



STANDARD POSITIONING

PROTOCOL SPECIFICATION

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# UFirebird IV Series

GNSS Four-Constellation Single-Frequency  
Positioning Products



# Foreword

## About This Document

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This document provides information on the protocols of the UFirebird IV series positioning chips and modules.

### Target Readers

This protocol is intended for technical personnel familiar with GNSS receivers.

## Statement

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# Revision History

Version	Revision History	Date
R1.0	First release.	Feb. 2026

## Document Status

Releases	Status Descriptions	Current Status
Primary	This is a pre-release version with target specifications that are subject to revision.	
Alpha release	This is an alpha release version, which has been preliminarily tested and verified. The content may undergo minor modifications based on user feedback and further testing.	
Production release	The document contains the complete and final specifications.	√

# 1 Introduction

## 1.1 Range of Application

This manual is applicable to UC7510 series chips, UM760 series and UM761 series modules. See each message for its scope.

Product	Include
UC7510 series	UC7510I: Industrial-grade four-constellation single-frequency GNSS positioning chip UC7510A: Automotive-grade four-constellation single-frequency GNSS positioning chip
UM760 series	UM760: Industrial-grade four-constellation single-frequency GNSS positioning module UM760A: Automotive-grade four-constellation single-frequency GNSS positioning module
UM761 series	UM761: Industrial-grade four-constellation single-frequency GNSS+DR integrated positioning module UM761A: Automotive-grade four-constellation single-frequency GNSS+DR integrated positioning module

The receiver is delivered with default settings. Users can configure it according to [Configuration Messages](#).

## 1.2 GNSS/Satellite/Signal Identifiers

### 1.2.1 GNSS Identifiers

Constellation	NMEA	Unicore	RTCM
GPS	1	1	Refer to <a href="#">Reference</a> [1] RTCM Standard
BDS	4	4	Same as above
GAL	3	3	Same as above
GLO	2	2	Same as above
QZSS	5	5	Same as above
NavIC	6	6	Same as above

## 1.2.2 Satellite Identifiers

Constellation	NMEA	Unicore	RTCM
GPS	01 to 32	01 to 32	Refer to <a href="#">Reference [1]</a> RTCM Standard
SBAS (WAAS)	33 to 64	33 to 64	Same as above
BDS	01 to 64	01 to 64	Same as above
SBAS (BDS SBAS)	65 to 79	65 to 79	Same as above
GLO	65 to 99	65 to 99	Same as above
SBAS (SDCM)	33 to 64	33 to 64	Same as above
GAL	01 to 36	01 to 36	Same as above
SBAS (EGNOS)	37 to 64	37 to 64	Same as above
QZSS	01 to 14	01 to 14	Same as above
SBAS (MSAS)	55 to 63	55 to 63	Same as above
NavIC	01 to 15	01 to 15	Same as above
SBAS (GAGAN)	33 to 64	33 to 64	Same as above

## 1.2.3 Signal Identifiers

Frequency	NMEA	Unicore	RTCM
GPS L1C/A	1	1	Refer to <a href="#">Reference [1]</a> RTCM Standard
GAL E1BC	7	7	Same as above
BDS B1I	1	1	Same as above
BDS B1C	3	3	Same as above
GLO G1	1	1	Same as above
QZSS L1C/A, L1C/B	1	1	Same as above
QZSS L1S	4	4	Same as above

## 1.3 Data Types

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

Message Type	Description
Input	Message input to the receiver
Output	Message output by the receiver
Input/Output	Message that can be input to and output by the receiver

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

### String (STR)

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

### 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 and 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 and 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 and -245278.

### Double-Precision Floating-Point Data (DOUBLE)

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

### Unsigned Long Integers (UINT64)

If the integer is hexadecimal, it has 16 characters at most (excluding the starting h or H).

