

# 赛特思（香港）有限公司

SATES (HONG KONG) CO.,LTD

## ST-91-U7 GPS 使用说明书

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## 1. Product Information

### General Description:

ST-91-U7 is a compact, high performance, and low power consumption GPS engine board. It uses ublox 7 chipset which is high performance u-blox 7 multi-GNSS(GPS, GLONASS, QZSS, SBAS – Galileo and Compass ready) position engine delivers exceptional sensitivity and acquisition times.

ST-91-U7 is suitable for the following applications:

- Automotive navigation
- Personal positioning
- Fleet management
- Mobile phone navigation
- Marine navigation
- Tracking device

### Highlight Features:

- Ublox 7 high performance and low power consumption GPS Chipset
- Very high sensitivity (Tracking Sensitivity: -162dBm)
- Extremely fast TTFF (Time To First Fix) at low signal level
- Two serial ports :UART,I2C
- Built-in LNA
- A-GPS Support
- Compact size (9.7mm \* 10.1 mm \* 2.4mm) suitable for space-sensitive application
- Exceptional jamming immunity
- Support NMEA 0183 and ublox binary protocol

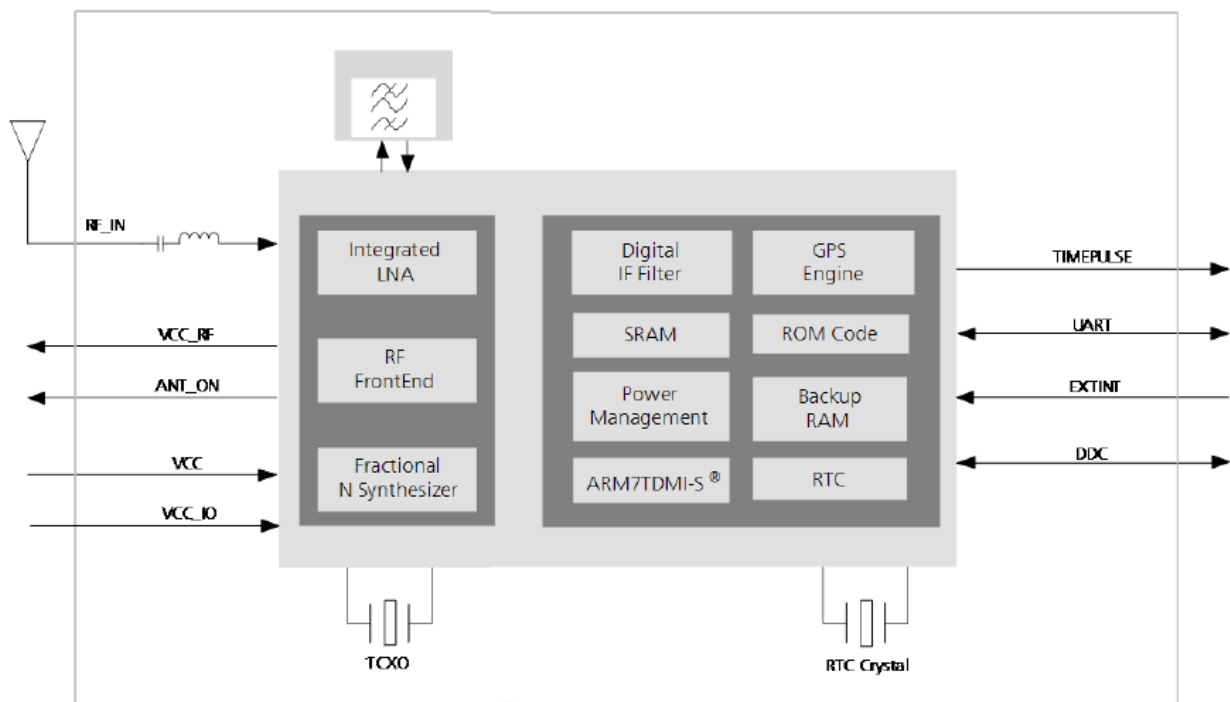
## 2. Product Specifications

<b>GPS Receiver</b>	
Chipset	ublox UBX-G7020,56-channel u-blox 7 engine, GPS & QZSS L1 C/A,
Frequency	L1 frequency band
Code	C/A Code
Protocol	NMEA 0183 v2.3 GALILEO L1 open service (with upgrade) Default:GGA,GSA,GSV,RMC Support:VTG,GLL,TXT ublox binary and NMEA Command
Available Baud	9,600 bps
Channels	56
Internal ROM	3Mbit of ROM and 2Mbit of RAM
Sensitivity(GPS)	Tracking:-162dBm Reacquisition:-160dBm ColdStart:-148dBm
Cold Start	29 seconds, average
Warm Start	29 seconds, average
Hot Start	1 second, average
Accuracy	HorizontalPosition:Autonomous<2.5maverage, SBAS < 2.0m average Velocity: 0.1 m/s Timepulse signal: RMS 30 ns
Maximum	50,000 meter
Maximum	500 m/s(1000 knots)
Dynamics	≅ 4G
Update Rate	10 Hz
A-GPS	AssistNow on-line and off-line,AOP
<b>Interface</b>	
I/O Pins	1 serial ports
<b>Physical Characteristic</b>	
Type	18 pin stamp holes
Dimensions	9.7mm * 10.1 mm * 2.4mm ±0.2mm
<b>DC Characteristics</b>	
Power Supply	3.3VDC ±5%
Backup Voltage	1.8~3.6VDC

