



STANDARD POSITIONING

PROTOCOL SPECIFICATION

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UFirebirdII Series

**GNSS Full-constellation Dual-frequency
Positioning Products**

Revision History

Version	Revision History	Date
R1.0	First release	Oct., 2022
R1.1	<p>Optimize the structure of the document</p> <p>Applicable to UFirebirdII series chip and module</p> <p>Add section 1.4 Start Information</p> <p>Add section 2.3 Second NMEA Output</p> <p>Add sections 3.2.2 PRODUCTINFO, 3.3.4 CFGDOP, 3.3.5 CFGMSM, 3.3.14 CFGWMODE, 3.3.16 CFGRTK, 3.3.17 CFGMSK, 3.3.18 CFGKILOWEEK, 3.3.19 CFGLEAPSEC, 3.3.20 CFGDYN, 3.3.21 CFGFWCHECK, 3.3.22 CFGLOGLIST, 3.3.26 CFGIMUMEAS, 3.4.4 NAVATT, 3.4.5 INSPVA, 3.4.7 INSTALL, 3.4.8 IMUVEH, 3.4.9 ODODATA and 3.6.3 OSNMA</p> <p>Add Chapter 5 Extended RTCM messages</p> <p>Update sections 3.3.1 CFGPRT, 3.3.2 CFGMSG, 3.3.6 CFGNAV, 3.3.7 CFGSYS, 3.3.15 CFGTP, 3.3.25 CFGINS and 3.4.3 IMURAW</p>	Jan., 2024



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Target Readers

This manual applies to technicians who have certain knowledge in GNSS modules.

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1 General Introduction

1.1 Range of Application

This manual is applicable to UC6580, UM620 series, UM621 series, UM670A, UM680A and UM681A. See the specific message for its scope.

Product	Include
UC6580	UC6580I: Industrial-grade multi-constellation dual-frequency GNSS navigation and positioning chip UC6580A: Automotive grade multi-constellation dual-frequency navigation and positioning chip
UM620 Series	UM620: Industrial grade multi-constellation dual-frequency navigation and positioning module; UM620N: Automotive grade multi-constellation dual-frequency navigation and positioning module; UM620S: Multi-constellation dual-frequency navigation and positioning module
UM621 Series	UM621: Industrial grade multi-constellation dual-frequency integrated navigation and positioning module; UM621N: Automotive grade multi-constellation dual-frequency Integrated navigation and positioning module;
UM670A	Automotive grade multi-constellation navigation and positioning module;
UM680A	Automotive grade multi-constellation dual-frequency high precision RTK positioning module
UM681A	Automotive grade multi-constellation dual-frequency high precision RTK integrated positioning module

The receiver is delivered to you with default settings, and you can configure it according to section 3.3 to meet your needs.

1.2 GNSS/Satellite/Signal Identifiers

1.2.1 GNSS Identifiers

Table 1-1 GNSS Identifiers

Constellation	NMEA	Unicore	RTCM
GPS	1*	1*	Refer to Chapter 6 [1] RTCM Standard
BDS	4	4	
GAL	3	3	
GLO	2	2	
QZSS	5	5	
NavIC	6	6	

1.2.2 Satellite Identifiers

Table 1-2 Satellite Identifiers

Constellation	NMEA	Unicore	RTCM
GPS	01 to 32	01 to 32	Refer to Chapter 6 [1] RTCM Standard
SBAS (WAAS etc.)	33 to 64	33 to 64	
BDS	01 to 64	01 to 64	
SBAS (BDS SBAS etc.)	65 to 79	65 to 79	
GLO	65 to 92	65 to 92	
SBAS (SDCM etc.)	33 to 64	33 to 64	
GAL	01 to 36	01 to 36	
SBAS (EGNOS etc.)	37 to 64	37 to 64	
QZSS	01 to 10*	01 to 10*	
SBAS (MSAS etc.)	33 to 64	33 to 64	
NavIC	01 to 15	01 to 15	
SBAS (GAGAN etc.)	33 to 64	33 to 64	

* For UM620S, it is 1- GPS/WAAS/QZSS/MSAS system ID and it does not support 5.

* For UM620S, the satellite ID of QZSS is 193 to 202.

1.2.3 Signal Identifiers

Table 1-3 Signal Identifiers

Frequency	NMEA	Unicore	RTCM
GPS L1C/A	1	1	Refer to Chapter 6 [1] RTCM Standard
GPS L2C-M	5	5	
GPS L5-Q	8	8	
GAL E5a	1	1	
GAL E5b	2	2	
GAL E1BC	7	7	
BDS B1I	1	1	
BDS B1C	3	3	
BDS B2a	5	5	
BDS B2b	6	6	
GLO G1	1	1	
GLO G2	3	3	
NavIC L5 SPS	1	1	
QZSS L1*	1	1	
QZSS L2C-M*	5	5	
QZSS L5-Q*	8	8	

1.3 Data Types

In the protocol, input and output commands are collectively called messages. Each message is a string composed of ASCII characters.

Table 1-4 Message Type

Message Type	Description
Input	The message that inputs to the receiver
Output	The message that is output by the receiver
Input/Output	The message that can input to the receiver and also can be output by the receiver

In this protocol, the data in the message contains the following types:

String (STR)

The string consists of up to 32 ASCII characters except '\r' and '\n', such as GPSL1.

* UM620S outputs GPS/QZSS together; signal ID GPS/QZSS: 1 = L1C/A, 5 = L2C-M, 8 = L5-Q.

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Unsigned Integers (UINT)

Unsigned integers range from 0 to 4294967295, and are defined in both decimal and hexadecimal. A decimal unsigned integer consists of ASCII characters 0 to 9 with a maximum of 10 characters, such as 123, 4291075193. A hexadecimal unsigned integer starts with the ASCII character h or H, followed by a string of 0 to 9 and a to f (or A to F), with a maximum of 8 characters (excluding the starting h or H), such as hE10, hE41BA7C0.

Signed Integers (INT)

Signed integers are composed of the ASCII characters 0 to 9 and a negative sign, in the range of -2147483648 to 2147483647, such as 123217754, -245278. It has 10 characters (excluding the negative sign) at most.

Double-precision Floating-point Data (DOUBLE)

Double-precision floating-point data consists of ASCII characters 0 to 9, a negative sign and decimal points, ranging from -2^{1023} to 2^{1023} , such as 3.1415926, -9024.12367225. It has 20 characters at most.

Unsigned Long Integers (UINT64)

The integer has 16 characters (excluding the starting h or H) at most if it is in hexadecimal.

Table 1-5 Data Types

Symbol	Type	Length (bit)	Range
U8	unsigned char	8	$[0, 2^8-1]$
S8	signed char	8	$[-2^7, 2^7-1]$
U16	unsigned short	16	$[0, 2^{16}-1]$
S16	signed short	16	$[-2^{15}, 2^{15}-1]$
U32	unsigned long	32	$[0, 2^{32}-1]$
S32	signed long	32	$[-2^{31}, 2^{31}-1]$
U64	unsigned long long	64	$[0, 2^{64}-1]$
S64	signed long long	64	$[-2^{63}, 2^{63}-1]$
int17	17 bit 2's complement integer	17	$[-2^{16}, 2^{16}-1]$

1.4 Start Information

At each power-on, the receiver outputs the start information, including product name, output port, part number, serial number, hardware version, firmware version and copyright information

Take UM621N for example:

UM621N-02 G1B1L1E1 COM1	Product name & output port
PN 2310414000008	Part number
SN OD12B5222400762	Serial number
HWVer 1.2	Hardware version
FWVer R6.0.0.0Build4274	Firmware version
Copyright (c), Unicore Communications Inc. All rights reserved.	Copyright information

2 NMEA Messages

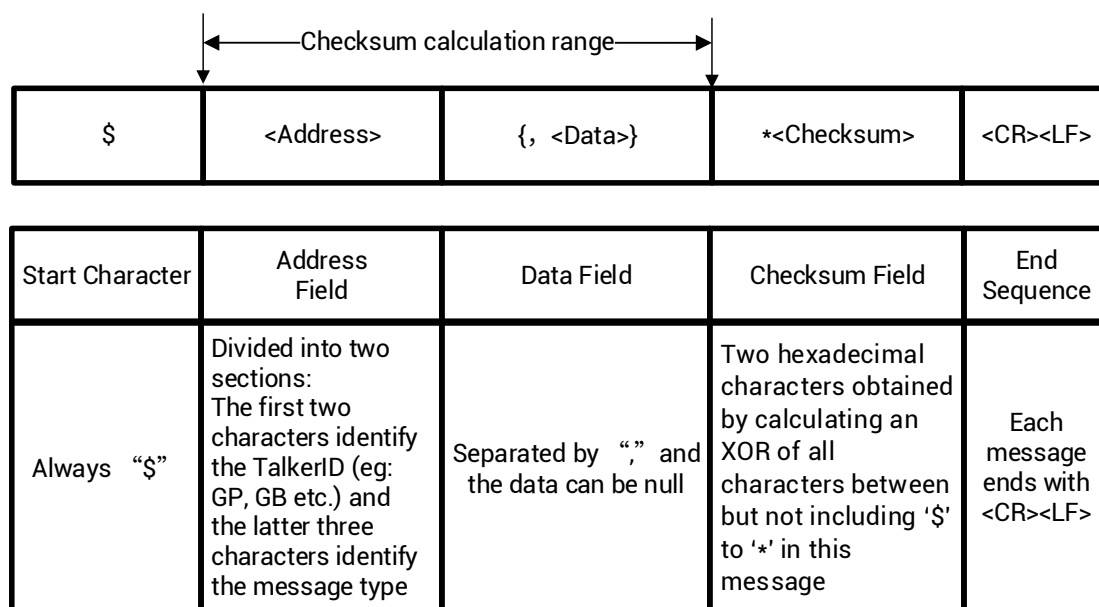
This chapter describes the NMEA V4.11 messages supported by the receivers, including GGA, GBS, GLL, GSA, GSV, RMC, VTG, ZDA and GST. Refer to the document [2] in Chapter 6 for more information.

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A.

The integrated products support the second NMEA output. See section 2.3 for more details.

2.1 NMEA Messages Structure

The following figure shows the structure of a NMEA message.



2.2 Standard NMEA Messages

2.2.1 GGA

Table 2-1 GGA Description

Syntax	\$-- GGA,time,Lat,N,Lon,E,FS,NoSV,HDOP,msl,M,Altref,M,DiffAge,DiffStation*cs\r\n	
Example	\$GPGGA,060845.00,4004.74005,N,11614.19613,E,1,10,0.85,53.5,M,,M,,*7B\r\n	
Description	GNSS positioning data	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
time	STR	UTC time; in the format of hhmmss.ss: hh - Hour mm - Minute ss.ss - Second
Lat	STR	Latitude; in the format of ddmm.mmmmm or ddmm.mmmmmmm: dd - Degree mm.mmmmm - Minute (applicable to UC6580, UM620 series, UM621 series, UM670A) mm.mmmmmmm - Minute (applicable to UM680A, UM681A)
N	STR	North or south latitude indicator N - North latitude S - South latitude
Lon	STR	Longitude; in the format of dddmm.mmmmm or dddmm.mmmmmmm: ddd - Degree mm.mmmmm - Minute (applicable to UC6580, UM620 series, UM621 series, UM670A) mm.mmmmmmm - Minute (applicable to UM680A, UM681A)
E	STR	East longitude or west longitude indicator: E - East longitude

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		W - West longitude
FS	UINT	Positioning status indicator: 0 - Invalid 1 - Single point positioning 2 - Differential positioning 4 - RTK fixed solution 5 - RTK float solution 6 - INS positioning
NoSV	UINT	Number of satellites participating in positioning
HDOP	DOUBLE	Horizontal dilution of precision; fixedly output 2 decimal places; value range is 0.00 to 99.99 and the value is 99.99 when not positioning
mssl	DOUBLE	Ellipsoidal height or geoid height; fixedly output 1 or 3 decimal places: 1 decimal place applicable to UC6580, UM620 series, UM621 series and UM670A 3 decimal places applicable to UM680A and UM681A
M	STR	Unit of ellipsoidal height or geoid height; specified to constant M
Altref	DOUBLE	Geoidal separation; only valid when the geoidal separation function is enabled; fixedly output 1 or 3 decimal places: 1 decimal place applicable to UC6580, UM620 series, UM621 series and UM670A 3 decimal places applicable to UM680A and UM681A
M	STR	Unit of Geoidal separation; specified to constant M
DiffAge	DOUBLE	Differential correction latency; unit: s; fixedly output 1 decimal place; null for non-differential positioning
DiffStation	UINT	Differential reference station ID; null for non-differential positioning
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.2.2 GLL

Table 2-2 GLL Description

Syntax	\$--GLL,Lat,N,Lon,E,time,Valid,Mode*cs\r\n	
Example	\$GPGLL,4004.74005,N,11614.19613,E,060845.00,A,A*6F\r\n	
Description	Geographic position - Longitude/Latitude	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
Lat	STR	Latitude; in the format of ddmm.mmmmm or ddmm.mmmmmmm: dd - Degree mm.mmmmm - Minute (applicable to UC6580, UM620 series, UM621 series, UM670A) mm.mmmmmmm - Minute (applicable to UM680A, UM681A)
N	STR	North or south latitude indicator: N - North latitude S - South latitude
Lon	STR	Longitude; in the format of dddmm.mmmmm or dddmm.mmmmmmm: ddd - Degree mm.mmmmm - Minute (applicable to UC6580, UM620 series, UM621 series, UM670A) mm.mmmmmmm - Minute (applicable to UM680A, UM681A)
E	STR	East longitude or west longitude indicator: E - East longitude W - West longitude
time	STR	UTC time; in the format of hhmmss.ss: hh - Hour mm - Minute ss.ss - Second
Valid	STR	Position valid indicator: V - Invalid A - Valid

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Mode	STR	Positioning system mode indicator: N - Not positioning A - Single Point positioning D - Differential positioning E - INS positioning
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.2.3 GSA