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	$[-2^{31}, 2^{31}-1]$



Symbol	Type	Length (bit)	Range
U64	unsigned long long	64	[0, 2 <sup>64</sup> -1]
S64	signed long long	64	[-2 <sup>63</sup> , 2 <sup>63</sup> -1]
int17	17 bit 2's complement integer	17	[-2 <sup>16</sup> , 2 <sup>16</sup> -1]

## 1.4 Start Information

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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. For example:

Start Information	Description
UM760A-02 G1B1L1E1 COM1	Product name & output port
PN 2310414123456	Part number
SN OD12B5222400762	Serial number
HWVer 1.0	Hardware version
FWVer R7.0.0.0Build1111	Firmware version
Copyright (c), Unicore Communications Inc. All rights reserved.	Copyright information

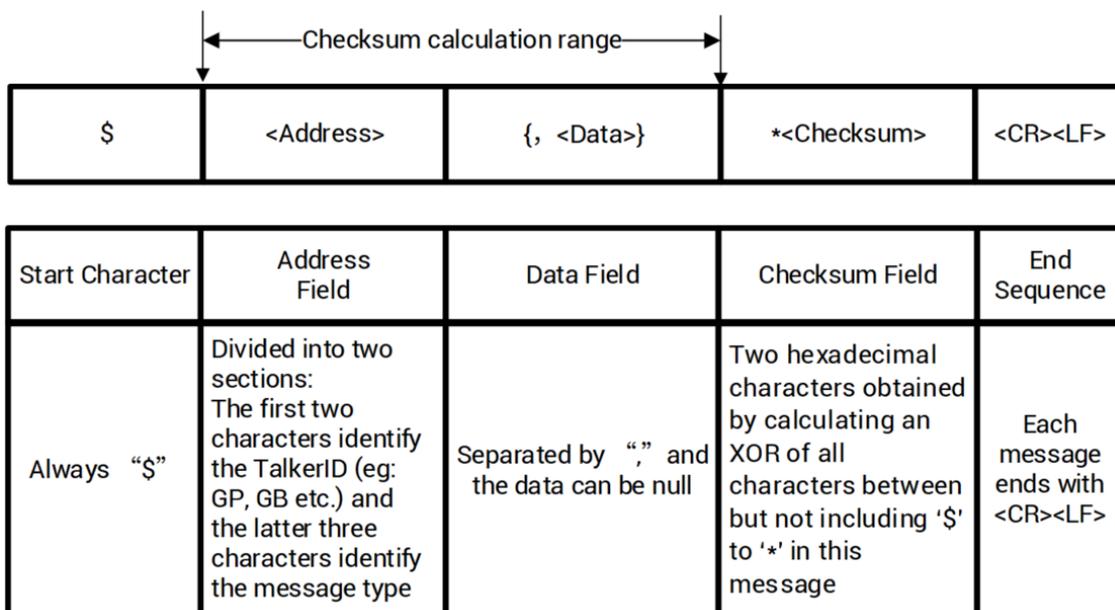
## 2 NMEA Messages

This chapter describes the NMEA V4.11 messages supported by Unicore receivers, including GGA, GLL, GSA, GSV, RMC, VTG, ZDA, GST, GBS, and DTM. See [Reference document \[2\]](#) for more information.

The GNSS/INS integrated positioning products support a secondary NMEA output. See [Secondary NMEA Output](#) for more information.

### 2.1 NMEA Message Structure

The following figure shows the structure of a NMEA message.



### 2.2 Standard NMEA Messages

#### 2.2.1 GGA

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$--GGA,time,Lat,N,Lon,E,FS,NoSV,HDOP,msl,M,Altref,M,DiffAge,DiffStatio n*cs
Example	\$GPGGA,060845.00,4004.74005,N,11614.19613,E,1,10,0.85,53.5,M,,M,,*7B
Description	GNSS positioning data
Input/ Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS 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 dd - Degree mm.mmmmm - Minute
N	STR	North or south latitude indicator N - North latitude S - South latitude
Lon	STR	Longitude; in the format of dddmm.mmmmm ddd - Degree mm.mmmmm - Minute
E	STR	East longitude or west longitude indicator: E - East longitude W - West longitude
FS	UINT	Positioning mode indicator: 0 - Invalid 1 - Single point positioning 2 - Differential positioning 4 - RTK fixed solution 5 - RTK float solution 6 - Dead reckoning
NoSV	UINT	Number of satellites in use
HDOP	DOUBLE	Horizontal dilution of precision; 2 decimal places; range: 0.00 to 99.99; outputs 99.99 when position is not available
msl	DOUBLE	Ellipsoidal height or geoid height; 1 decimal place
M	STR	Unit of ellipsoidal height or geoid height; fixed to M
Altref	DOUBLE	Geoidal separation; only valid when the geoidal separation function is enabled; 1 decimal place
M	STR	Unit of Geoidal separation; fixed to M

Parameter	Format	Description
DiffAge	DOUBLE	Age of differential data; unit: s; 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