Power Consumption	Continuous Mode: Tracking<35mA Acquisition<34mA Simulated constellation of 8 satellites is used. All signals are at -130 dBm. update period 1 sec.
<b>Environmental Range</b>	
Humidity Range	5% to 95% non-condensing
Operation Temperature	-40°C to 85°C
Storage Temperature	-40°C to 85°C

### 3. Technical Information

#### Block Diagram



## 4. Position Fix Flags in NMEA Mode

The following list shows how u-blox implements the NMEA protocol, and the conditions determining how flags are set in version 2.3 and above.

NMEA Message: Field	No position fix (at power-up, after losing satellite lock)	Valid position fix with GPS, but user limits exceeded	Valid dead reckoning fix, but user limits exceeded	Dead reckoning (linear extrapolation, ADR with external sensors, or map matching)	2D position fix	3D position fix	combined GPS/SFDR position fix (ADR with external sensors)
GLL, RMC: Status	V	V	V	A	A	A	A
A=Data VALID, V=Data Invalid (Navigation Receiver Warning)							
GGA: Quality Indicator	0	0	6	6	1 / 2	1 / 2	1 / 2
0=Fix not available/invalid, 1=GPS SPS Mode, Fix valid, 2=Differential GPS, SPS Mode, Fix Valid, 6=Estimated/Dead Reckoning							
GSA: Nav Mode	1	1	2	2	2	3	3
1=Fix Not available, 2=2D Fix, 3=3D Fix							
GLL, RMC, VTG, GNS: Mode Indicator	N	N	E	E	A / D	A / D	A / D
N=No Fix, A=Autonomous GNSS Fix, D=Differential GNSS Fix, E=Estimated/Dead Reckoning Fix							
UBX GPSTFixOK	0	0	0	1	1	1	1
UBX GPSTFix	0	>1	1	1	2	3	4

The following list shows how u-blox implements the NMEA protocol, and the conditions determining how flags are set in version 2.2 and below.

NMEA Message: Field	No position fix (at power-up, after losing satellite lock)	Valid position fix with GPS, but user limits exceeded	Valid dead reckoning fix, but user limits exceeded	Dead reckoning (linear extrapolation, ADR with external sensors, or map matching)	2D position fix	3D position fix	combined GPS/SFDR position fix (ADR with external sensors)
GLL, RMC: Status	V	V	V	A	A	A	A
A=Data VALID, V=Data Invalid (Navigation Receiver Warning)							
GGA: Quality Indicator	0	0	1	1	1 / 2	1 / 2	1 / 2
0=Fix not available/invalid, 1=GPS SPS Mode, Fix valid, 2=Differential GPS, SPS Mode, Fix Valid							
GSA: Nav Mode	1	1	2	2	2	3	3
1=Fix Not available, 2=2D Fix, 3=3D Fix							
GLL, RMC, VTG: Mode Indicator. This field is not output by this NMEA version.							
GNS: This message is not defined in this NMEA version.							
UBX GPSTFixOK	0	0	0	1	1	1	1
UBX GPSTFix	0	>1	1	1	2	3	4



*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

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



In Antaris firmware versions older than 3.0, the receiver did output invalid data and marked it with the 'Invalid/Valid' Flags. If required, this function can still be enabled in later firmware versions, 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).

## 5. 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
<b>NMEA Proprietary Messages</b>		<b>Proprietary Messages</b>	
66	<a href="#">UBX,00</a>	0xF1 0x00	Poll a PUBX,00 message
67	<a href="#">UBX,00</a>	0xF1 0x00	Lat/Long Position Data
69	<a href="#">UBX,03</a>	0xF1 0x03	Poll a PUBX,03 message
70	<a href="#">UBX,03</a>	0xF1 0x03	Satellite Status
72	<a href="#">UBX,04</a>	0xF1 0x04	Poll a PUBX,04 message
73	<a href="#">UBX,04</a>	0xF1 0x04	Time of Day and Clock Information
74	<a href="#">UBX,05</a>	0xF1 0x05	Poll a PUBX,05 message
75	<a href="#">UBX,05</a>	0xF1 0x05	Lat/Long Position Data
77	<a href="#">UBX,06</a>	0xF1 0x06	Poll a PUBX,06 message
78	<a href="#">UBX,06</a>	0xF1 0x06	Lat/Long Position Data
80	<a href="#">UBX,40</a>	0xF1 0x40	Set NMEA message output rate
81	<a href="#">UBX,41</a>	0xF1 0x41	Set Protocols and Baudrate
<b>NMEA Standard Messages</b>		<b>Standard Messages</b>	
53	<a href="#">DTM</a>	0xF0 0x0A	Datum Reference
54	<a href="#">GBS</a>	0xF0 0x09	GNSS Satellite Fault Detection
55	<a href="#">GGA</a>	0xF0 0x00	Global positioning system fix data
56	<a href="#">GLL</a>	0xF0 0x01	Latitude and longitude, with time of position fix and status
57	<a href="#">GPQ</a>	0xF0 0x40	Poll message
58	<a href="#">GRS</a>	0xF0 0x06	GNSS Range Residuals
59	<a href="#">GSA</a>	0xF0 0x02	GNSS DOP and Active Satellites
60	<a href="#">GST</a>	0xF0 0x07	GNSS Pseudo Range Error Statistics
61	<a href="#">GSV</a>	0xF0 0x03	GNSS Satellites in View
62	<a href="#">RMC</a>	0xF0 0x04	Recommended Minimum data
63	<a href="#">TXT</a>	0xF0 0x41	Text Transmission
64	<a href="#">VTG</a>	0xF0 0x05	Course over ground and Ground speed
65	<a href="#">ZDA</a>	0xF0 0x08	Time and Date