Table 2-3 GSA Description

Syntax	\$-- GSA,Smode,FS,sv1,sv2,sv3,sv4,sv5,sv6,sv7,sv8,sv9,sv10,sv11,sv12,PD OP,HDOP,VDOP,systemID*cs\r\n	
Example	\$GPGSA,A,3,02,03,06,09,12,17,19,23,28,25,,,1.34,0.85,1.04,1*1E\r\n	
Description	GNSS dilution of precision and active satellites	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
Smode	STR	Positioning mode specified states: M - Manually specify 2D or 3D positioning A - Automatically switch to 2D or 3D positioning
FS	UINT	Positioning mode: 1 - Not positioning 2 - 2D positioning 3 - 3D positioning
sv1 to sv12	UINT	ID of satellites participating in positioning; when there are less than 12 satellites participating in positioning, the insufficient area is filled in empty; when there are more than 12 satellites, it only outputs the first 12 satellites; see Table 1-2 for satellite IDs
PDOP	DOUBLE	Position dilution of precision; range: 0.00 to 99.99; the value is 99.99 when not positioning
HDOP	DOUBLE	Horizontal dilution of precision; range: 0.00 to 99.99; the

		value is 99.99 when not positioning
VDOP	DOUBLE	Vertical dilution of precision; range: 0.00 to 99.99; the value is 99.99 when not positioning
systemID	UINT	GNSS system ID; see Table 1-1
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.2.4 GSV

Table 2-4 GSV Description

Syntax	\$-- GSV,NoMsg,MsgNo,NoSv,sv1,elv1,az1,cno1,sv2,elv2,az2,cno2,sv3,elv3,az3,cno3,sv4,elv4,az4,cno4, signalID*cs\r\n	
Example	<pre>\$GPGSV,3,01,11,02,34,277,41,03,16,043,35,05,04,215,35,06,69,333,48,0*57\r\n \$GPGSV,3,02,11,09,25,110,41,12,31,305,43,17,55,116,46,19,76,088,46,0*56\r\n \$GPGSV,3,03,11,23,23,077,40,25,04,328,32,28,05,171,36,0*67\r\n \$GBGSV,3,01,12,01,37,145,42,02,34,225,39,03,44,188,42,04,25,123,37,0*4C\r\n \$GBGSV,3,02,12,05,17,249,36,06,30,169,38,07,03,188,31,08,69,027,43,0*4E\r\n \$GBGSV,3,03,12,09,09,186,34,10,15,211,36,12,26,306,40,13,60,316,44,0*48\r\n</pre>	
Description	GNSS satellites in view; each GSV message contains information for only 4 satellites. When the number of satellites exceeds 4, the receiver sends multiple GSV messages continuously	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag: GP - GPS/WAAS satellite information ¹ GB - BDS/BDS SBAS satellite information GA - GAL/EGNOS satellite information GL - GLO/SDCM satellite information GI - NavIC/GAGAN satellite information GQ - QZSS/MASAS satellite information ¹
NoMsg	UINT	Total number of GSV messages on the current system at the current frequency; the minimum value is 1 and the

¹ For UM620S, the output is GP - GPS/QZSS joint positioning, and does not support GQ.

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		maximum value is 9
MsgNo	UINT	GSV message ID; the minimum value is 1 and the maximum value is 9
NoSv	UINT	Total number of visible satellites on the current system at the current frequency
sv1 to sv4	UINT	Satellite IDs of the first to fourth satellite; see Table 1-2.
elv1 to elv4	UINT	Elevation of the first to fourth satellite; unit: deg; range: 0 to 90; fixed output of 2 digits; add leading zeros if less than 2 digits
az1 to az4	UINT	Azimuth of the first to fourth satellite; unit: deg; range: 0 to 359; fixed output of 3 digits; add leading zeros if less than 3 digits
cno1 to cno4	UINT	CNR of the first to fourth satellite; unit: dB-Hz; range: 0 to 99; fixed output of 2 digits; add leading zeros if less than 2 digits; fill null for untracked satellites
signalID	UINT	Signal ID defined by NMEA protocol; see Table 1-3.
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.2.5 RMC

Table 2-5 RMC Description

Syntax	\$-- RMC,time,status,Lat,N,Lon,E,spd,cog,date,mv,mvE,mode,navStates*cs\r \n	
Example	\$GPRMC,060845.00,A,4004.74005,N,11614.19613,E,0.000,,180817,,,A,V *0B\r\n	
Description	The recommended minimum data	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
time	STR	UTC time; in the format of hhmmss.ss: hh - Hours mm - Minute ss.ss - Second
status	STR	Position valid indicator: V - Invalid A - Valid
Lat	STR	Latitude; in the format of ddmm.mmmmm or ddmm.mmmmmmm: dd - Degree mm.mmmmm - Minute (applicable to UC6580, UM620 series, UM621 series, UM670A) mm.mmmmmmm - Minute (applicable to UM680A, UM681A)
N	STR	North or south latitude indicator: N - North latitude S - South latitude
Lon	STR	Longitude; in the format of dddmm.mmmmm or ddd mm.mmmmmmm: ddd - Degree mm.mmmmm - Minute (applicable to UC6580, UM620 series, UM621 series, UM670A) mm.mmmmmmm - Minute (applicable to UM680A, UM681A)

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E	STR	East longitude or west longitude indicator: E - East longitude W - West longitude
spd	DOUBLE	Speed over ground; unit: knot; fixedly output 3 decimal places
cog	DOUBLE	Course over ground; unit: deg; fixedly output 2 decimal places; calculated clockwise from north
date	STR	UTC date; in the format of ddmmyy: dd - Day mm - Month yy - Year
mv	DOUBLE	Magnetic variation; specified to null
mvE	STR	Magnetic variation direction; specified to null
mode	STR	Positioning mode: N - Not positioning A - Single point positioning D - Differential positioning E - INS positioning F - RTK floating solution R - RTK fixed solution
navStates	STR	Navigation states flag; fixedly output 'V': V - Device does not provide navigation state information
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.2.6 VTG

Table 2-6 VTG Description

Syntax	\$--VTG,cogt,T,cogm,M,sog,N,kph,K,mode*cs\r\n	
Example	\$GPVTG,,T,,M,0.000,N,0.000,K,A*23\r\n	
Description	Course over ground and ground speed	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
cogt	DOUBLE	Course over ground with reference to true north; unit: deg; range: 0.000 to 359.999; specified to constant null
T	STR	Course flag; specified to constant T
cogm	DOUBLE	Course over ground with reference to magnetic north; unit: deg; range: 0.000 to 359.999; specified to constant null
M	STR	Course flag; specified to constant M
sog	DOUBLE	Speed over ground; unit: knot; fixedly output 3 decimal places
N	STR	Unit of speed; specified to constant N
kph	DOUBLE	Speed over ground; unit: km/h; fixedly output 3 decimal places
K	STR	Unit of speed; specified to constant K
mode	STR	Positioning mode: N - Not positioning A - Point positioning D - Differential positioning E - Inertial positioning
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.2.7 ZDA

Table 2-7 ZDA Description

Syntax	\$--ZDA,time,day,mon,year,ltzh,ltzn*cs\r\n	
Example	\$GPZDA,060845.00,18,08,2017,00,00*6C\r\n	
Description	Time and date	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
time	STR	UTC time; in the format of hhmmss.ss: hh - Hours mm - Minute ss.ss - Second
day	UINT	UTC day with two digits; range: 01 to 31
mon	UINT	UTC month with two digits; range: 01 to 12
year	UINT	UTC year with four digits
ltzh	UINT	Local zone hours; fixedly output 00
ltzn	UINT	Local zone minutes; fixedly output 00
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.2.8 GST

Table 2-8 GST Description

Syntax	\$--GST,time,rngRMS,stdMajor,stdMinor,hdg,stdLat,stdLon,stdAlt*cs\r\n	
Example	\$GPGST,060845.00,0.6,,,,0.07,0.09,0.09*47\r\n	
Description	GNSS pseudorange error statistics	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
time	STR	UTC time; in the format of hhmmss.ss: hh - Hour mm - Minute ss.ss - Second
rngRMS	DOUBLE	Standard deviation of pseudorange error; unit: m; with a maximum of 99.9; fixedly output 1 decimal place
stdMajor	DOUBLE	Standard deviation of semi-major axis of the error ellipse; unit: m; specified to null
stdMinor	DOUBLE	Standard deviation of semi-minor axis of the error ellipse; unit: m; specified to null
hdg	DOUBLE	Orientation of semi-major axis of the error ellipse; unit: deg; clockwise from north; specified to null
stdLat	DOUBLE	Standard deviation of latitude error; unit: m; fixedly output 1 decimal place
stdLon	DOUBLE	Standard deviation of longitude error; unit: m; fixedly output 1 decimal place
stdAlt	DOUBLE	Standard deviation of altitude error; unit: m; fixedly output 1 decimal place
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.2.9 GBS

Table 2-9 GBS Description

Syntax	\$- GBS,time,errLat,errLon,Lon,errAlt,Svid,Prob,Bias,Std,systemID*cs\r\n	
Example	\$GPGBS,121314.00,0.5,0.6,0.9,03,,100.4,5.0,1,0*5C\r\n	
Description	RAIM error information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
time	STR	UTC time; in the format of hhmmss.ss: hh - Hour mm - Minute ss.ss - Second
errLat	DOUBLE	Latitude error; unit: m; fixedly output 1 decimal place
errLon	DOUBLE	Longitude error; unit: m; fixedly output 1 decimal place
errAlt	DOUBLE	Altitude error; unit: m; fixedly output 1 decimal place
Svid	UINT	Number of satellites that most likely have problems; fixedly output 2 digits
Prob	DOUBLE	Probability of missed detection for the satellites that most likely have problems; specified to constant null
Bias	DOUBLE	Estimation error of the satellites that most likely have problems; specified to constant null
Std	DOUBLE	Standard deviation of the estimation error; specified to constant null
systemID	UINT	GNSS system ID; see Table 1-1
signalID	UINT	Signal ID defined by NMEA protocol; see Table 1-3
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

2.3 Second NMEA Output


Applicable to: UM621 series

The message is applicable to the integrated products to output the GNSS positioning results only. It has a format of adding a TAG BLOCK `\s:1*78\` before the standard NMEA sentences. Take outputting GGA as an example, the second output format is:

```
\s:1*78\$$-GGA,time,Lat,N,Lon,E,FS,NoSV,HDOP,msl,M,Altref,M,DiffAge,DiffStation*cs\r\n
```

Table 2-10 TAG BLOCK Description

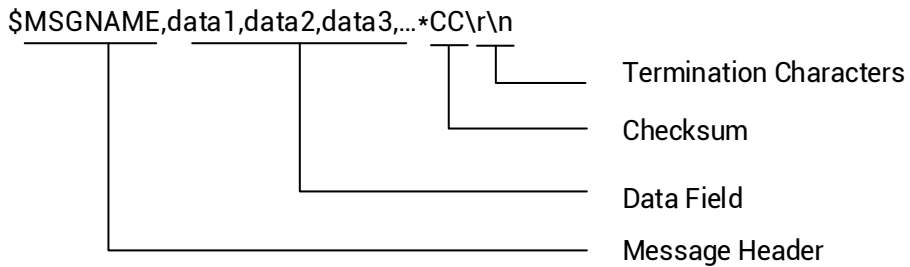
Parameter	Format	Description
tagStart	STR	TAG BLOCK start character; specified to constant '\'
parameter-code	STR	Parameter code; specified to constant 's:' meaning source identification
value	UINT	Parameter value; specified to constant 1 meaning the second output
tagCs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including the '\' and '*' in the TAG BLOCK
tagEnd	STR	TAG BLOCK end character; specified to constant '\'

 To enable the second NMEA output, you need to configure the mode to 2 - Vehicle-mounted mode (dual-engine) in the message CFGINS. See section 3.3.25 for more information.

3 Unicore Messages

3.1 Messages


The basic format of the Unicore message is:



All messages include the following parts:

- Message header. It starts with '\$' (0x24).
- Data field. It follows a delimiter "," (0x2C) and consists of a number of parameters or data. The adjacent data are also separated by the delimiter ",".
- Checksum. It is separated from the previous data by '*' (0x2A).
- Termination characters. The input message ends with '\r' (0x0D) or '\n' (0x0A) or any combination of the two. The output message ends with '\r\n'.

 The termination characters are omitted in Unicore Messages, as shown in each table of message introduction.

 Message header and parameters, as well as letters in the checksum are case-sensitive, and the command echoes according to your inputs.

The total length of each message cannot exceed 128 bytes.

Some parameters of the commands can be omitted (marked as optional in the command description), which means that those parameters can be empty and there is no character between the two delimiters ',' or '*'. If there is no special instruction, the parameter is ignored and the option it controls remains unchanged.

Most of the message headers can be used for both input commands and output messages. As the input, it sets parameters or queries the current configuration; as the output, it outputs the receiver information or configuration.

Checksum

The two characters after '*'(0x2A) in the message are the checksum, which is the XOR of all characters (excluding '\$' and '*') from '\$' to '*' in hexadecimal.

The checksum in the input command is optional. If the input message contains '*' followed by two characters, the checksum is examined. If it is wrong, the command is not executed, and the receiver outputs the \$FAIL message, in which a checksum error appears. If the message does not contain a checksum, the command is executed directly.

The output message always contains a checksum.