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$--GLL,Lat,N,Lon,E,time,Valid,Mode*cs
Example	\$GPGLL,4004.74005,N,111614.19613,E,060845.00,A,A*6F
Description	Geographic position - Longitude/Latitude
Input/Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GN - Dual or multiple constellations joint positioning
Lat	STR	Latitude; in the format of ddmm.mmmmm: dd - Degree mm.mmmmm - Minute
N	STR	North or south latitude indicator: N - North latitude S - South latitude
Lon	STR	Longitude; in the format of dddmm.mmmmm ddd - Degree mm.mmmmm - Minute
E	STR	East longitude or west longitude indicator: E - East longitude W - West longitude
time	STR	UTC time; in the format of hhmmss.ss:

Parameter	Format	Description
		hh - Hour mm - Minute ss.ss - Second
Valid	STR	Position validity indicator: V - Invalid A - Valid
Mode	STR	Positioning mode indicator: N - No position fix A - Single Point positioning D - Differential positioning E - Dead reckoning
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

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	\$--GSA,Smode,FS,sv1,sv2,sv3,sv4,sv5,sv6,sv7,sv8,sv9,sv10,sv11,sv12,PD OP,HDOP,VDOP,systemID*cs
Example	\$GPGSA,A,3,02,03,06,09,12,17,19,23,28,25,,,1.34,0.85,1.04,1*1E
Description	GNSS dilution of precision and active satellites
Input/ Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS 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 - No position fix

Parameter	Format	Description
		2 - 2D positioning 3 - 3D positioning
sv1 to sv12	UINT	ID of satellites used in solution; when less than 12 satellites are used in solution, the insufficient area is filled in empty; when more than 12 satellites are used in solution, it only outputs the first 12 satellites; see <a href="#">Satellite Identifiers</a> for the satellite IDs
PDOP	DOUBLE	Position dilution of precision; range: 0.00 to 99.99; outputs 99.99 when position is not available
HDOP	DOUBLE	Horizontal dilution of precision; range: 0.00 to 99.99; outputs 99.99 when position is not available
VDOP	DOUBLE	Vertical dilution of precision; range: 0.00 to 99.99; outputs 99.99 when position is not available
systemID	UINT	GNSS system ID; see <a href="#">GNSS Identifiers</a>
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

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$--GSV,NoMsg,MsgNo,NoSv,sv1,elv1,az1,cno1,sv2,elv2,az2,cno2,sv3,elv3,az3,cno3,sv4,elv4,az4,cno4,signalID*cs
Example	\$GPGSV,3,01,11,02,34,277,41,03,16,043,35,05,04,215,35,06,69,333,48,0*57 \$GPGSV,3,02,11,09,25,110,41,12,31,305,43,17,55,116,46,19,76,088,46,0*56 \$GPGSV,3,03,11,23,23,077,40,25,04,328,32,28,05,171,36,0*67 \$GBGSV,3,01,12,01,37,145,42,02,34,225,39,03,44,188,42,04,25,123,37,0*4C \$GBGSV,3,02,12,05,17,249,36,06,30,169,38,07,03,188,31,08,69,027,43,0*4E \$GBGSV,3,03,12,09,09,186,34,10,15,211,36,12,26,306,40,13,60,316,44,0*48
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	Format	Description
--	STR	Positioning system flag GP - GPS/WAAS satellite information GB - BDS/BDS SBAS satellite information GA - GAL/EGNOS satellite information GL - GLO/SDCM satellite information
NoMsg	UINT	Total number of messages; 1 to 9
MsgNo	UINT	Message number (the order of this message); 1 to 9
NoSv	UINT	Total number of satellites in view
sv1 to sv4	UINT	Satellite ID numbers of the first to fourth satellite; see <a href="#">Satellite Identifiers</a> .
elv1 to elv4	UINT	Elevation of the first to fourth satellite; unit: deg; range: 0 to 90; outputs 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; outputs 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; outputs 2 digits; add leading zeros if less than 2 digits; null for untracked satellites
signalID	UINT	Signal ID defined by NMEA protocol; see <a href="#">Signal Identifiers</a> .
cs	STR	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

## 2.2.5 RMC

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	<code>\$--RMC,time,status,Lat,N,Lon,E,spd,cog,date,mv,mvE,mode,navStates*cs</code>
Example	<code>\$GPRMC,060845.00,A,4004.74005,N,11614.19613,E,0.000,,180817,,,A,V*0B</code>
Description	The recommended minimum data
Input/ Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning

Parameter	Format	Description
		GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS 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 validity indicator: V - Invalid A - Valid
Lat	STR	Latitude; in the format of ddmm.mmmmm: dd - Degree mm.mmmmm - Minute
N	STR	North or south latitude indicator: N - North latitude S - South latitude
Lon	STR	Longitude; in the format of dddmm.mmmmm ddd - Degree mm.mmmmm - Minute
E	STR	East longitude or west longitude indicator: E - East longitude W - West longitude
spd	DOUBLE	Speed over ground; unit: knot; 3 decimal places
cog	DOUBLE	Course over ground; unit: deg; 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; fixed to null
mvE	STR	Magnetic variation direction; fixed to null
mode	STR	Positioning mode: N - No position fix A - Single point positioning D - Differential positioning E - Dead reckoning

Parameter	Format	Description
		F - RTK floating solution R - RTK fixed solution
navStates	STR	Navigation states flag; fixed to '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

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	<b>\$--VTG,cogt,T,cogm,M,sog,N,kph,K,mode*cs</b>
Example	\$GPVTG,,T,,M,0.000,N,0.000,K,A*23
Description	Course over ground and ground speed
Input/Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GN - Dual or multiple constellations joint positioning
cogt	DOUBLE	Course over ground with reference to true north; unit: deg; range: 0.00 to 359.99
T	STR	Course flag; fixed to T
cogm	DOUBLE	Course over ground with reference to magnetic north; unit: deg; range: 0.00 to 359.99; fixed to null
M	STR	Course flag; fixed to M
sog	DOUBLE	Speed over ground; unit: knot; 3 decimal places
N	STR	Unit of speed; fixed to N
kph	DOUBLE	Speed over ground; unit: km/h; 3 decimal places
K	STR	Unit of speed; fixed to K

Parameter	Format	Description
mode	STR	Positioning mode: N - No position fix A - Single point positioning D - Differential positioning E - Dead reckoning
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

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$--ZDA,time,day,mon,year,ltzh,ltzn*cs
Example	\$GPZDA,060845.00,18,08,2017,00,00*6C
Description	Time and date
Input/Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS 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, two digits; range: 01 to 31
mon	UINT	UTC month, two digits; range: 01 to 12
year	UINT	UTC year, four digits
ltzh	UINT	Local zone hours; fixed to 00
ltzn	UINT	Local zone minutes; fixed to 00
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including

Parameter	Format	Description
		'\$' to '*' in this message

## 2.2.8 GST

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$--GST,time,rngRMS,stdMajor,stdMinor,hdg,stdLat,stdLon,stdAlt*cs
Example	\$GNGST,062516.40,0.6,0.1,0.1,113.2,0.5,0.6,1.0*4E
Description	GNSS pseudorange error statistics
Input/Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS 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; 1 decimal place
stdMajor	DOUBLE	Standard deviation of semi-major axis of the error ellipse; unit: m; 1 decimal place
stdMinor	DOUBLE	Standard deviation of semi-minor axis of the error ellipse; unit: m; 1 decimal place
hdg	DOUBLE	Orientation of semi-major axis of the error ellipse; unit: deg; clockwise from north; 1 decimal place
stdLat	DOUBLE	Standard deviation of latitude error; unit: m; 1 decimal place
stdLon	DOUBLE	Standard deviation of longitude error; unit: m; 1 decimal place
stdAlt	DOUBLE	Standard deviation of altitude error; unit: m; 1 decimal place
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not

Parameter	Format	Description
		including '\$' to '*' in this message

## 2.2.9 GBS

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$--GBS,time,errLat,errLon,lon,errAlt,Svid,Prob,Bias,Std,systemID*cs
Example	\$GPGBS,121314.00,0.5,0.6,0.9,03,,100.4,5.0,1,0*5C
Description	RAIM error information
Input/Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS 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; 1 decimal place
errLon	DOUBLE	Longitude error; unit: m; 1 decimal place
errAlt	DOUBLE	Altitude error; unit: m; 1 decimal place
Svid	UINT	ID number of most likely failed satellite; outputs 2 digits
Prob	DOUBLE	Probability of missed detection for most likely failed satellite; fixed to null
Bias	DOUBLE	Estimation error of the most likely failed satellite; fixed to null
Std	DOUBLE	Standard deviation of the estimation error; fixed to null
systemID	UINT	GNSS system ID; see <a href="#">GNSS Identifiers</a>
signalID	UINT	Signal ID defined by NMEA protocol; see <a href="#">Signal Identifiers</a> .
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not