## 6. Standard Messages

Standard Messages : i.e. Messages as defined in the NMEA Standard

### 6.1 DTM

<i>Message</i>	<b>DTM</b>		
<i>Description</i>	<b>Datum Reference</b>		
<i>Firmware</i>	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
<i>Type</i>	Output Message		
<i>Comment</i>	<p>This message gives the difference between the currently selected Datum, and the reference Datum.</p> <p>If the currently configured Datum is not WGS84 or WGS72, then the field <b>LLL</b> will be set to 999, and the field <b>LSD</b> is set to a variable-length string, representing the Name of the Datum. The list of supported datums can be found in <a href="#">CFG-DAT</a>.</p> <p>The reference Datum can not be changed and is always set to WGS84.</p>		
<i>Message Info</i>	<i>ID for CFG-MSG</i>	<i>Number of fields</i>	
	0xF0 0x0A	11	

Message Structure:

```
$GPDTM,LLL,LSD,lat,N/S,lon,E/W,alt,RRR*cs<CR><LF>
```

Example:

```
$GPDTM,W84,,0.0,N,0.0,E,0.0,W84*6F
$GPDTM,W72,,0.00,S,0.01,W,-2.8,W84*4F
$GPDTM,999,CH95,0.08,N,0.07,E,-47.7,W84*1C
```

Field No.	Example	Format	Name	Unit	Description
0	\$GPDTM	string	\$GPDTM	-	Message ID, DTM protocol header
1	W72	string	LLL	-	Local Datum Code, W84 = WGS84, W72 = WGS72, 999 = user defined
2	-	string	LSD	-	Local Datum Subdivision Code, This field outputs the currently selected Datum as a string (see also note above).
3	0.08	numeric	lat	minutes	Offset in Latitude
4	S	character	NS	-	North/South indicator
5	0.07	numeric	lon	minutes	Offset in Longitude
6	E	character	EW	-	East/West indicator
7	-2.8	numeric	alt	m	Offset in altitude
8	W84	string	RRR	-	Reference Datum Code, W84 = WGS 84. This is the only supported Reference datum.
9	*67	hexadecimal	cs	-	Checksum
10	-	character	<CR><LF>	-	Carriage Return and Line Feed



**6.2 GBS**

Message	<b>GBS</b>		
Description	<b>GNSS Satellite Fault Detection</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	<p>This message outputs the results of the Receiver Autonomous Integrity Monitoring Algorithm (RAIM).</p> <ul style="list-style-type: none"> <li>The fields <b>errlat</b>, <b>errlon</b> and <b>erralt</b> output the standard deviation of the position calculation, using all satellites which pass the RAIM test successfully.</li> <li>The fields <b>errlat</b>, <b>errlon</b> and <b>erralt</b> are only output if the RAIM process passed successfully (i.e. no or successful Edits happened). These fields are never output if 4 or fewer satellites are used for the navigation calculation (because - in this case - integrity can not be determined by the receiver autonomously)</li> <li>The fields <b>prob</b>, <b>bias</b> and <b>stddev</b> are only output if at least one satellite failed in the RAIM test. If more than one satellites fail the RAIM test, only the information for the worst satellite is output in this message.</li> </ul>		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x09	11	

Message Structure:

```
$GPGBS,hhmmss.ss,errlat,errlon,erralt,svid,prob,bias,stddev*cs<CR><LF>
```

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*5B
```

Field No.	Example	Format	Name	Unit	Description
0	\$GPGBS	string	\$GPGBS	-	Message ID, GBS protocol header
1	235503.00	hhmmss.sss	hhmmss.ss	-	UTC Time, Time to which this RAIM sentence belongs
2	1.6	numeric	errlat	m	Expected error in latitude
3	1.4	numeric	errlon	m	Expected error in longitude
4	3.2	numeric	erralt	m	Expected error in altitude
5	03	numeric	svid	-	Satellite ID of most likely failed satellite
6	-	numeric	prob	-	Probability of missed detection, no supported (empty)
7	-21.4	numeric	bias	m	Estimate on most likely failed satellite (a priori residual)
8	3.8	numeric	stddev	m	Standard deviation of estimated bias
9	*40	hexadecimal	cs	-	Checksum
10	-	character	<CR><LF>	-	Carriage Return and Line Feed

**6.3 GGA**

Message	<b>GGA</b>		
Description	<b>Global positioning system fix data</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	<b>The output of this message is dependent on the currently selected datum (Default: WGS84)</b> 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:

```
$GPGGA,hhmmss.ss, Latitude,N, Longitude,E, FS, NoSV, HDOP, msl,m, Altref,m, DiffAge, DiffStation*cs<CR><LF>
```

Example:

```
$GPGGA,092725.00,4717.11399,N,00833.91590,E,1,8,1.01,499.6,M,48.0,M,,0*5B
```

Field No.	Example	Format	Name	Unit	Description
0	\$GPGGA	string	\$GPGGA	-	Message ID, GGA protocol header
1	092725.00	hhmmss.sss	hhmmss.ss	-	UTC Time, Current time
2	4717.11399	ddmm.mmmm	Latitude	-	Latitude, Degrees + minutes, see Format description
3	N	character	N	-	N/S Indicator, N=north or S=south
4	00833.91590	dddmm.mmmm	Longitude	-	Longitude, Degrees + minutes, see Format description
5	E	character	E	-	E/W indicator, E=east or W=west
6	1	digit	FS	-	Position Fix Status Indicator, See Table below and Position Fix Flags description
7	8	numeric	NoSV	-	Satellites Used, Range 0 to 12
8	1.01	numeric	HDOP	-	HDOP, Horizontal Dilution of Precision
9	499.6	numeric	msl	m	MSL Altitude
10	M	character	uMsl	-	Units, Meters (fixed field)
11	48.0	numeric	Altref	m	Geoid Separation
12	M	character	uSep	-	Units, Meters (fixed field)
13	-	numeric	DiffAge	s	Age of Differential Corrections, Blank (Null) fields when DGPS is not used
14	0	numeric	DiffStation	-	Diff. Reference Station ID
15	*5B	hexadecimal	cs	-	Checksum
16	-	character	<CR><LF>	-	Carriage Return and Line Feed

**Table Fix Status**

Fix Status	Description, see also Position Fix Flags description
0	No Fix / Invalid
1	Standard GPS (2D/3D)
2	Differential GPS
6	Estimated (DR) Fix

## 6.4 GLL

Message	<b>GLL</b>		
Description	<b>Latitude and longitude, with time of position fix and status</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	<b>The output of this message is dependent on the currently selected datum (Default: WGS84)</b> -		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x01	(9) or (10)	

### Message Structure:

```
$GPGLL, Latitude, N, Longitude, E, hhhmmss.ss, Valid, Mode*cs<CR><LF>
```

### Example:

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

Field No.	Example	Format	Name	Unit	Description
0	\$GPGLL	string	\$GPGLL	-	Message ID, GLL protocol header
1	4717.11364	ddmm.mmmm	Latitude	-	Latitude, Degrees + minutes, see Format description
2	N	character	N	-	N/S Indicator, hemisphere N=north or S=south
3	00833.91565	dddmm.mmmm	Longitude	-	Longitude, Degrees + minutes, see Format description
4	E	character	E	-	E/W indicator, E=east or W=west
5	092321.00	hhmmss.sss	hhmmss.ss	-	UTC Time, Current time
6	A	character	Valid	-	V = Data invalid or receiver warning, A = Data valid. See Position Fix Flags description
<i>Start of optional block</i>					
7	A	character	Mode	-	Positioning Mode, see Position Fix Flags description
<i>End of optional block</i>					
7	*60	hexadecimal	cs	-	Checksum
8	-	character	<CR><LF>	-	Carriage Return and Line Feed

## 6.5 GPQ

Message	<b>GPQ</b>		
Description	<b>Poll message</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Input Message		
Comment	Polls a standard NMEA message.		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x40	4	

Message Structure:

```
$xxGPQ,sid*cs<CR><LF>
```

Example:

```
$EIGPQ,RMC*3A
```

Field No.	Example	Format	Name	Unit	Description
0	\$EIGPQ	string	\$xxGPQ	-	Message ID, GPQ protocol header, xx = talker identifier
1	RMC	string	sid	-	Sentence identifier
2	*3A	hexadecimal	cs	-	Checksum
3	-	character	<CR><LF>	-	Carriage Return and Line Feed

## 6.6 GRS

Message	<b>GRS</b>		
Description	<b>GNSS Range Residuals</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	<b>This messages relates to associated GGA and GSA messages.</b> If less than 12 SVs are available, the remaining fields are output empty. If more than 12 SVs are used, only the residuals of the first 12 SVs are output, in order to remain consistent with the NMEA standard.		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x06	17	

Message Structure:

```
$GPGRS,hhmmss.ss, mode {,residual}*cs<CR><LF>
```

Example:

```
$GPGRS,082632.00,1,0.54,0.83,1.00,1.02,-2.12,2.64,-0.71,-1.18,0.25,,,*70
```

Field No.	Example	Format	Name	Unit	Description
0	\$GPGRS	string	\$GPGRS	-	Message ID, GRS protocol header
1	082632.00	hhmmss.sss	hhmmss.ss	-	UTC Time, Time of associated position fix
2	1	digit	mode	-	Mode (see table below), u-blox receivers will always

					output Mode 1 residuals
<i>Start of repeated block (12 times)</i>					
3 + 1*N	0.54	numeric	residual	m	Range residuals for SVs used in navigation. The SV order matches the order from the GSA sentence.
<i>End of repeated block</i>					
15	*70	hexadecimal	cs	-	Checksum
16	-	character	<CR><LF>	-	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.

**6.7 GSA**

<i>Message</i>	<b>GSA</b>		
<i>Description</i>	<b>GNSS DOP and Active Satellites</b>		
<i>Firmware</i>	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
<i>Type</i>	Output Message		
<i>Comment</i>	<p>The GPS receiver operating mode, satellites used for navigation, and DOP values.</p> <ul style="list-style-type: none"> <li>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.</li> <li>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)</li> </ul>		
<i>Message Info</i>	<i>ID for CFG-MSG</i>	<i>Number of fields</i>	
	0xF0 0x02	20	

**Message Structure:**

```
$GPGSA, Smode, FS{, 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.	Example	Format	Name	Unit	Description
0	\$GPGSA	string	\$GPGSA	-	Message ID, GSA protocol header
1	A	character	Smode	-	Smode, see first table below
2	3	digit	FS	-	Fix status, see second table below and Position Fix Flags description
<i>Start of repeated block (12 times)</i>					
3 + 1*N	29	numeric	sv	-	Satellite number
<i>End of repeated block</i>					
15	1.94	numeric	PDOP	-	Position dilution of precision
16	1.18	numeric	HDOP	-	Horizontal dilution of precision
17	1.54	numeric	VDOP	-	Vertical dilution of precision
18	*0D	hexadecimal	cs	-	Checksum

19	-	character	<CR><LF>	-	Carriage Return and Line Feed
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**Table Smode**

Mode	Description
M	Manual - forced to operate in 2D or 3D mode
A	Allowed to automatically switch 2D/3D mode

**Table Fix Status**

1	Fix not available
2	2D Fix
3	3D Fix

**6.8 GST**

Message	<b>GST</b>		
Description	<b>GNSS Pseudo Range Error Statistics</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	-		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x07	11	

**Message Structure:**

```
$GPGST,hhmmss.ss,range_rms,std_major,std_minor,hdg,std_lat,std_long,std_alt*cs<CR><LF>
```

**Example:**

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

Field No.	Example	Format	Name	Unit	Description
0	\$GPGST	string	\$GPGST	-	Message ID, GST protocol header
1	082356.00	hhmmss.sss	hhmmss.ss	-	UTC Time, Time of associated position fix
2	1.8	numeric	range_rms	m	RMS value of the standard deviation of the ranges
3	-	numeric	std_major	m	Standard deviation of semi-major axis, not supported (empty)
4	-	numeric	std_minor	m	Standard deviation of semi-minor axis, not supported (empty)
5	-	numeric	hdg	degrees	Orientation of semi-major axis, not supported (empty)
6	1.7	numeric	std_lat	m	Standard deviation of latitude, error in meters
7	1.3	numeric	std_long	m	Standard deviation of longitude, error in meters
8	2.2	numeric	std_alt	m	Standard deviation of altitude, error in meters
9	*7E	hexadecimal	cs	-	Checksum
10	-	character	<CR><LF>	-	Carriage Return and Line Feed

## 6.9 GSV

Message	<b>GSV</b>		
Description	<b>GNSS Satellites in View</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	The number of satellites in view, together with each PRN (SV ID), elevation and azimuth, and C/No (Signal/Noise Ratio) 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:

```
$GPGSV,NoMsg,MsgNo,NoSv,{,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.	Example	Format	Name	Unit	Description
0	\$GPGSV	string	\$GPGSV	-	Message ID, GSV protocol header
1	3	digit	NoMsg	-	Number of messages, total number of GPGSV messages being output
2	1	digit	MsgNo	-	Number of this message
3	10	numeric	NoSv	-	Satellites in View
<i>Start of repeated block (1..4 times)</i>					
4 + 4*N	23	numeric	sv	-	Satellite ID
5 + 4*N	38	numeric	elv	degrees	Elevation, range 0..90
6 + 4*N	230	numeric	az	degrees	Azimuth, range 0..359
7 + 4*N	44	numeric	cno	dBHz	C/N0, range 0..99, null when not tracking
<i>End of repeated block</i>					
5.. 16	*7F	hexadecimal	cs	-	Checksum
6.. 16	-	character	<CR><LF>	-	Carriage Return and Line Feed

**6.10 RMC**

Message	<b>RMC</b>		
Description	<b>Recommended Minimum data</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	<b>The output of this message is dependent on the currently selected datum (Default: WGS84)</b> The Recommended Minimum sentence defined by NMEA for GPS/Transit system data.		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x04	15	

**Message Structure:**