3.2 General Messages

3.2.1 PDTINFO: Product Information Inquiry

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-1 Read Product Information

Syntax	\$PDTINFO
Example	\$PDTINFO
Description	Read product information. The receiver outputs PDTINFO message after receiving this command.
Input/Output	Input
No parameters	

Table 3-2 Output Product Information

Syntax	\$PDTINFO,pdtName,config,hwVer,fwVer,PN,SN*cs	
Example	\$PDTINFO,UM621N-01,G1B1L1E1,V1.0,R4.0.0Build5428,2310414000002,000101114303845*4A	
Description	The receiver outputs product information.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
pdtName	STR	Product model
config	STR	Flag of satellite system: Gx - GPS Bx - BDS Lx - GLONASS Ex - Galileo Nx - NavIC Note: This flag does not change with configuration changes.
hwVer	STR	Hardware version
fwVer	STR	Firmware version
PN	STR	Part number (null for a chip)
SN	STR	Serial number (chip ID for a chip)
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.2.2 PRODUCTINFO: Complete Product Information Inquiry

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-3 Read Complete Product Information

Syntax	\$PRODUCTINFO
Example	\$PRODUCTINFO
Description	Read complete product information. The receiver outputs PRODUCTINFO message after receiving this command.
Input/Output	Input
No parameters	

Table 3-4 Output Complete Product Information


Syntax	\$PRODUCTINFO,pdtName,config,hwVer,fwVer,PN,SN,PTV,RSV,RSV,RSV,RSV*cs	
Example	\$PRODUCTINFO,UM621N-02,G1B1L1E1,V1.0,R6.0.0.0Build4526,2310414000002,000101114303845,1.1,,,,*4A	
Description	The receiver outputs complete product information.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
pdtName	STR	Product model
config	STR	Flag of satellite system: Gx - GPS Bx - BDS Lx - GLONASS Ex - Galileo Nx - NavIC Note: This flag does not change with configuration changes.
hwVer	STR	Hardware version
fwVer	STR	Firmware version
PN	STR	Part number (null for a chip)
SN	STR	Serial number (here is the chip ID for a chip)
PTV	DOUBLE	Protocol version
RSV		Reserved
RSV		Reserved
RSV		Reserved
RSV		Reserved
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message


3.2.3 RESET: Receiver Reset

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-5 Receiver Reset

Syntax	\$RESET,type,clrMask	
Example	\$RESET,0,h01 (warm start)	
Description	Receiver reset	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
type	UINT	Reset type: 0 - Software reset 1 - Chip-level reset (watchdog reset) 2 - Board-level reset (not supported currently) 3 - Receiver stops working
clrMask	UINT	Set the corresponding bit to 1 to clear the saved information during the reset: bit0 - Clear ephemeris bit1 - Reserve0 bit2 - Clear receiver position and time bit3 - Clear initial navigation parameter (applicable to integrated products) bit4 - Clear ionosphere correction parameter and UTC parameter bit5 - Reserve2 bit6 - Reserve3 bit7 - Clear almanac Three common start methods: H00 - Hot start H01 - Warm start H85/HFF - Cold start

 Use H85 or HFF (recommended) to have a cold start, and an incorrect parameter can cause the receiver to start in a wrong state.

 When a leap second occurs, it may take the receiver 25 minutes to sync with the UTC time after a cold start reset.

3.2.4 OK: Message Response Mechanism

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-6 Correct Execution of a Command

Syntax	\$OK*cs	
Example	\$OK*04	
Description	A response that the receiver executed the command correctly. This message only outputs at the port receiving the command.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.2.5 FAIL: Message Response Mechanism

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-7 Incorrect Execution of a Command

Syntax	\$FAIL,errorCode*cs	
Example	\$FAIL,0*1E	
Description	A response that the parameters or the checksum in the input command is incorrect. No response to the illegal command. This message only outputs at the port receiving the command.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
errorCode	UINT	Error code: 0 - Incorrect parameters 1 - Incorrect checksum
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.3 Configuration Messages

3.3.1 CFGPRT: Configure the Output Port

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-8 Read Port Configuration

Syntax	\$CFGPRT,portID	
Example	\$CFGPRT,1	
Description	Read the receiver port configuration. The receiver outputs CFGPRT message after receiving this command.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
portID	UINT	Port number: 0, 1, 2, 4

Table 3-9 Set/Output Port Configuration

Syntax	\$CFGPRT,portID,addr,baud,inPro,outPro	
Example	\$CFGPRT,1,0,115200,1,3	
Description	Set or output the port configuration.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
portID	UINT	Port number: 0 - I ² C* 1 - UART1 2 - UART2* 4 - SPI* If empty, configure the current port.
addr	UINT	UART - fixed at 0 or null I ² C - slave address ² ; fixed at 0x46 when inquiring and must be null when configuring, otherwise it would return FAIL.
baud	UINT	For UART, the baud rate could be set as: 9600/14400/19200/38400/57600/115200/230400/ 460800/921600

* I²C and SPI interfaces are only supported by the specific firmware; if your firmware does not support I²C and SPI, this message will return \$FAIL,0*1E when you set or make an inquiry. UART2 is not supported by UM670A.

² The default slave address is 0x46 which cannot be changed via commands.

		For I ² C, the parameter is null while inquiring and must be null while configuring, otherwise it would return FAIL.
inPro	UINT	Port input protocol; set the corresponding bit to 1 to enable it: bit0 - UNICORE bit7 - RTCM3.3 (compatible with RTCM3.2) bit10 – MAPFB and ODODATA input protocol (applicable to UM621 series and UM681A)
outPro	UINT	Port output protocol; set the corresponding bit to 1 to enable it: bit0 - UNICORE bit1 - NMEA bit2 - RTCM3.3 (compatible with RTCM3.2) bit5 - Notice messages bit7 - Extended RTCM 4074_DR messages (applicable to UM621 series and UM681A) bit8 - Extended RTCM 4074_PVT messages (applicable to UC6580, UM670A and UM680A)

☞ If you need to output a message at a higher rate, such as 10 Hz, increase the baud rate. Otherwise, incomplete satellite information may appear.

☞ Do not disable the UNICORE input, otherwise it can cause an abnormal command receiving and returns FAIL.

3.3.2 CFGMSG: Configure Message Output Frequency

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-10 Read Message Output Configuration

Syntax	\$CFGMSG,msgClass,msgID	
Example	\$CFGMSG,0,1	
Description	Read the message output configuration. The receiver outputs CFGMSG message after receiving this command.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
msgClass	UINT	Message class; see Table 3-12 Message Class and ID
msgID	UINT	Message ID; see Table 3-12 Message Class and ID

Table 3-11 Set/Output Message Output Frequency

Syntax	\$CFGMSG,msgClass,msgID,Rate/Switch	
Example	\$CFGMSG,0,1,1	
Description	Set or output the message output frequency.	

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Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
msgClass	UINT	Message class; see Table 3-12 Message Class and ID
msgID	UINT	Message ID; see Table 3-12 Message Class and ID;
Rate/Switch	UINT	<p>Rate: The ratio of reference output frequency to the configured output frequency; range: 0 to 100; 0 means disable the output.</p> <p>Take a NMEA message as an example: The NMEA message reference output frequency is equal to the positioning frequency (1000/NavRate), and the Rate defines that the receiver selects a message to output after performing N times positioning solutions. Eg. When the positioning frequency is configured to be 10 Hz by CFGNAV, if you need an output frequency at 10 Hz, then you configure the rate to 1, and similarly configure the rate to 2 if 5 Hz output frequency is needed. In summary, in NMEA messages Rate = 1000/NavRate/Output frequency</p> <p>Note: The reference output frequency cannot be less than the actual output frequency, and 1000/NavRate can be divisible by Rate or Rate can be divisible by 1000/NavRate.</p> <p>Switch: 0 - Disable the corresponding message 1 - Enable the corresponding message</p>

Table 3-12 Message Class and ID

Messages	Class	ID	Rate
GGA	0: Configure the four ports or query the current port	0	1000/NavRate/Output frequency
GLL		1	
GSA	100: NMEA messages at I ² C port	2	
GSV		3	
RMC	200: NMEA messages at UART1 port	4	
VTG		5	
ZDA	300: NMEA messages at UART2 port	6	
GST		7	
GBS	400: NMEA messages at SPI port	8	

Messages ³	Class	ID	Rate	
RTCM MSM	2: Configure the four ports or query the current port	3	1000/MeasRate/Output frequency	
RTCM EPH		4		
RTCM STM (1005)	102: Observation messages at I ² C port	5		
System Parameters (1013)	202: Observation messages at UART1 port 302: Observation messages at UART2 port 402: Observation messages at SPI port	14		
Messages ⁴	Class	ID	Rate	
GYOACC	4: Configure the four ports or query the current port	0	1000/DRNavRate/Output frequency	
SNRSTAT		104: Sensor fusion messages at I ² C port		1
NAVATT		204: Sensor fusion messages at UART1 port		2
IMURAW	304: Sensor fusion messages at UART2 port	3	1000/IMUMeasRate/Output frequency	
INSPVA	404: Sensor fusion messages at SPI port	4	1000/DRNavRate/Output frequency	
IMUVEH		5	1000/IMUMeasRate/Output frequency	
Messages	Class	ID	Switch	
CWOUT ⁵	5: Configure the four ports or query the current port	0	0 - disable; 1 - enable	
OSNMA ⁶		105: Misc messages at I ² C port	1	0 - disable; 1 - enable

³ Supported by UM670A, UM680A and UM681A.

⁴ Supported by UM621 series and UM681A.

⁵ Output at constant 1 Hz.

⁶ Output at constant 0.5 Hz only when there is no error code in GALILEO messages

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	205: Misc messages at UART1 port 305: Misc messages at UART2 port 405: Misc messages at SPI port		
Messages	Class	ID	Rate
General Notice Messages	6: Configure the four ports or query the current port 106: Notice messages at I ² C port	0	1000/NavRate/Output frequency
Notice Message Package	206: Notice messages at UART1 port	1	
Command Echo	306: Notice messages at UART2 port 406: Notice messages at SPI port	2	0 - disable; 1 - enable
Messages ⁷	Class	ID	Rate
GGA	7: Configure the four ports or query the current port	0	1000/NavRate/Output frequency
GLL		1	
GSA	107: Second NMEA	2	
GSV	messages at I ² C port	3	
RMC	207: Second NMEA	4	
VTG	messages at UART1 port	5	
ZDA	307: Second NMEA	6	
GST	messages at UART2 port	7	
GBS	407: Second NMEA messages at SPI port	8	
Messages ⁴	Class	ID	Rate
GYOACC	8: Configure the four ports or query the current port	0	1000/DRNavRate/Output frequency
SNRSTAT		1	
NAVATT		2	

⁷ Supported by UM621N series.

IMURAW	108: Observation messages at I ² C port	3	1000/IMUMeasRate/Output frequency
INSPVA	208: Observation messages at UART1 port	4	1000/DRNavRate/Output frequency
IMUVEH	308: Observation messages at UART2 port 408: Observation messages at SPI port	5	1000/IMUMeasRate/Output frequency
Messages ⁸	Class	ID	Rate
Receiver Information	9: Configure the four ports or query the current port	1	1000/MeasRate/Output frequency
Signal Information	109: Observation messages at I ² C port	2	
TGD	209: Observation messages at UART1 port	3	
ION	309: Observation messages at UART2 port 409: Observation messages at SPI port	4	

☞ See section 3.3.6 CFGNAV for the information of NavRate, MeasRate and DRNavRate, and section 3.3.26 CFGIMUMEAS for that of IMUMeasRate.

⁸ Supported by UC6580, UM670A and UM680A.

3.3.3 CFGNMEA: Read NMEA Configuration

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-13 Read NMEA Configuration

Syntax	\$CFGNMEA
Example	\$CFGNMEA
Description	Read the current NMEA configuration. The receiver outputs the NMEA version H52 (NMEA 4.11) after receiving this command. The output is \$CFGNMEA,H52*26.
Input/Output	Input
No parameters	

3.3.4 CFGDOP: Configure Doppler Sign

Applicable to: UM670A, UM680A, UM681A

Table 3-14 Read Doppler Sign Configuration

Syntax	\$CFGDOP
Example	\$CFGDOP
Description	Read the current Doppler sign configuration. The receiver outputs the CFGDOP message after receiving this command.
Input/Output	Input
No parameters	

Table 3-15 Set/Output Doppler Sign Configuration

Syntax	\$CFGDOP,DopplerSignal,Reserved	
Example	\$CFGDOP,0,0	
Description	Set/Output the configuration of Doppler sign in the observations.	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
DopplerSignal	UINT	Doppler sign configuration: 0 - Output raw Doppler information 1 - Output the Doppler information after taking the opposite number
Reserved	UINT	Reserved

3.3.5 CFGMSM: Configure the Observation Type

Applicable to: UM670A, UM680A, UM681A

Table 3-16 Read Observations Type Configuration

Syntax	\$CFGMSM
Example	\$CFGMSM
Description	Read the current observations type configuration. The receiver outputs the CFGMSM message after receiving this command.
Input/Output	Input

Table 3-17 Set/Output Observations Type

Syntax	\$CFGMSM,MsmType,Reserved	
Example	\$CFGMSM,7,0	
Description	Set/Output the configuration of observations type	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
MsmType	UINT	Output the observations type: 4 - Pseudoranges and PhaseRanges plus CNR 5 - Pseudoranges PhaseRanges PhaseRangeRate and CNR 7 - Pseudoranges PhaseRanges PhaseRangeRate and CNR (high resolution)
Reserved	UINT	Reserved

3.3.6 CFGNAV: Configure Positioning Frequency

Applicable to: UC6580, UM620 series⁹, UM621 series, UM670A, UM680A, UM681A

Table 3-18 Read Positioning Frequency Configuration





Syntax	\$CFGNAV
Example	\$CFGNAV
Description	Read the positioning frequency configuration. The receiver outputs CFGNAV message after receiving this command.
Input/Output	Input
No parameters	

⁹ Not supported by UM620S.

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Table 3-19 Set/Output Positioning Frequency Configuration

Syntax	\$CFGNAV,MeasRate,NavRate,DRNavRate	
Example	\$CFGNAV,1000,1000,100	
Description	Set or output positioning frequency configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
MeasRate	UINT	Observation interval; unit: ms; 1000 - corresponding to 1 Hz observation frequency 200 - corresponding to 5 Hz observation frequency 100 - corresponding to 10 Hz observation frequency
NavRate	UINT	GNSS positioning interval; unit: ms; 1000 - corresponding to 1 Hz GNSS positioning frequency 200 - corresponding to 5 Hz GNSS positioning frequency 100 - corresponding to 10 Hz GNSS positioning frequency
DRNavRate	UINT	INS positioning interval; unit: ms; 100 - corresponding to 10 Hz INS positioning frequency 50 - corresponding to 20 Hz INS positioning frequency 20 - corresponding to 50 Hz INS positioning frequency Except for the integrated products, the parameter is invalid for other modules which return 0 when making an inquiry.

-  measRate and navRate should be the same, otherwise, the message would return FAIL.
-  When the GNSS positioning frequency is 10 Hz, CFGINS cannot be configured to 2 - Vehicle-mounted mode to enable the second NMEA output.
-  After the configuration of NavRate is finished, GSV and the RTCM Ephemeris will be reset to output at 1 Hz, and the Ionosphere Information and TGD/ISC Information in extended RTCM messages will output once every 30 s.
-  After the configuration of DRNavRate is finished, SNRSTAT will output at 1 Hz.

