,187,47,28,43,056,46*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
<i>Start of repeated block (1..4 times)</i>					
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	dBH z	numeric	44	Signal strength (C/N0, range 0-99), blank when not tracking
<i>End of repeated block</i>					
5.. 16	cs	-	hexadecimal	*7F	Checksum
6.. 16	<CR><LF>	-	character	-	Carriage return and line feed