```
$GPRMC,hhmmss,status,latitude,N,longitude,E,spd,cog,ddmmyy,mv,mvE,mode*cs<CR><LF>
```

**Example:**

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

Field No.	Example	Format	Name	Unit	Description
0	\$GPRMC	string	\$GPRMC	-	Message ID, RMC protocol header
1	083559.00	hhmmss.sss	hhmmss.ss	-	UTC Time, Time of position fix
2	A	character	Status	-	Status, V = Navigation receiver warning, A = Data valid, see <a href="#">Position Fix Flags description</a>
3	4717.11437	ddmm.mmmm	Latitude	-	Latitude, Degrees + minutes, see <a href="#">Format description</a>
4	N	character	N	-	N/S Indicator, hemisphere N=north or S=south
5	00833.91522	dddmm.mmmm	Longitude	-	Longitude, Degrees + minutes, see <a href="#">Format description</a>
6	E	character	E	-	E/W indicator, E=east or W=west
7	0.004	numeric	Spd	knots	Speed over ground
8	77.52	numeric	Cog	degrees	Course over ground
9	091202	ddmmyy	date	-	Date in day, month, year format
10	-	numeric	mv	degrees	Magnetic variation value, not being output by receiver
11	-	character	mvE	-	Magnetic variation E/W indicator, not being output by receiver
12	-	character	mode	-	Mode Indicator, see <a href="#">Position Fix Flags description</a>
13	*57	hexadecimal	cs	-	Checksum
14	-	character	<CR><LF>	-	Carriage Return and Line Feed



**6.11 TXT**

Message	<b>TXT</b>		
Description	<b>Text Transmission</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	<b>This message is not configured through CFG-MSG, but instead through <a href="#">CFG-INF</a>.</b> 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 <a href="#">CFG-INF</a>		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x41	7	

Message Structure:

```
$GPTXT,xx,yy,zz,ascii data*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.	Example	Format	Name	Unit	Description
0	\$GPTXT	string	\$GPTXT	-	Message ID, TXT protocol header
1	01	numeric	xx	-	Total number of messages in this transmission, 01..99
2	01	numeric	yy	-	Message number in this transmission, range 01..xx
3	02	numeric	zz	-	Text identifier, u-blox GPS receivers specify the severity of the message with this number. - 00 = ERROR - 01 = WARNING - 02 = NOTICE - 07 = USER
4	www.u-blox.com	string	string	-	Any ASCII text
5	*67	hexadecimal	cs	-	Checksum
6	-	character	<CR><LF>	-	Carriage Return and Line Feed

## 6.12 VTG

Message	<b>VTG</b>		
Description	<b>Course over ground and Ground speed</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
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:

```
$GPVTG,cogt,T,cogm,M,sog,N,kph,K,mode*cs<CR><LF>
```

Example:

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

Field No.	Example	Format	Name	Unit	Description
0	\$GPVTG	string	\$GPVTG	-	Message ID, VTG protocol header
1	77.52	numeric	cogt	degrees	Course over ground (true)
2	T	character	T	-	Fixed field: true
3	-	numeric	cogm	degrees	Course over ground (magnetic), not output
4	M	character	M	-	Fixed field: magnetic
5	0.004	numeric	sog	knots	Speed over ground
6	N	character	N	-	Fixed field: knots
7	0.008	numeric	kph	km/h	Speed over ground
8	K	character	K	-	Fixed field: kilometers per hour
9	A	character	mode	-	Mode Indicator, see <a href="#">Position Fix Flags description</a>
10	*06	hexadecimal	cs	-	Checksum
11	-	character	<CR><LF>	-	Carriage Return and Line Feed

## 6.13 ZDA

Message	<b>ZDA</b>		
Description	<b>Time and Date</b>		
Firmware	Supported on u-blox 6 from firmware version 6.00 up to version 7.03.		
Type	Output Message		
Comment	-		
Message Info	ID for CFG-MSG	Number of fields	
	0xF0 0x08	9	

Message Structure:

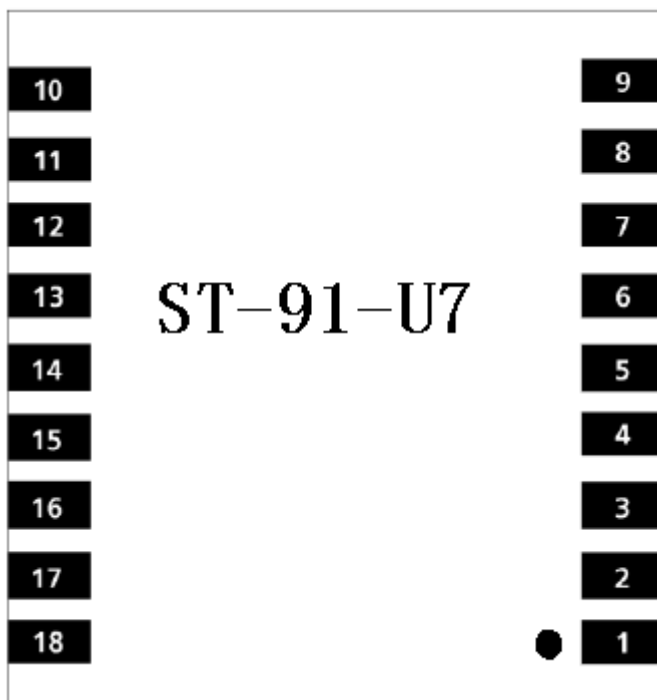
\$GPZDA,hhmmss.ss,day,month,year,ltzh,ltzn\*cs<CR><LF>