3.3.7 CFGSYS: Configure Satellite System

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-20 Read Satellite System Configuration

Syntax	\$CFGSYS
Example	\$CFGSYS
Description	Read the current satellite system configuration. The receiver outputs the CFGSYS message after receiving the command.
Input/Output	Input
No parameter	

Table 3-21 Set/Output Satellite System Configuration


Syntax	\$CFGSYS,sysMask	
Example	\$CFGSYS,h55155	
Description	Set or output satellite system and frequency configuration. The receiver resets automatically after receiving the command, and the enabled frequencies take effect after the reset.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
sysMask	UINT	<p>Enabled frequency; set the corresponding bit to 1 to enable it:</p> <ul style="list-style-type: none"> bit0 - GPS L1CA bit1 - GPS L2* bit2 - GPS L5 bit3 - GPS L1C (reserved) bit4 - BDS B1I bit5 - BDS B2b (reserved) bit6 - BDS B2a bit7 - BDS B1C (reserved) bit8 - GLONASS L1 bit9 - GLONASS L2 (reserved) bit10:11 - Reserved bit12 - GALILEO E1 bit13 - GALILEO E5b (reserved) bit14 - GALILEO E5a bit15 - Reserved bit16: - QZSS L1CA bit17 - QZSS L2 (reserved) bit18 - QZSS L5 bit19 - reserved

* Supported by the specific firmware.

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		bit20 - SBAS bit21 to bit23 - reserved bit24 - NavIC L5 SPS (reserved) bit25 to bit31 - reserved
--	--	---

 The reserved bit is specified to constant 0.

 QZSS and SBAS can only be enabled when GPS is enabled; each constellation must be enabled or disabled at the same time when configuring L5.

3.3.8 CFGGEOID: Configure Height

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-22 Read Height Configuration

Syntax	\$CFGGEOID
Example	\$CFGGEOID
Description	Read the current height configuration. The receiver outputs the CFGGEOID message after receiving the command.
Input/Output	Input
No parameter	

Table 3-23 Set/Output Height Configuration


Syntax	\$CFGGEOID,Model	
Example	\$CFGGEOID,1	
Description	Set or output the height configuration.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
Model	UINT	0 - Outputs the ellipsoidal height 1 - Outputs the geoid height

3.3.9 CFGSAVE: Save the Configuration

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-24 Save the Configuration

Syntax	\$CFGSAVE
Example	\$CFGSAVE
Description	Save the current configuration, which is stored in the memory.
Input/Output	Input
No parameter	

 Do NOT power off the product within one second after entering the **\$CFGSAVE** command. A power off during this process may cause damage to the receiver's

configuration, and the configuration will be restored to factory settings. After configuring the parameters, if you do not type in the CFGSAVE, the configurations will not be effective after the reset.

 This command is only applicable to the flash-version products.

3.3.10 CFGCLR: Clear the Configuration

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-25 Clear the Configuration

Syntax	\$CFGCLR
Example	\$CFGCLR
Description	Clear current receiver's configuration.
Input/Output	Input
No parameter	

 The configuration changed by this command takes effect after resetting the receiver.

 CFGCLR command does not clear the satellite system configuration of UM620S.

3.3.11 AIDTIME: Configure Assisted Time

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-26 Input Assisted Time Information

Syntax	\$AIDTIME,year,month,day,hour,minute,second,millisecond	
Example	\$AIDTIME,2018,4,9,17,41,36,200	
Description	Input the assisted time, UTC time	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
year	UINT	Year
month	UINT	Month
day	UINT	Day
hour	UINT	Hour
minute	UINT	Minute
second	UINT	Second
millisecond	UINT	Millisecond

3.3.12 AIDPOS: Configure Assisted Position

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-27 Input Assisted Position

Syntax	\$AIDPOS,Latitude,N,Longitude,E,altitude	
Example	\$AIDPOS,4002.229934,N,11618.096855,E,37.254	
Description	Input the assisted position	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
Latitude	DOUBLE	Latitude; in the format of ddmm.mmmmmm: dd - Degree mm.mmmmmm - Minute Range: 0 to 90
N	STR	North or south latitude indicator: N - North latitude S - South latitude
Longitude	DOUBLE	Longitude; in the format of dddmm.mmmmmm: ddd - Degree mm.mmmmmm - Minute Range: 0 to 180
E	STR	East or west longitude indicator: E - East longitude W - West longitude
altitude	DOUBLE	Ellipsoidal height; unit: m

3.3.13 AIDINFO: Configure Assisted Information

Applicable to: UM6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-28 Read Assisted Information Configuration

Syntax	\$AIDINFO
Example	\$AIDINFO
Description	Read the assisted information configuration. The receiver outputs AIDINFO message after receiving this command.
Input/Output	Input
No parameter	

Table 3-29 Output Assisted Information

Syntax	\$AIDINFO,GPSRS,GPSUS,BDSRS,BDSUS,GALRS,GALUS,GLORS,GLOUS,IRNRS,IRNUS,AType*cs	
Example	\$AIDINFO,H003FFFFFFF7,H000000FA00,H0000003F7F,H0000001A3F,H0000000000,H0000000000,H0000000000,H0000000000,,,H0000000F*52	
Description	Output the status and type of the assisted information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
GPSRS	UINT64	Receiving status of the GPS ephemeris; set the corresponding bit to 1 as long as the received data pass the verification; fill Null when the GPS is not enabled
GPSUS	UINT64	Set the corresponding bit to 1 when GPS ephemeris is effective and can be used in positioning; fill Null when the GPS is not enabled
BDSRS	UINT64	Receiving status of the BDS ephemeris; set the corresponding bit to 1 as long as the received data pass the verification; fill Null when the BDS is not enabled.
BDSUS	UINT64	Set the corresponding bit to 1 when BDS ephemeris is effective and can be used in positioning; fill Null when the BDS is not enabled.
GALRS	UINT64	Receiving status of the GAL ephemeris; set the corresponding bit to 1 as long as the received data pass the verification; fill Null when the GAL system is not enabled.
GALUS	UINT64	Set the corresponding bit to 1 when GAL ephemeris is effective and can be used in positioning; fill Null when the GAL system is not enabled.
GLORS	UINT64	Receiving status of the GLO ephemeris; set the corresponding bit to 1 as long as the received data pass the verification; fill Null when the GLO system is not enabled

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GLOUS	UINT64	Set the corresponding bit to 1 when GLO ephemeris is effective and can be used in positioning; fill Null when the GLO system is not enabled.
IRNRS	UINT64	Receiving status of the NavIC ephemeris; Set the corresponding bit to 1 as long as the received data pass the verification; fill Null when the NavIC system is not enabled.
IRNUS	UINT64	Set the corresponding bit to 1 when NavIC ephemeris is effective and can be used in positioning; fill Null when the NavIC system is not enabled.
Atype	UINT	Assistance type: Bit 0:4 - Corresponding to the assisted GPS/BDS/GAL/GLO/NavIC ephemeris respectively Bit 5 - Assisted position valid Bit 6 - Using the assisted position Bit 7:8 - Reserved Bit 9 - Assisted time valid Bit 10 - Using the assisted time Bit 11:16 - Reserved
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.3.14 CFGWMODE: Configure Working Mode¹⁰

Applicable to: UM620S

Table 3-Read Working Mode Configuration

Syntax	\$CFGWMODE
Example	\$CFGWMODE
Description	Read the current working mode configuration. The receiver outputs CFGWMODE message after receiving this command
Input/Output	Input
Parameter Definition	
No parameter	

Table 3-30 Set or Output Working Mode Configuration

Syntax	\$CFGWMODE,mode	
Example	\$CFGWMODE,0	
Description	Configure the working mode of the product	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
mode	UINT	0 - Vehicle mode 1 - Pedestrian mode

¹⁰ Only supported by UM620S.

3.3.15 CFGTP: Configure PPS

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-Read PPS Configuration

Syntax	\$CFGTP
Example	\$CFGTP
Description	Read the time pulse configuration. The receiver outputs CFGTP message after receiving this command
Input/Output	Input
Parameter Definition	
No parameter	

Table 3-31 Set/Output PPS Configuration

Syntax	\$CFGTP;interval,length,flag,antDelay,rfDelay,usrDelay	
Example	\$CFGTP;1000000,500000,1,0,800,0	
Description	Set or output time pulse configuration.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
interval	UINT	Time pulse frequency; unit: μ s; supports: 1000000, 500000, 200000, 100000
length	UINT	Time pulse width; unit: μ s; recommended: $25\% \cdot \text{interval} \leq \text{length} \leq 75\% \cdot \text{interval}$ (High-level when the rising edge is aligned to top of second; low-level when the falling edge is aligned to top of second)
flag	UINT	Time pulse configuration: Bit 0 0 - Disable time pulse output 1 - Enable time pulse output Bit 1 0 - Rising edge at top of second 1 - Falling edge at top of second Bit 2 0 - Output when positioning 1 - Output when switching on the receiver
antDelay	INT	Antenna delay; unit: ns; range: -32768 to 32767
rfDelay	INT	RF delay; unit: ns; range: -32768 to 32767

usrDelay	INT	User-set delay; unit: ns; range: -32768 to 32767; modifying the delay may result in a loss of precision when time pulse is adapting to the value
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3.3.16 CFGRTK: Configure RTK Mode

Applicable to: UM680A, UM681A

Table 3-32 Read RTK Mode Configuration

Syntax	\$CFGRTK
Example	\$CFGRTK
Description	Read RTK mode configuration. The receiver outputs CFGRTK message after receiving this command.
Input/Output	Input
No parameters	

Table 3-33 Set/Output RTK Mode Configuration

Syntax	\$CFGRTK,TIMEOUT,RELIABILITY,ENABLE	
Example	\$CFGRTK,1,1,1	
Description	Set or output RTK mode configuration	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
TIMEOUT	UINT	Maximum age of corrections; unit: s; range: 1 to 1800
RELIABILITY	UINT	RTK engine reliability threshold: 1 - Low reliability 2 - Normal reliability 3 - Relatively high reliability (default) 4 - High reliability (may cause low fix)
ENABLE	UINT	0 - Disable RTK solution, including float solution and fixed solution 1 - Enable RTK solution, including float solution and fixed solution (default)

3.3.17 CFGMSK: Configure Satellite Cutoff Angle

Applicable to: UM680A, UM681A

The message is to configure the cutoff angle when RTK algorithm participates the positioning.

Table 3-34 Read Satellite Cutoff Angle

Syntax	\$CFGMSK
Example	\$CFGMSK
Description	Read the current satellite cutoff angle
Input/Output	Input
No parameters	

Table 3-35 Set/Output Satellite Cutoff Angle

Syntax	\$CFGMSK,ANGLE	
Example	\$CFGMSK,10	
Description	Set/Output satellite cutoff angle	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
ANGLE	INT	Satellite cutoff angle; unit: deg; range: -90 to 90

3.3.18 CFGKILOWEEK: Configure GPS Epoch

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-36 Read GPS Week Number When Epoch Begins

Syntax	\$CFGKILOWEEK
Example	\$CFGKILOWEEK
Description	Read the GPS week number when the epoch begins.
Input/Output	Input
No parameters	

Table 3-37 Set/Output GPS Week Number When Epoch Begins

Syntax	\$CFGKILOWEEK,GpsStartWeekNum	
Example	\$CFGKILOWEEK,2243	
Description	Read/Output the GPS week number when the epoch begins	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
GpsStartWeekNum	UINT	The week number at the beginning of the epoch

3.3.19 CFGLEAPSEC: Configure Leap Second

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-38 Read Leap Second Configuration

Syntax	\$CFGLEAPSEC
Example	\$CFGLEAPSEC
Description	Read the leap second configuration
Input/Output	Input
No parameters	

Table 3-39 Set/Output Leap Second

Syntax	\$CFGLEAPSEC,DefaultMode,NavBitsEnable,GpsLeapSec,BdsLeapSec,GalLeapSec,NavICLeapSec	
Example	\$CFGLEAPSEC,0,1,18,4,18,18	
Description	Set/Output leap second configuration; you can only set the leap seconds of GPS, BDS, GAL and NavIC systems when the parameter DefaultMode = 1.	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
DefaultMode	UINT	0 - default leap second in firmware 1 - leap second mode configured by user 2 - automatic calculation mode
NavBitsEnable	UINT	0 - Do not use the leap second parsing from the message 1 - Use the leap second parsing from the message
GpsLeapSec	UINT	GPS leap second set by user
BdsLeapSec	UINT	BDS leap second set by user
GalLeapSec	UINT	GAL leap second set by user
IrnLeapSec	UINT	NavIC leap second set by user

3.3.20 CFGDYN: Configure Lock Point

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-40 Read Lock Point Configuration

Syntax	\$CFGDYN
Example	\$CFGDYN
Description	Read Lock Point Configuration
Input/Output	Input
No parameters	

Table 3-41 Set/Output Lock Point Configuration

Syntax	\$CFGDYN,mask,DynModel,StaticHoldThresh	
Example	\$CFGDYN,1,0,0	
Description	Set/Output the lock point configuration	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
mask	UINT	Set the corresponding bit to 1 to enable: bit0 - dynModel; bit1 - staticHoldThresh
dynModel	UINT	Lock Point Mode: 0 - Portable 1 - Static
StaticHoldThresh	UINT	Speed threshold in static hold mode; unit: cm/s; range: 0 to 51500; if this value is 0, it means the static hold mode is disabled.

3.3.21 CFGFWCHECK: Configure Firmware Check

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-42 Configure Random Number

Syntax	\$CFGFWCHECK,CRCIN	
Example	\$CFGFWCHECK,HAE1206	
Description	Configure the random number for the firmware check.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
CRCIN	UINT	Random number typed in by user; a hexadecimal input beginning with H, with a length of 0 to 32 bytes, that is 64 hexadecimal characters at most.