Example:

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

Field No.	Example	Format	Name	Unit	Description
0	\$GPZDA	string	\$GPZDA	-	Message ID, ZDA protocol header
1	082710.00	hhmmss.sss	hhmmss.ss	-	UTC Time
2	16	dd	day	day	UTC time: day, 01..31
3	09	mm	month	month	UTC time: month, 01..12
4	2002	yyyy	year	year	UTC time: 4 digit year
5	00	-xx	ltzh	-	Local zone hours, not supported (fixed to 00)
6	00	zz	ltzn	-	Local zone minutes, not supported (fixed to 00)
7	*64	hexadecimal	cs	-	Checksum
8	-	character	<CR><LF>	-	Carriage Return and Line Feed

## 7. Module Pin Assignment



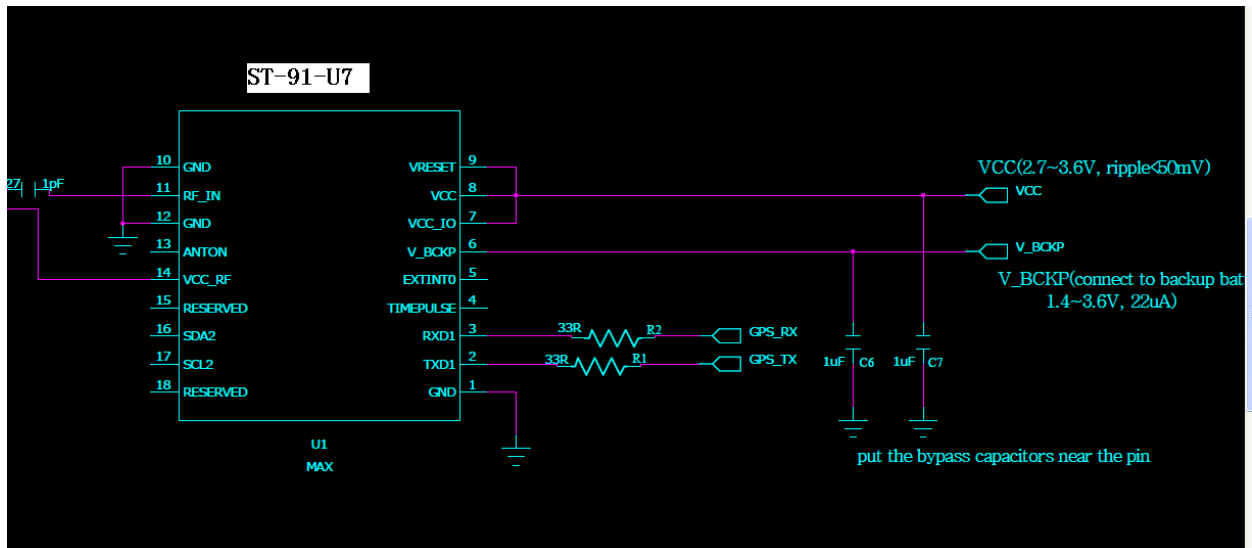
### ST-91-U7 Pin Assignment

Pin No	Module	Name	I/O	Description
1	All	GND		Ground
2	All	TXD	O	UART, leave open if not used, Voltage level referred VCC_IO. Can be configured as Data ready <sup>12</sup> indication for the DDC interface.
3	All	RXD	I	UART, leave open if not used, Voltage level referred VCC_IO
4	All	1PPS	O	Pulse output at 1pulse per second aligned to the GPS signal. Leave open if not used, Voltage level referred VCC_IO
5	All	INT	I	Can be used as an external wakeup signal. Leave open if not used, Voltage level referred VCC_IO
6	All	VBACK	I	Backup voltage input pin. Connect to GND if not used.
7	All	VCC_IO		IO supply voltage Input must be always supplied. Usually connect to VCC Pin 8
8	All	VCC		Power supply of module (1.8-3.6V)
9	All	RST	I	Must be connected to VCC always. Can be used as reset input pin with additional circuit (connected to VCC by 3k3 resistor)
10	All	GND	I	Ground
11	All	RF_IN	I	Matched RF-Input, DC block inside.
12	All	GND	I	Ground
13	All	ANT_ON	O	Active antenna or ext. LNA control pin in power save mode
14	All	VCC_RF	O	Can be used for active antenna or external LNA supply.
15	All	NC		Leave open.
16	All	SDA	I/O	DDC Communication interface. Leave open if not used.
17	All	SCL	I/O	DDC Communication interface. Leave open if not used.
18	All	NC		Leave open.

				Reserved Pin
--	--	--	--	--------------

## ST-91-U7 Pinout

### 8. Application Circuit



Typical Application.