Table 3-43 Output Integrity Check Value

Syntax	\$CFGFWCHECK,CRCOUT*cs	
Example	\$CFGFWCHECK,H3E9E7680*72	
Description	Output the check code.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
CRCOUT	UINT	The result after the CRC check
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.3.22 CFGLOGLIST: Configure LOGLIST Information

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-44 Read LOGLIST Information

Syntax	\$CFGLOGLIST,portID	
Example	\$CFGLOGLIST,1	
Description	Read LOGLIST information. The receiver outputs the LOGLIST message of the corresponding port after receiving the command.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
portID	UINT	Port ID: 0, 1, 2, 4

Table 3-45 Output LOGLIST Information

Syntax	\$LOGLIST,NoMsg,MsgNo,NoSv,msgClass1,msgID1,rate1,msgClass2,msgID2,rate2,msgClass3,msgID3,rate3,msgClass4,msgID4,rate4,msgClass5,msgID5,rate5,msgClass6,msgID6,rate6,msgClass7,msgID7,rate7,msgClass8,msgID8,rate8*cs	
Example	\$LOGLIST,2,1,11,200,0,1,200,2,1,200,3,5,200,4,1,207,0,1,207,2,1,207,3,5,207,4,1*69 \$LOGLIST,2,2,11,204,0,1,204,1,10,206,0,1*42	
Description	The receiver outputs the LOGLIST message.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
LOGLIST	STR	Header
NoMsg	UINT	Total number of LOGLIST message; minimum value: 1
MsgNo	UINT	The LOGLIST message number; minimum value: 1
NoSv	UINT	Total number of msg configuration information that LOGLIST outputs
msgClassX	UINT	Message class; output maximum 8 classes; see section 3.3.2 CFGMSG
msgIDX	UINT	Message ID; see section 3.3.2 CFGMSG
rateX	UINT	Message output rate; see section 3.3.2 CFGMSG
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.3.23 CFGACC: Configure Awakening Command

Applicable to: UM621 series¹¹

This message is used when a collision or dragging occurs while the vehicle is in sleep mode. Then the module would output a pulse signal via the WAKE UP pin.

Table 3-46 Read Awakening Threshold Configuration

Syntax	\$CFGACC
Example	\$CFGACC
Description	Read the parameter of the receiver's accelerometer threshold. The receiver outputs the awakening threshold of the accelerometer after receiving the command.
Input/Output	Input
No parameter	

Table 3-47 Set/Output Awakening Command Configuration

Syntax	\$CFGACC,accthreshold,modeenable	
Example	\$CFGACC,100,1	
Description	Set or output the awakening configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
accthreshold	UINT	Configure the accelerometer threshold under the awakening mode; unit: mg; range: 0 to 1500
modeenable	UINT	Enable or disable awakening function: 0 - Disable 1 - Enable

¹¹ Only supported by UM621A-32.

3.3.24 CFGODOFWD: Configure Direction Signal

Applicable to: UM621 series, UM681A

Table 3-48 Read Direction Signal Configuration

Syntax	\$CFGODOFWD
Example	\$CFGODOFWD
Description	Read the configuration of odometer's direction signal
Input/Output	Input
No parameter	

Table 3-49 Set/Output Direction Signal Configuration

Syntax	\$CFGODOFWD,FWD	
Example	\$CFGODOFWD,1	
Description	Set or output the odometer's direction signal in the integrated navigation module.	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
FWD	UINT (optional)	Mode configuration: 0 - Low level forward; high level backward 1 - High level forward; low level backward

3.3.25 CFGINS: Configure Integrated Navigation

Applicable to: UM621 series, UM681A

Table 3-50 Read Integrated Navigation Configuration

Syntax	\$CFGINS
Example	\$CFGINS
Description	Read the integrated navigation configuration. The receiver outputs the CFGINS message after receiving the command.
Input/Output	Input
No parameter	

Table 3-51 Set/Output Integrated Navigation Configuration

Syntax	\$CFGINS,mode,ImusrcType,OdosrcType,MapsrcType	
Example	\$CFGINS,1,1,1,1	
Description	Set or output the integrated navigation mode and IMU input.	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
mode	UINT (Optional)	Mode configuration: 0 - Disable the integrated navigation function. The NMEA messages only output the GNSS positioning results. 1 - Vehicle-mounted mode (single-engine) 2 - Vehicle-mounted mode (dual-engine) 5 - Two-wheeled mode (only supported by the firmware for two-wheeled vehicles; can be queried) 9 - Reserved
ImusrcType	UINT (Optional)	0 - Disable IMU input 1 - Built-in IMU chip input
OdosrcType	UINT (Optional)	0 - Disable the odometer's signal input 1 - Input from the built-in odometer pulse counter 2 - Odometer signal input via an external port ¹²
MapsrcType	UINT (Optional)	0 - Disable Map input 1 - Use the external port to input the map-matching information

¹² Supported by the specific firmware.

3.3.26 CFGIMUMEAS: Configure IMU Measurement

Interval

Applicable to: UM621 series, UM681A

Table 3-52 Read IMU measurement Interval Configuration

Syntax	\$CFGIMUMEAS
Example	\$CFGIMUMEAS
Description	Read the IMU measurement interval configuration. The receiver outputs the CFGIMUMEAS message after receiving the command.
Input/Output	Input
No parameter	

Table 3-53 Set/Output IMU measurement Interval Configuration

Syntax	\$CFGIMUMEAS,IMUMeasRate	
Example	\$CFGIMUMEAS,10	
Description	Configure IMURAW measurement output rate	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
IMUMeasRate	UINT	IMU measurement output rate; unit: ms: 20 - Corresponding to 50 Hz IMURAW reference output rate 10 - Corresponding to 100 Hz IMURAW reference output rate

3.3.27 CFGROTAT: Configure Installation Angle

Applicable to: UM621 series, UM681A

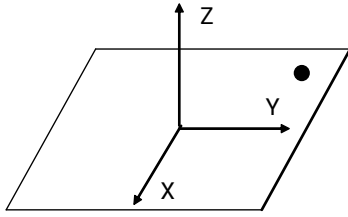
Table 3-54 Read Configuration of Installation Angle

Syntax	\$CFGROTAT
Example	\$CFGROTAT
Description	Read the current installation angle of the positioning module. The receiver outputs the CFGROTAT message after receiving the command.
Input/Output	Input
No parameter	

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Table 3-55 Set/Output Configuration of Installation Angle

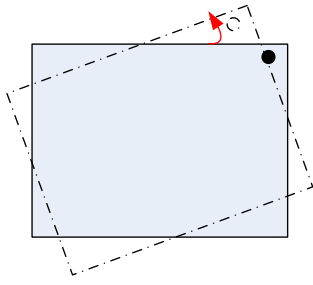
Syntax	\$CFGROTAT,angleX,angleY,angleZ,mode	
Example	\$CFGROTAT,0,0,0,2	
Description	Set or output the configuration of the module's installation angle relative to the vehicle body coordinate.	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
angleX	UINT (Optional)	Rotation angle of the module X axis relative to the body coordinate X axis (right-hand screw rule); unit: 0.01 deg; range: 0 to 36000
angleY	UINT (Optional)	Rotation angle of the module Y axis relative to the body coordinate Y axis (right-hand screw rule); unit: 0.01 deg; range: 0 to 36000
angleZ	UINT (Optional)	Rotation angle of the module Z axis relative to the body coordinate Z axis (right-hand screw rule); unit: 0.01 deg; range: 0 to 36000
mode	UINT (Optional)	Configuration mode of installation angle: 0 - General installation mode; the accuracy of input installation angle is rough (within 10 degrees) 2 - Auto installation mode; no need to input the installation angle but need to complete a calibration



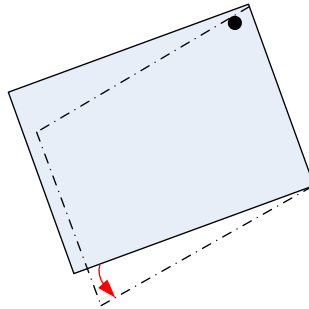
Module Coordinate



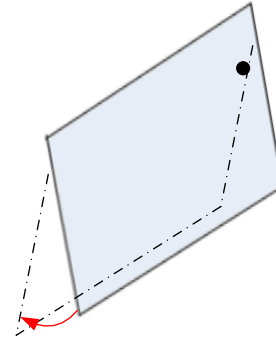
Align the module coordinate with the body coordinate



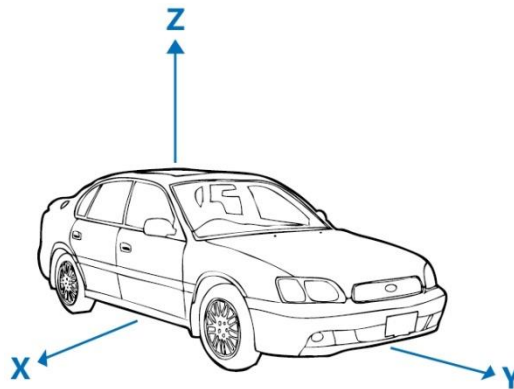
Rotate the module γ deg around the Z axis (right-hand screw rule)



Rotate the module α deg around the X axis (right-hand screw rule)



Rotate the module β deg around the Y axis (right-hand screw rule)



Vehicle Body Coordinate

3.3.28 CFGCOG: Configure Heading Angle

Applicable to: UM621 series, UM681A

Table 3-56 Read Configuration of Heading Angle

Syntax	\$CFGCOG
Example	\$CFGCOG
Description	Read the output configuration of heading angle
Input/Output	Input
No parameter	

Table 3-57 Set/Output Configuration of Heading Angle

Syntax	\$CFGCOG,mode	
Example	\$CFGCOG,0	
Description	Set or output heading angle configuration	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
mode	UINT (Optional)	0 - Heading angle is aligned with the front of the vehicle 1 - Heading angle is aligned with the driving direction

3.4 Sensor Fusion Message

3.4.1 GYOACC

Applicable to: UM621 series, UM681A

Table 3-58 Output MEMS Sensor Data

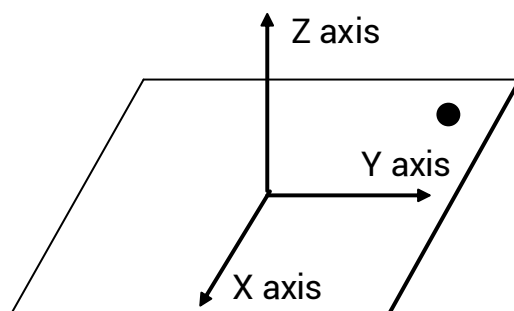
Syntax	\$GYOACC,date,time,gyroX,gyroY,gyroZ,gyroPeriod,accX,accY,accZ,accPeriod,temp,speed,pulsePeriod,fwd*cs	
Example	\$GYOACC,081118,053152.000,0.017618,0.031686,0.019729,200,6.489322,-6.913150,2.960812,200,0,5,200,1*01	
Description	Output the sensor data of MEMS and odometer etc.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
date	STR	UTC date; in the format of ddmmyy: dd - Day mm - Month yy - Year Fill null if no exact year, month and day are parsed.
time	STR	UTC time; in the format of hhmmss.sss: hh - Hour mm - Minute ss.sss - Second Fill null if no exact hour, minute and second are parsed.
gyroX	DOUBLE	X-axis angular velocity of the built-in gyroscope; unit: rad/s
gyroY	DOUBLE	Y-axis angular velocity of the built-in gyroscope; unit: rad/s
gyroZ	DOUBLE	Z-axis angular velocity of the built-in gyroscope; unit: rad/s
gyroPeriod	UINT	Output interval of the built-in gyroscope data; unit: ms
accX	DOUBLE	X-axis acceleration of the built-in accelerometer; unit: m/s ²
accY	DOUBLE	Y-axis acceleration of the built-in accelerometer; unit: m/s ²
accZ	DOUBLE	Z-axis acceleration of the built-in accelerometer; unit: m/s ²
accPeriod	UINT	Output interval of the built-in accelerometer data; unit: ms
temp	INT	Temperature; unit: °C; no meaning if not connecting a temperature sensor
speed	INT	Vehicle speed pulse; no meaning if not accessing the pulse signal.

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pulsePeriod	UINT	Output interval of pulses; unit: ms; no meaning if not accessing the pulse signal.
fwd	UINT	Vehicle direction signal: 0: Forward 1: Backward No meaning if not accessing the signal.
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

Note:

- To output GYOACC message at 10 Hz, you need to set the baud rate of the serial port 1 or 2* to 230400 bps.
- GYOACC message is based on the module coordinate defined as follows (see the figure):
 - Positive direction of X axis: ID point right-hand direction, horizontal.
 - Positive direction of Y axis: ID point forward direction, horizontal.
 - Positive direction of Z axis: Vertical to the module plane, upward.



Module Coordinate

* Not supported by UM681A

3.4.2 SNRSTAT

Applicable to: UM621 series, UM681A

Table 3-59 Output Initialization Status

Syntax	\$SNRSTAT,insstatus,odostatus,InstallState,mapstat*cs	
Example	\$SNRSTAT,3,0,0,2*5C	
Description	Output initialization status	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
insstatus	INT	INS initialization state: -1 - IMU device failure 0 - Disable 1 - Initialization started 2 - Known installation angle 3 - Initialization completed
odostatus	INT	Odometer initialization status: -1 - Odometer device failure 0 - Disable 1 - Initialization of scale factor 2 - Initialization of scale factor completed 3 - Scale factor calibration completed
InstallState	INT	-1 - IMU device failure, unable to estimate the installation angle 0 - Calibration in progress 1 - The quality of current satellite information is insufficient and better satellite conditions are needed 2 - The current vehicle mobility conditions are insufficient, and acceleration is required 3 - The current carrier speed is too low, and it is required to increase the speed
mapstat	INT	-2 - Abnormal map data is detected -1 - No port is configured to receive MAP information 0 - The port fails to receive MAP information or the MAP information transmission times out 1 - The MAP information is received but not applied to the integrated navigation

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		2 - The MAP information is received and applied to the integrated navigation
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.4.3 IMURAW

Applicable to: UM621 series, UM681A

Table 3-60 Output MEMS Sensor Raw Data in Module Coordinate System

Syntax	\$IMURAW,date,time,gyroX,gyroY,gyroZ,accX,accY,accZ,speed*cs	
Example	\$IMURAW,111223,064122.661,-0.017642,0.016745,0.015113,0.347367,-0.004711,10.241478,2*29	
Description	Output the raw data of the MEMS sensor	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
date	STR	UTC date; in the format of ddmmyy: dd - Day mm - Month yy - Year Fill null if no exact year, month and day are parsed.
time	STR	UTC time; in the format of hhmmss.sss: hh - Hour mm - Minute ss.sss - Second Fill null if no exact hour, minute and second are parsed.
gyroX	DOUBLE	X-axis angular velocity of the built-in gyroscope; unit: rad/s
gyroY	DOUBLE	Y-axis angular velocity of the built-in gyroscope; unit: rad/s
gyroZ	DOUBLE	Z-axis angular velocity of the built-in gyroscope; unit: rad/s
accX	DOUBLE	X-axis acceleration of the built-in accelerometer; unit: m/s ²
accY	DOUBLE	Y-axis acceleration of the built-in accelerometer; unit: m/s ²
accZ	DOUBLE	Z-axis acceleration of the built-in accelerometer; unit: m/s ²
speed	INT	Vehicle speed pulses; >0 means forward and <0 means backward; the field is invalid if there is no vehicle pulse signal.
cs	U8	Checksum; two hexadecimal characters obtained by

		calculating an XOR of all characters between but not including '\$' to '*' in this message
--	--	--