**GPS Active Antenna Specifications (Recommendation)**

Frequency: 1575.42 + 2MHz

Axial Ratio: 3 dB Typical

Output Impedance: 50Ω

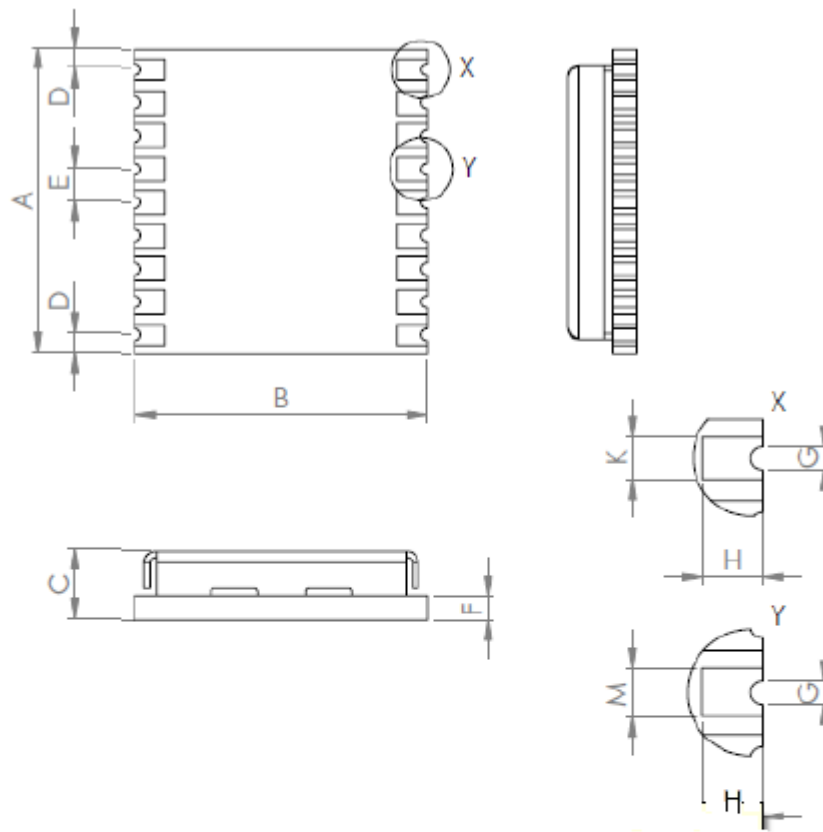
Polarization: RHCP

Amplifier Gain: 15~20dB Typical

Output VSWR: 2.0 Max

Noise Figure: 2.0 dB Max

Antenna Input Voltage: 3.3V (Typ.)



Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
A	10.0	10.1	10.7
B	9.6	9.7	9.8
C	2.2	2.5	2.7
D	0.55	0.65	0.95
E	1.0	1.1	1.2
F		0.76	
G	0.3	0.4	0.5
H	0.9	1.0	1.1
K	0.6	0.7	0.8
M	0.7	0.8	0.9
Weight		tbd	

### ST-91-U7 Dimensions

## ST-91-U7 Application guideline

### Layout Rules

Do not routing the other signal or power trace under the engine board .

**\* RF:**

This pin receives signal of GPS analog via external active antenna .It has to be a controlled impedance trace at 50ohm.

Do not place the RF traces close to the other signal path and not routing it on the top layer.

Keep the RF traces as short as possible.

**\* Antenna:**

Keep the active antenna on the top of your system and confirm the antenna radiation pattern , axial ratio, power gain, noise figure, VSWR are correct when you Setup the antenna in your case.

### GPS Passive (or Active ) Antenna Specifications(Recommendation)

Frequency: 1575.42  $\pm$ 2 MHz

Axial Ratio: 3 dB Typical

Output Impedance: 50 $\Omega$

Polarization: RHCP

Output VSWR: 1.5 Max.

### Active option

**Low Noise Amplifier:**

Amplifier Gain :16~20dB Typical

Output VSWR: 2.0 Max.

Noise Figure: 2.0 dB Max.

Antenna Input Voltage :3.3V Typical

### Design Notes

**VCC**

This is the main power supply to the engine board. (3.3Vdc  $\pm$ 5%),VCC Ripple less than 50Mv.

**GND**

Ground pin for the baseband circuit.



**RXD**

This is the main channel for receiving software commands from u-blox software or from your proprietary software.

**TXD**

This is the main transmits channel for outputting navigation and measurement data to user's navigation software or user written software. Output TTL level, 0V ~ 2.85V

**RF\_IN**

This pin receives signal of GPS analog via external active antenna . It has to be a controlled impedance trace at 50ohm. Do not have RF traces closed the other signal path and routing it on the top layer.

Keep the RF traces as short as possible.

**VBCK**

This is the battery backup power input for the SRAM and RTC when main power is removed. Typical, the current draw is 15uA. Without the external backup battery, the module/engine board will always execute a cold star after turning on. To achieve the faster start-up offered by a hot or warm start, a battery backup must be connected. The battery voltage should be between 1.8v and 3.6v.

**1PPS**

1 pulse per second synchronized at rising edge pulse length 100ms.

**INT**

This pin will used in future functions in low-power modes.