3.4.4 NAVATT

Applicable to: UM621 series, UM681A

Table 3-61 Output Attitude and Heading Information

Syntax	\$NAVATT,time,quality,roll_v,pitch_v,yaw_v,roll_acc,pitch_acc,yaw_acc*cs	
Example	\$NAVATT,091649.00,0,-3562,-43265,0,0,0,0*31	
Description	Output the vehicle's attitude and heading information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
time	STR	UTC time in the format of hhmmss.sss: hh - Hour mm - Minute ss.sss - Second
quality	UINT	Current quality: 0 - Invalid 1 - Externally set 2 - Coarse 3 - Precise
roll_v	INT	Roll; unit: 1e-5 deg; range: -180*1e5 to 180*1e5
pitch_v	INT	Pitch; unit: 1e-5 deg; range: -90*1e5 to 90*1e5
yaw_v	INT	Yaw; unit: 1e-5 deg; range: 0 to 360*1e5
roll_acc	INT	Roll accuracy; unit: 1e-5 deg,
pitch_acc	INT	Pitch accuracy; unit: 1e-5 deg,
yaw_acc	INT	Yaw accuracy; unit: 1e-5 deg,
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.4.5 INSPVA

Applicable to: UM621 series, UM681A

Table 3-62 Output the DR Position, Velocity and Attitude

Syntax	\$INSPVA,date,time,Lon,Lat,Hae,Vel_E, Vel_N,Vel_U, roll_v,pitch_v,yaw_v*cs	
Example	\$INSPVA,020822,111025.10,40.0865224,116.2181950,34.01,0.000,0.001,-0.002,-0.801,0.416,291.386*55	
Description	Output the dead reckoning position, velocity and attitude.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
date	STR	UTC date; in the format of ddmmyy dd - day mm - month yy - year If the calculation of date fails, this field is null.
time	STR	UTC time; in the format hhmmss.sss hh - hour mm - minute ss.sss - second If the calculation of date fails, this field is null.
Lon	DOUBLE	Longitude; unit: deg; positive means east and negative means west; fixedly output 7 decimal places
Lat	DOUBLE	Latitude; unit: deg; positive means north and negative means south; fixedly output 7 decimal places
Hae	DOUBLE	Ellipsoidal height; unit: m; fixedly output 2 decimal places
Vel_E	DOUBLE	East velocity in ENU coordinate system; unit: m/s; fixedly output 3 decimal places
Vel_N	DOUBLE	North velocity in ENU coordinate system; unit: m/s; fixedly output 3 decimal places
Vel_U	DOUBLE	Up velocity in ENU coordinate system; unit: m/s; fixedly output 3 decimal places
roll_v	DOUBLE	Roll; unit: deg; fixedly output 3 decimal places
pitch_v	DOUBLE	Pitch; unit: deg; fixedly output 3 decimal places
yaw_v	DOUBLE	Yaw; unit: deg; fixedly output 3 decimal places
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.4.6 IMUVEH

Applicable to: UM621 series, UM681A

Table 3-63 Output Compensated MEMS Sensor Data in Vehicle Body Coordinate System

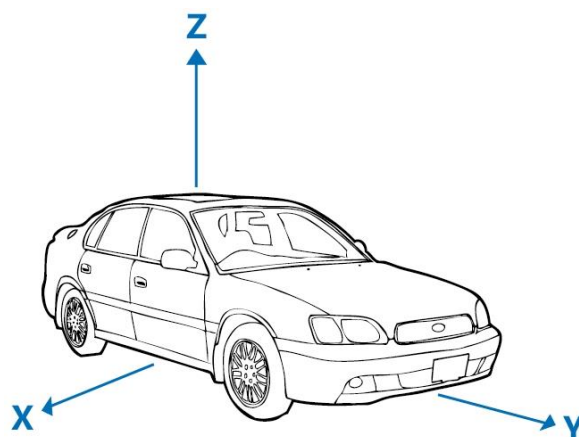
Syntax	\$IMUVEH,date,time,gyroX,gyroY,gyroZ,accX,accY,accZ,speed*cs	
Example	\$IMUVEH,260124,072202.910,0.013316,-0.011917,-0.022969,-0.418275,-0.106812,9.719531,0*09	
Description	Output the compensated built-in sensor data in vehicle body coordinate system.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
date	STR	UTC date; in the format of ddmmyy: dd - Day mm - Month yy - Year Fill null if no exact year, month and day are parsed
time	STR	UTC time; in the format of hhhmmss.sss: hh - Hour mm - Minute ss.sss - Second Fill null if no exact hour, minute and second are parsed
gyroX	DOUBLE	X-axis angular velocity of the built-in gyroscope in body coordinate system; unit: rad/s; fill null before the finish of MEMS calibration
gyroY	DOUBLE	Y-axis angular velocity of the built-in gyroscope in body coordinate system; unit: rad/s; fill null before the finish of MEMS calibration
gyroZ	DOUBLE	Z-axis angular velocity of the built-in gyroscope in body coordinate system; unit: rad/s; fill null before the finish of MEMS calibration
accX	DOUBLE	X-axis acceleration of the built-in accelerometer in body coordinate system; unit: m/s ² ; fill null before the finish of MEMS calibration
accY	DOUBLE	Y-axis acceleration of the built-in accelerometer in body coordinate system; unit: m/s ² ; fill null before the finish of MEMS calibration
accZ	DOUBLE	Z-axis acceleration of the built-in accelerometer in body coordinate system; unit: m/s ² ; fill null before the finish of MEMS calibration
speed	INT	Vehicle speed pulses; >0 means forward and <0 means backward; the field is null if there is no vehicle pulse

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		signal.
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

Note:

- IMUVEH message is based on the body coordinate defined as follows:
 - Positive direction of X axis: Driver's right-hand direction, horizontal.
 - Positive direction of Y axis: Vehicle forward direction, horizontal.
 - Positive direction of Z axis: Vertical to the body plane, upward.



Vehicle Body Coordinate

3.4.7 INSTALL

Applicable to: UM621 series, UM681A

Table 3-64 Read Installation Angle Information

Syntax	\$INSTALL
Example	\$INSTALL
Description	Read the calculated installation angle of the module. The receiver outputs \$INSTALL message after receiving this command.
Input/Output	Input
No parameter	

Table 3-65 Output Installation Angle Information


Syntax	\$INSTALL,angleX,angleY,angleZ,valid*cs	
Example	\$INSTALL,100,100,100,1*41	
Description	Output the calculated installation angle of the module.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
angleX	UINT	Rotation angle of the module X axis relative to the body coordinate X axis (right-hand screw rule); unit: 1e-2 deg; range: 0 to 36000
angleY	UINT	Rotation angle of the module Y axis relative to the body coordinate Y axis (right-hand screw rule); unit: 1e-2 deg; range: 0 to 36000
angleZ	UINT	Rotation angle of the module Z axis relative to the body coordinate Z axis (right-hand screw rule); unit: 1e-2 deg; range: 0 to 36000
Valid	UINT	0 - Invalid output of calculated installation angle 1 - Valid output of calculated installation angle
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.4.8 MAPFB

Applicable to: UM621 series, UM681A

Table 3-66 Input Map Feedback

Syntax	\$MAPFB,hhmmss.sss>TotalRoadCount,RoadIdx,RoadType,Probability,LatDiff,LonDiff,UpDiff,RoadWidth,RoadAzi	
Example	\$MAPFB, 082324.000,3,1,1,520,15,-4,0,4,4945 \$MAPFB, 082324.000,3,2,1,320,25,8,0,3,4745 \$MAPFB, 082324.000,3,3,1,160,-17,-4,0,8,4645	
Description	Input map feedback	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
hhmmss.sss	STR	UTC timestamp
TotalRoadCount	INT	Total number of the matched road
RoadIdx	INT	Road number; each message only outputs one road-matching information
RoadType	INT	Road type: 0 - Invalid 1 - Normal 2 - Tunnel 3 - Roundabout 4 - Viaduct 5 - Bridge
Probability	INT	Matching probability; unit: 1e-3
LatDiff	INT	Latitude offset; unit: 1e-6 deg
LonDiff	INT	Longitude offset; unit: 1e-6 deg
UpDiff	INT	Height offset; unit: m
RoadWidth	INT	Road width; unit: m
RoadAzi	INT	Road angle; unit: 1e-2 deg

 The command needs to be sent to the module within 700 ms after the current integer seconds, for example, the current is 1 second, and the matching protocol needs to be sent to the module within 1.7 seconds.

3.4.9 ODODATA

Applicable to: UM621 series, UM681A

Table 3-67 Input Odometer Information

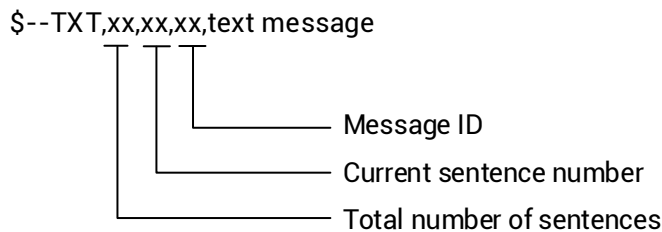
Syntax	\$ODODATA,time,speed,forward,RSV,RSV,RSV	
Example	\$ODODATA,091649.00,10000,1,,,	
Description	Input odometer information	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
time	STR	UTC time; in the format of hhmmss.ss hh - Hour mm - Minute ss.ss - Second
speed	UINT	Driving speed; unit: 1e-3 m/s
forward	UINT	Driving direction: 0 - Forward 1 - Backward
RSV		Reserved
RSV		Reserved
RSV		Reserved

3.5 Notice Message

3.5.1 General Notice Message and Notice Message Package

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

General Notice Message and Notice Message Package are used by Unicore for research and development. See the following for the syntax of the output message.



3.5.2 Command Echo

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-68 Command Echo

Syntax	\$--TXT,01,01,00,command*cs
--------	-----------------------------

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Example	\$GNTXT,01,01,00,PDTINFO*1F	
Description	Output the command that input by the user currently	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - NavIC standalone positioning GN - Dual or multiple constellations joint positioning
01	INT	Total number of sentences
01	INT	Current sentence number
00	INT	Message ID
Command	STR	Unicore command currently input by users
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.6 Misc Message

3.6.1 CWOUT

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-69 Output Interference Detection Information

Syntax	\$CWOUT,CWFlagOut,CWToneFreqOut_GPL1,CWRatioOut-GPL1,CWToneFreqOut_GL,CWRatioOut-GL,CWToneFreqOut_BDB1,CWRatioOut-BDB1,CWToneFreqOut_L5,CWRatioOut-L5*cs	
Example	\$CWOUT,1,1575620,-100,1602100,-80,1561088,-90,1176470,-79*7E	
Description	Output interference detection information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
CWFlagOut	UINT	Interference flag: 0 - No interference 1 - Having interference
CWToneFreqOut_GPL1	UINT	GPS L1 interference signal frequency; unit: KHz
CWRatioOut-GPL1	INT	GPS L1 interference strength; unit: dBm; range: -150 to 0
CWToneFreqOut_GL	UINT	GLONASS L1 interference signal frequency; unit: KHz
CWRatioOut-GL	INT	GLONASS L1 interference strength; unit: dBm; range: -150 to 0
CWToneFreqOut_BDB1	UINT	BDS B1 interference signal frequency; unit: KHz
CWRatioOut-BDB1	INT	BDS B1 interference strength; unit: dBm; range: -150 to 0
CWToneFreqOut_L5	UINT	L5 interference signal frequency; unit: KHz
CWRatioOut-L5	INT	L5 interference strength; unit: dBm; range: -150 to 0
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

3.6.2 LSF

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-70 Query Leap Seconds Forecast Information

Syntax	\$LSF,system	
Example	\$LSF,1	
Description	Query leap seconds forecast information of the specified satellite, and the receiver outputs LSF message after receiving the command	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
system	UINT	Query the system corresponding to the leap seconds forecast information 0 - GPS 1 - BDS 2 - GLO 3 - GAL 4 - NavIC

Table 3-71 Output Leap Seconds Forecast Information

Syntax	\$LSF,system,flag,utcTLS,utcTLSF,utcTOT,utcWN,utcDN,utcWNLSF,utcA0,utcA1*cs	
Example	\$LSF,0,1,15,16,462836,82,6,86,7811626,14*5C	
Description	Output leap seconds forecast information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
System	UINT	Output the system corresponding to the leap seconds forecast information 0 - GPS 1 - BDS 2 - GLO 3 - GAL 4 - NavIC
Flag	UINT	Validity flag of leap seconds forecast information 0 - Invalid 1 - Valid
utcTLS	UINT	Time difference between UTC and the system before a leap second event occurs; unit: s; GLO system does not have this parameter

utcTLSF	UINT	Time difference between UTC and the system after a leap second event occurs; unit: s; GLO system does not have this parameter
utcTOT	UINT	UTC reference seconds of week; unit: s (Fill 0 for BDS); GLO system: the parameter corresponds to GLO UTC A0
utcWN	UINT	UTC reference week number; unit: week (Fill 0 for BDS); GLO system: the parameter corresponds to GLO UTC A1
utcDN	UINT	Days of week when the leap second event occurs; unit: day; GLO system: the parameter corresponds to GLO UTC DN
utcWNLSF	UINT	UTC week number when the leap second event occurs; unit: week; GLO system: the parameter corresponds to GLO UTC KP
utcA0	INT	Constant coefficient A0 of UTC polynomial (scale factor 2^{-30}); unit: s; GLO system: the parameter corresponds to GLO UTC tc
utcA1	INT	First-order coefficient A1 of UTC polynomial (scale factor 2^{-50}); unit: s/s; GLO system: the parameter corresponds to GLO UTC tg
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

Note

- GPS Week is the time system adopted in the GPS system. Time Zero is defined as: 00:00 on January 6, 1980 and every 1024 weeks (7168 days) is a cycle. The first roll-over happened at 00:00:00 on August 22, 1999. That is, from this moment on, the week number starts again from zero. In GPST, 1 to 7 corresponds to Sunday to Saturday.
- The BDS time starts at 00:00:00 UTC on 1 January 2006, and uses week and day of week to count. 0 to 6 corresponds to Sunday to Saturday.
- utcWNLSF: The decimal number converted from the binary lower eight bits of the week when a leap second occurs.

For example: A leap second occurred in the week 900 (binary: 1110000100), then the utcWNLSF broadcasts 132 (binary: 10000100).

- Calculating the GPS week when a leap second occurs:
 1. Convert the RMC date into GPS week;
 2. Convert the GPS week into binary, set the lower eight bits to zero, and then convert to decimal.
 3. Add utcWNLSF to the number got from step 2.

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- Calculating the BDS week when a leap second occurs:
 1. Convert the RMC date into BDS week;
 2. Convert the BDS week into binary, set the lower eight bits to zero, and then convert to decimal.
 3. Add utcWNLSF to the number got from step 2.
- utcDN: Day of week when a leap second occurs. GPS: 1 to 7 corresponding to Sunday to Saturday; BDS: 0 to 6 corresponding to Sunday to Saturday
- Leap seconds occur at 23:59:59

3.6.3 OSNMA¹³

Applicable to: UC6580, UM620 series, UM621 series, UM670A, UM680A, UM681A

Table 3-72 Output Galileo I/NAV Message

Syntax	\$PNAVMMSG,svid,wordtype,x1, x2, x3, ..., x30*cs	
Example	\$PNAVMMSG,1,0,BE,DA,49,72,CB,C3,80,EA,AA,AA,4D,41,0A,3F,40*7F	
Description	Output Galileo I/NAV message	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
svid	UINT	Satellite ID
wordtype	UINT	Galileo I/NAV message word type; range: 1 to 32
x1, x2, x3, ..., x30	INT	Odd and even part of I/NAV message; range: -128 to 127
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

¹³ Output at constant 0.5 Hz only when there is no error code in GALILEO messages.

4 RTCM Messages

UM670A, UM680A and UM681A all support the rawdata observations output of RTCM MSM, RTCM EPH and RTCM STM.

Refer to Chapter 6 [1] for the information of RTCM format.

The supported messages include:

Messages	Type
Station Coordinates	1005
System Parameters	1013
GPS MSMs	107x, x depends on CFGMSM
BDS MSMs	112x, x depends on CFGMSM
GALILEO MSMs	109x, x depends on CFGMSM
GLONASS MSMs	108x, x depends on CFGMSM
QZSS MSMs	111x, x depends on CFGMSM
SBAS MSMs	110x, x depends on CFGMSM
GPS Ephemeris Data	1019
QZSS Ephemeris Data	1044
BDS Ephemeris Data	1042
GALILEO Ephemeris Data	1046
GLONASS Ephemeris Data	1020
Unicore proprietary messages	4074

5 Extended RTCM Messages

The messages obey RTCM3.3 standards, and Unicore defines the filed **Variable Length Data Message**.

5.1 Data Structure

See the following tables for the format of the extended RTCM messages defined by Unicore.

Table 5-1 Description of Binary Format

ID	Structure	Description
1	Header	See Table 5-2
2	Data	Data field, the length is variable according to different messages. Please see the specific messages for more information
3	CRC	CRC24Q check

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Table 5-2 Description of Header

Field	Bits	Unit	Range	Description
Preamble	8	—	—	Constant 11010011
Reserved	6	—	—	Reserved; set to 000000
Data Field Length	10	—	—	Data Field length in bytes
Message Type	12	—	—	UINT; Unicore message type = 4074
Sub Message Type	12	—	—	UINT 0x00B: GYOACC; 0x00C: SNRSTAT 0x00D: NAVATT 0x00E: IMURAW 0x00F: INSPVA 0x010: IMUVEH 0x0FF: Receiver information 0x0FE: Signal information 0x0FB: Ionosphere information 0x0FD: TGD/ISC information

The messages use CRC24Q check, and the following is an example in C programming language.

```

1  U32 Crc24Q_U8(U8 *src, int len)
2  {
3  int i;
4  U32 crc = 0;
5  for (i = 0; i < len; i++)
6  crc = (crc << 8) ^ CRC24Q_Table[src[i] ^ (U8)(crc >> 16)];
7  return crc & 0xFFFFFF;
8  }

```

5.2 Message Definition

5.2.1 Sensor Fusion Message

5.2.1.1 GYOACC (Sub ID 0x00B)

Applicable to: UM621 series, UM681A

Table 5-3 Output MEMS, Odometer Data Etc.

ID	Field	Type	Description	Bytes	Byte Offset
1	Year	U16	Year: (UTC) 0xFFFF means invalid	2	0
2	Month	U8	Month: 1 to 12 (UTC) 0xFF means invalid	1	2
3	Day	U8	Day: 1 to 31 (UTC) 0xFF means invalid	1	3
4	Hour	U8	Hour: 0 to 23 (UTC) 0xFF means invalid	1	4
5	Min	U8	Minute: 0 to 59 (UTC) 0xFF means invalid	1	5
6	mSec	U16	Millisecond 0xFFFF means invalid	2	6
7	gyroX	S32	X-axis angular velocity of the built-in gyroscope; unit: 2 ⁻¹⁶ rad/s	4	8
8	gyroY	S32	Y-axis angular velocity of the built-in gyroscope; unit: 2 ⁻¹⁶ rad/s	4	12
9	gyroZ	S32	Z-axis angular velocity of the built-in gyroscope; unit: 2 ⁻¹⁶ rad/s	4	16
10	gyroPeriod	U8	Output interval of the built-in gyroscope data; unit: ms	1	20
11	accX	S32	X-axis acceleration of the built-in accelerometer; unit: 2 ⁻¹⁶ m/s ²	4	21

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ID	Field	Type	Description	Bytes	Byte Offset
12	accY	S32	Y-axis acceleration of the built-in accelerometer; unit: 2 ⁻¹⁶ m/s ²	4	25
13	accZ	S32	Z-axis acceleration of the built-in accelerometer; unit: 2 ⁻¹⁶ m/s ²	4	29
14	accPeriod	U8	Output interval of the built-in accelerometer data; unit: ms	1	33
15	temp	S8	Temperature; unit: °C; 0x80 means invalid	1	34
16	speed	U16	Vehicle speed pulse; output 0xFFFF if not accessing the odometer signal, meaning invalid	1	35
17	pulsePeriod	U8	Output interval of pulses; unit: ms; output 0xFF if not accessing the odometer signal, meaning invalid	1	36
18	fwd	U8	Vehicle direction signal: 0 - Forward 1 - Backward; output 0xFF if not accessing the odometer signal, meaning invalid	1	37
Total				39	

5.2.1.2 SNRSTAT (Sub ID 0x00C)

Applicable to: UM621 series, UM681A

Table 5-4 Output Initialization Status

ID	Field	Type	Description	Bytes	Byte Offset
1	insstatus	S8	INS initialization state: -1 - IMU device failure 0 - Disable 1 - Initialization started 2 - Known installation angle 3 - Initialization completed	1	0
2	odostatus	S8	Odometer initialization status: -1 - Odometer device failure 0 - Disable 1 - Initialization of scale factor 2 - Initialization of scale factor completed 3 - Scale factor calibration completed	1	1
3	InstallState	S8	-1 - IMU device failure, unable to estimate the installation angle 0 - Calibration in progress 1 - The quality of current satellite information is insufficient and better satellite conditions are needed 2 - The current vehicle mobility conditions are insufficient, and acceleration is required 3 - The current vehicle speed is too low, and it is required to increase the speed	1	2
4	mapstat	S8	-2 - Abnormal map data is detected	1	3

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ID	Field	Type	Description	Bytes	Byte Offset
			-1 - No port is configured to receive MAP information 0 - The port fails to receive MAP information or the MAP information transmission times out 1 - The MAP information is received but not applied to the integrated navigation 2 - The MAP information is received and applied to the integrated navigation		
Total				4	

5.2.1.3 IMURAW (Sub ID 0x00E)

Applicable to: UM621 series, UM681A

Table 5-5 Output Raw MEMS Data

ID	Field	Type	Description	Bytes	Byte Offset
1	Year	U16	Year: (UTC); 0xFFFF means invalid	2	0
2	Month	U8	Month: 1 to 12 (UTC); 0xFF means invalid	1	2
3	Day	U8	Day: 1 to 31 (UTC); 0xFF means invalid	1	3
4	Hour	U8	Hour: 0 to 23 (UTC); 0xFF means invalid	1	4
5	Min	U8	Minute: 0 to 59 (UTC); 0xFF means invalid	1	5
6	mSec	U16	Millisecond; 0xFFFF means invalid	2	6
7	gyroX	S32	X-axis angular velocity of the built-in gyroscope; unit: 2 ⁻¹⁶ rad/s	4	8
8	gyroY	S32	Y-axis angular velocity of the built-in gyroscope; unit: 2 ⁻¹⁶ rad/s	4	12
9	gyroZ	S32	Z-axis angular velocity of the built-in gyroscope; unit: 2 ⁻¹⁶	4	16

ID	Field	Type	Description	Bytes	Byte Offset
			rad/s		
10	accX	S32	X-axis acceleration of the built-in accelerometer; unit: 2 ⁻¹⁶ m/s ²	4	20
11	accY	S32	Y-axis acceleration of the built-in accelerometer; unit: 2 ⁻¹⁶ m/s ²	4	24
12	accZ	S32	Z-axis acceleration of the built-in accelerometer; unit: 2 ⁻¹⁶ m/s ²	4	28
13	Speed	S16	Vehicle speed pulses; >0 means forward and <0 means backward The field is invalid if there is no vehicle pulse signal.	2	32
Total				34	

5.2.1.4 NAVATT (Sub ID 0x00D)

Applicable to: UM621 series, UM681A

Table 5-6 Output Vehicle's Attitude and Heading Information

ID	Field	Description	Type	Bytes	Bytes Offset
1	Hour	U8	Hour 0 to 23 (UTC); 0xFF means invalid	1	0
2	Min	U8	Minute 0 to 59 (UTC); 0xFF means invalid	1	1
3	mSec	U16	Millisecond; 0xFFFF means invalid	2	2
4	quality	U8	Current quality: 0 - Invalid 1 - Coarse 2 - Precise	1	4
5	roll_v	S32	Roll; unit: 1e-5 deg; 0x80000000 means invalid	4	5
6	pitch_v	S32	Pitch; unit: 1e-5 deg; 0x80000000 means invalid	4	9
7	yaw_v	S32	Yaw; unit: 1e-5 deg; 0x80000000 means invalid	4	13
8	roll_acc	U32	Roll accuracy; unit: 1e-5 deg; 0xFFFFFFFF means invalid	4	17
9	pitch_acc	U32	Pitch accuracy; unit: 1e-5 deg;	4	21

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ID	Field	Description	Type	Bytes	Bytes Offset
			0xFFFFFFFF means invalid		
10	yaw_acc	U32	Yaw accuracy; unit: 1e-5 deg; 0xFFFFFFFF means invalid	4	25
Total				29	

5.2.1.5 INSPVA (Sub ID 0x00F)

Applicable to: UM621 series, UM681A

Table 5-7 Output the DR Position, Velocity and Attitude

ID	Field	Description	Type	Bytes	Bytes Offset
1	Year	U16	Year: (UTC); 0xFFFF means invalid	2	0
2	Month	U8	Month: 1 to 12 (UTC); 0xFF means invalid	1	2
3	Day	U8	Day: 1 to 31 (UTC); 0xFF means invalid	1	3
4	Hour	U8	Hour: 0 to 23 (UTC); 0xFF means invalid	1	4
5	Min	U8	Minute: 0 to 59 (UTC); 0xFF means invalid	1	5
6	mSec	U16	Millisecond; 0xFFFF means invalid	2	6
7	Lon	S64	Longitude; unit: 2 ⁻³² deg; positive means east, and negative means west; 0x8000000000000000 means invalid	8	8
8	Lat	S64	Latitude; unit: 2 ⁻³² deg; positive means north, and negative means south; 0x8000000000000000 means invalid	8	16
9	Hae	S32	Ellipsoidal height; unit: mm; 0x80000000 means invalid	4	24
10	Vel_E	S32	East velocity in ENU coordinate system; unit: mm/s; 0x80000000 means invalid	4	28
11	Vel_N	S32	North velocity in ENU coordinate system; unit: mm/s; 0x80000000	4	32

ID	Field	Description	Type	Bytes	Bytes Offset
			means invalid		
12	Vel_U	S32	Up velocity in ENU coordinate system; unit: mm/s; 0x80000000 means invalid	4	36
13	roll_v	S32	Roll; unit: 1e-5 deg; 0x80000000 means invalid	4	40
14	pitch_v	S32	Pitch; unit: 1e-5 deg; 0x80000000 means invalid	4	44
15	yaw_v	S32	Yaw; unit: 1e-5 deg; 0x80000000 means invalid	4	48
Total				52	

5.2.1.6 IMUVEH (Sub ID 0x010)

Applicable to: UM621 series, UM681A

Table 5-8 Output Compensated MEMS data in the Vehicle Body Coordinate System

ID	Field	Description	Type	Bytes	Bytes Offset
1	Year	U16	Year: (UTC); 0xFFFF means invalid	2	0
2	Month	U8	Month: 1 to 12 (UTC); 0xFF means invalid	1	2
3	Day	U8	Day: 1 to 31 (UTC); 0xFF means invalid	1	3
4	Hour	U8	Hour: 0 to 23 (UTC); 0xFF means invalid	1	4
5	Min	U8	Minute: 0 to 59 (UTC); 0xFF means invalid	1	5
6	mSec	U16	Millisecond; 0xFFFF means invalid	2	6
7	gyroX	S32	X-axis angular velocity of the built-in gyroscope in body coordinate system; unit: 2 ⁻¹⁶ rad/s; before the calibration of the initial device, it is invalid and outputs 0x80000000	4	8
8	gyroY	S32	Y-axis angular velocity of the built-in gyroscope in body coordinate system; unit: 2 ⁻¹⁶ rad/s; before the calibration of the initial device, it is invalid and outputs 0x80000000	4	12

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ID	Field	Description	Type	Bytes	Bytes Offset
9	gyroZ	S32	Z-axis angular velocity of the built-in gyroscope in body coordinate system; unit: 2 ⁻¹⁶ rad/s; before the calibration of the initial device, it is invalid and outputs 0x80000000	4	16
10	accX	S32	X-axis acceleration of the built-in accelerometer in body coordinate system; unit: 2 ⁻¹⁶ m/s ² ; before the calibration of the initial device, it is invalid and outputs 0x80000000	4	20
11	accY	S32	Y-axis acceleration of the built-in accelerometer in body coordinate system; unit: 2 ⁻¹⁶ m/s ² ; before the calibration of the initial device, it is invalid and outputs 0x80000000	4	24
12	accZ	S32	Z-axis acceleration of the built-in accelerometer in body coordinate system; unit: 2 ⁻¹⁶ m/s ² ; before the calibration of the initial device, it is invalid and outputs 0x80000000	4	28
13	Speed	S16	Vehicle speed pulses; >0 means forward and <0 means backward; the field is invalid if there is no vehicle pulse signal	2	32
Total				34	

5.2.2 PVT messages

5.2.2.1 Receiver Information (Sub ID 0x0FF)

Applicable to: UC6580, UM670A, UM680A

The message **Receiver Information** contains parameters related to receiver status, including position, speed, positioning quality, Dop value and clock information etc. The data transmission uses Big Endian method. See the following table for more details.

Table 5-9 Receiver Information Structure

ID	Field	Type	Description	Bytes	Bytes Offset
1	Version	U8	Protocol version; the current one is 0x01	1	0
2	Week	U16	GPS week, starting from Jan. 6 th 1980; 0xFFFF means invalid	2	1
3	Tow	U32	GPS time of week; unit: ms; 0xFFFFFFFF means invalid	4	3
4	SatNum	U8	Number of satellites used in positioning; 0xFF means invalid	1	7
5	Lon	S64	Longitude; unit: 2 ⁻³² deg; positive - East; negative - West; 0x8000000000000000 means invalid	8	8
6	Lat	S64	Latitude; unit: 2 ⁻³² deg; positive - North; negative - South; 0x8000000000000000 means invalid	8	16
7	Hae	S32	Ellipsoidal height; unit: mm; 0x80000000 means invalid	4	24
8	Hmsl	S32	Altitude; unit: mm; 0x80000000 means invalid	4	28
9	X	S64	ECEF X coordinate; unit: mm; 0x8000000000000000 means invalid	8	32
10	Y	S64	ECEF Y coordinate; unit: mm; 0x8000000000000000 means invalid	8	40
11	Z	S64	ECEF Z coordinate; unit: mm; 0x8000000000000000 means invalid	8	48
12	Quality	U8	Quality of current positioning and velocity measurement: 0 - Invalid 1 - Single point positioning 2 - DGPS 4 - RTK fixed solution 5 - RTK floating solution 6 - INS positioning	1	56
13	Vel_E	S32	East velocity in ENU coordinate; unit: mm/s; 0x80000000 means invalid.	4	57

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14	Vel_N	S32	North velocity in ENU coordinate; unit: mm/s; 0x80000000 means invalid	4	61
15	Vel_U	S32	Up velocity in ENU coordinate; unit: mm/s; 0x80000000 means invalid	4	65
16	Speed	S32	Speed over ground; unit: mm/s; 0x80000000 means invalid	4	69
17	Heading	U16	Heading; unit: 1e-2 deg; range: 0 to 35999; 0xFFFF means invalid	2	73
18	HDOP	U16	Horizontal dilution of precision; unit: 1e-2; range: 0 to 9999; 0xFFFF means invalid	2	75
19	VDOP	U16	Vertical dilution of precision; unit: 1e-2; range: 0 to 9999; 0xFFFF means invalid	2	77
20	PDOP	U16	Position dilution of precision; unit: 1e-2; range: 0 to 9999; 0xFFFF means invalid	2	79
21	GDOP	U16	Geometric dilution of precision; unit: 1e-2; range: 0 to 9999; 0xFFFF means invalid	2	81
22	TDOP	U16	Time dilution of precision; unit: 1e-2; range: 0 to 9999; 0xFFFF means invalid	2	83
23	EACC	U32	East mean square error; unit: mm; 0xFFFFFFFF means invalid	4	85
24	NACC	U32	North mean square error; unit: mm; 0xFFFFFFFF means invalid	4	89
25	UACC	U32	Up mean square error; unit: mm; 0xFFFFFFFF means invalid	4	93
26	TACC	U32	Time mean square error; unit: ns; 0xFFFFFFFF means invalid	4	97
27	XACC	U32	Mean square error of X coordinate; unit: mm; 0xFFFFFFFF means invalid	4	101
28	YACC	U32	Mean square error of Y coordinate; unit: mm; 0xFFFFFFFF means invalid	4	105
29	ZAcc	U32	Mean square error of Z coordinate; unit: mm; 0xFFFFFFFF means invalid	4	109
30	VelEAcc	U32	Mean square error of east	4	113

			velocity; unit: mm/s; 0xFFFFFFFF means invalid		
31	VelNAcc	U32	Mean square error of north velocity; unit: mm/s; 0xFFFFFFFF means invalid	4	117
32	VelUAcc	U32	Mean square error of up velocity; unit: mm/s; 0xFFFFFFFF means invalid	4	121
33	ClkErr	S32	Receiver clock error; unit: ns; 0x80000000 means invalid	4	125
34	ClkDrift	S32	Equivalent speed of clock drift; unit: 1e-1 Hz; 0x80000000 means invalid	4	129
35	Year	U16	Year: (UTC); 0xFFFF means invalid	2	133
36	Month	U8	Month: 1 to 12 (UTC); 0xFF means invalid	1	135
37	Day	U8	Day: 1 to 31 (UTC); 0xFF means invalid	1	136
38	Hour	U8	Hour: 0 to 23 (UTC); 0xFF means invalid	1	137
39	Min	U8	Minute: 0 to 59 (UTC); 0xFF means invalid	1	138
40	mSec	U16	Millisecond; 0xFFFF means invalid	2	139
41	StationID	U16	Reference station ID; 0xFFFF means invalid	2	141
42	DiffAge	U8	Differential age; unit: s; 0xFF means invalid	1	143
43	CACC	U16	Mean square error of course error; unit: 1e-2 deg; 0xFFFF means invalid	2	144
44	Rsv	U16*7	Reserved	14	146
Total	-			160	-

5.2.2.2 Signal Information (Sub ID 0x0FE)

Applicable to: UC6580, UM670A, UM680A

The message **Signal Information** contains parameters related to satellite status, including PRN, CNO, elevation, azimuth and pseudo-range residual etc. If there is no GNSS signal, the message outputs the header and the field SatNum = 0. The data transmission uses Big Endian method. See the following tables for the details of the message structure.

Table 5-10 Signal Information Structure

ID	Field	Type	Description	Bytes	Byte Offset
1	Version	U8	Protocol version	1	0
2	Week	U16	GPS week, starting from Jan. 6 th 1980; 0xFFFF means invalid	2	1
3	Tow	U32	GPS time of week; unit: ms; 0xFFFFFFFF means invalid	4	3
4	SatNum	U32	Repeat time of satellite status	4	7
5	SatInfo	—	See Table 5-11 for details	SatNum* (8 + 6*N _f)	11
Total	-	-	-	11+SatNum * (8 + 6*N _f)	-

Table 5-11 shows the encoding structure of satellite information.

Table 5-11 Satellite Information Encoding Structure

ID	Field	Type	Description	Bytes	Byte Offset
1	Prn	U8	Satellite number: GPS 01 to 32 QZSS 01 to 10 GLO 65 to 99 BDS 01 to 64 GAL 01 to 36 SBAS 33 to 51	1	0
2	System	U8	1 - GPS 2 - GLO 3 - GAL 4 - BDS 5 - QZSS 6 - SBAS	1	1
3	El	U16	Satellite elevation; unit: 1e-1 deg; range: 0 to 900; 0xFFFF means invalid	2	2
4	Az	U16	Satellite azimuth; unit: 1e-1 deg; range: 0 to 3600; 0xFFFF means invalid	2	4
5	InUse	U8	0 - not used in positioning 1 - used in positioning	1	6
6	Freq Num (N_f)	U8	The frequency number of the satellite	1	7
Field 7 to 10 repeat N_f times (see Field 6)					
7	Freq ID	U8	GPS 2 - GPS L1C/A 16 - GPS L2C(L) 23 - GPS L5Q GLO 2 - G1C/A BDS 2 - B1I 14 - B2I 23 - B2a_pilot GAL 2 - E1C no data 15 - E5bQ	1	$2 + 6*N_f$

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			23 - E5aQ QZSS 2 - QZSS L1C/A 16 - QZSS L2C(L) 23 - QZSS L5Q SBAS 2 - SBAS L1C/A 23 - SBAS L5Q		
8	CNO	U8	Unit: dB.Hz	1	$3 + 6*N_f$
9	PrResi	U16	Positioning pseudo-range residual of each satellite; unit: 1e-1 m; 0xFFFF means invalid	2	$4 + 6*N_f$
10	DpResi	U16	Velocity measurement Doppler residual of each satellite; unit: 1e-1 Hz; 0xFFFF means invalid	2	$6 + 6*N_f$
Total	-			$8 + 6*N_f$	-

5.2.2.3 Ionosphere Information (Sub ID 0x0FB)

Applicable to: UC6580, UM670A, UM680A

This message outputs the ionosphere parameters broadcasted by GPS and BDS. See

Table 5-12 for the details. The data transmission uses Big Endian method.

Table 5-12 Ionosphere Information Structure

ID	Field	Type	Description	Bytes	Byte Offset
1	System	U8	0 - GPS 1 - BDS	1	0
2	a0	S8	Alpha parameter constant term; LSB: 2^{-30}	1	1
3	a1	S8	Alpha parameter 1st order term; LSB: 2^{-27}	1	2
4	a2	S8	Alpha parameter 2nd order term; LSB: 2^{-24}	1	3
5	a3	S8	Alpha parameter 3rd order term; LSB: 2^{-24}	1	4

6	b0	S8	Beta parameter constant term; LSB: 2 ¹¹	1	5
7	b1	S8	Beta parameter 1st order term; LSB: 2 ¹⁴	1	6
8	b2	S8	Beta parameter 2nd order term; LSB: 2 ¹⁶	1	7
9	b3	S8	Beta parameter 3rd order term; LSB: 2 ¹⁶	1	8
Total	-			9	-

5.2.2.4 TGD/ISC Information (Sub ID 0x0FD)

Applicable to: UC6580, UM670A, UM680A

This message outputs the parsed TGD/ISC information of each satellite. The data transmission uses Big Endian method.

Table 5-13 TGD/ISC Information Structure

ID	Field	Type	Description	Bits	Bit Offset
1	System	U8	1 - GPS 2 - GLO 3 - GAL 4 - BDS 5 - QZSS	8	0
2	SatNum	U8	Output the TGD satellite numbers	8	8
3	TGDInfo	-	See Table 5-14 to Table 5-16	SatNum * 89	16
Total	-			16 + SatNum * 89	-

Table 5-14 to Table 5-16 are the TGD/ISC information encoding structure for GPS/QZSS, BDS and GAL systems.

Table 5-14 GPS/QZSS TGD/ISC Info

ID	Field	Type	Description	Bytes	Byte Offset
1	Svid	U8	GPS satellite number: 01 to 32 QZSS satellite number: 01 to 10	8	0
2	toe	Int17	Time of ephemeris; LSB: 2 ⁴ ; unit: s	17	8
3	TGDL1	S16	L1 group delay; LSB: 2 ⁻³¹ ; unit: s; 0x8000 means invalid	16	25
4	ISCL1C	S16	L1 group delay; LSB: 2 ⁻³⁵ ; unit: s; 0x8000 means invalid	16	41
5	TGDL5	S16	L5 group delay; LSB: 2 ⁻³⁵ ; unit: s; 0x8000 means invalid	16	57
6	ISCL5Q	S16	L5 group delay; LSB: 2 ⁻³⁵ ; unit: s; 0x8000 means invalid	16	73

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Total		89	
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Table 5-15 BDS TGD/ISC Info

ID	Field	Type	Description	Bytes	Byte Offset
1	Svid	U8	BDS satellite number: 01 to 64	8	0
2	toe	Int17	Time of ephemeris; LSB: 2 ³ ; unit: s	17	8
3	TGDB1I	S16	B1I group delay; LSB:1e-1; unit: ns; 0x8000 means invalid		25
4	ISCB1I	S16	Specified to constant 0x8000		41
5	TGDB2A	S16	B2A group delay; LSB:2 ⁻³⁴ ; unit: s; 0x8000 means invalid;	16	57
6	ISCB2A	S16	B2A (data) delay; LSB:2 ⁻³⁴ ; unit: s; 0x8000 means invalid	16	73
Total				89	

Table 5-16 GAL TGD/ISC info

ID	Field	Type	Description	Bytes	Byte Offset
1	Svid	U8	GAL satellite number: 01 to 36	8	0
2	toe	Int17	Time of ephemeris; LSB:6e1; unit: s	17	8
3	TGDE1	S16	E1 group delay; LSB:2 ⁻³² ; unit: s; 0x8000 means invalid	16	25
4	ISCE1	S16	Specified to constant 0x8000	16	41
5	TGDE5A	S16	E5A group delay; LSB:2 ⁻³² ; unit: s; 0x8000 means invalid;	16	57
6	ISCE5A	S16	Specified to constant 0x8000	16	73
Total				89	

5.3 Decoding Example

5.3.1 TOW (U32)

Hex-ASCII	07 92 04 08
U32 value	0x7920408 (127009800)
Tow	127009800 ms

5.3.2 Lon (S64)

Hex-ASCII	00 00 00 74 3D EC E6 E1
S64 value	0x000000743DECE6E1(499255142113)
Lon	$(499255142113/(2^{32}))^{\circ} = 116.24189608567^{\circ}$

5.3.3 Vel_E (S32)

Hex-ASCII	00 00 00 1B
S32 value	0x0000001B (27)
Vel_E	27 mm/s

5.3.4 Year (U16)

Hex-ASCII	07 E7
S32 value	0x07E7 (2023)
Year	2023

6 Reference

[1] RTCM STANDARD 10403.3, DIFFERENTIAL GNSS(GLOBAL NAVIGATION SATELLITE SYSTEMS) SERVICES: VERSION 3

[2] NMEA 0183 Standard for Interfacing Marine Electronic Devices, Version 4.11

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