Parameter	Format	Description
		including '\$' to '*' in this message

## 2.2.10 DTM

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$--DTM,datCod,subCod,latOff,N,lonOff,E,altOff,refDatCod *cs
Example	\$GPDTM,W84,,0.0,N,0.0,W,0.0,W84*7D
Description	Datum reference
Input/Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GN - Dual or multiple constellations joint positioning
datCod	STR	Local datum code: W84 - WGS84 W72 - WGS72 S85 - SGS85 P90 - PE90 999 - User defined IHO datum code
subCod	STR	Local datum subdivision code: One character subdivision datum code when available or user defined reference character for user defined datums, null field otherwise.
latOff	DOUBLE	Latitude offset; unit: minutes; 1 decimal place
N	STR	Latitude indicator N - North latitude S - South latitude
lonOff	DOUBLE	Longitude offset; unit: minutes; 1 decimal place
E	STR	Longitude indicator E - East longitude W - West longitude
altOff	DOUBLE	Altitude offset; unit: meters; 1 decimal place

Parameter	Format	Description
refDatCod	STR	Reference data code W84 – WGS-84 W72 – WGS-72 S85 – SGS85 P90 – PE90
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

## 2.3 Secondary NMEA Output

Applicable to: UM761 series

The secondary NMEA output is applicable to GNSS/INS integrated positioning products for providing GNSS-only positioning results. Each message begins with a TAG BLOCK `\s:1*78\` followed by a standard NMEA sentence. For example, the secondary output format for a GGA sentence is:

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

### TAG BLOCK Description

Parameter	Format	Description
tagStart	STR	TAG BLOCK start character, fixed to '\'
parameter-code	STR	Parameter code, fixed to 's:', meaning source identification
value	UINT	Parameter value, fixed to '1', meaning the secondary 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, fixed to '\'

To enable the secondary NMEA output, you need to configure the CFGINS mode to 2 - Vehicle-mounted mode (dual-engine). See [CFGINS](#) for more information.

## 2.4 Unicore-Extended NMEA Messages

### 2.4.1 PUNICORE

Applicable to: UC7510 series

This message is supported by specific firmware.

<b>Syntax</b>	\$PUNICORE,msgID,time,lat,NS,long,EW,altRef,navStat,hAcc,vAcc,SOG,COG,vVel,diffAge,HDOP,VDOP,TDOP,numSvs,reserved,DR,*cs
<b>Example</b>	\$PUNICORE,00,040716.00,3540.75015,N,13941.30718,E,68.240,1,18.2,35.9,1.386,-0.000,,2.66,6.64,6.47,13,0,0*12
<b>Description</b>	Position-related information defined by Unicore.
<b>Input/Output</b>	Output

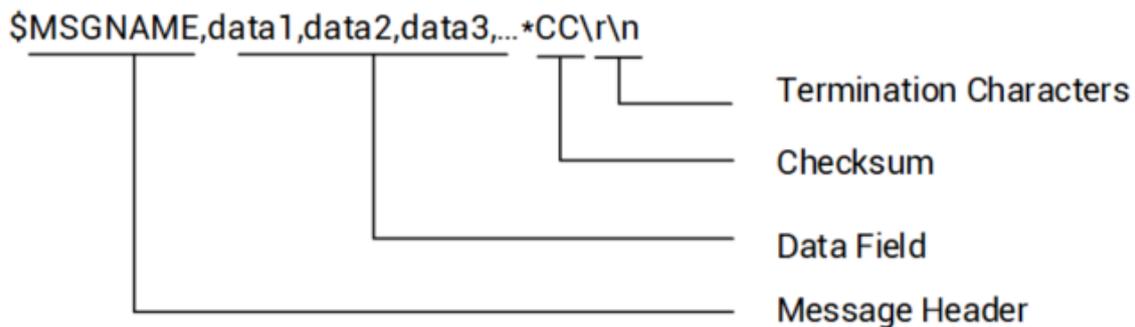
Parameter	Format	Description
msgID	INT	Message ID, 00
time	STR	UTC time; in the format of hhmmss.ss hh – Hour mm – Minute ss.ss – Second
lat	STR	Latitude; in the format of ddmm.mmmmm dd – Degree mm.mmmmm – Minute
NS	STR	North or south latitude indicator N – North latitude S – South latitude
long	STR	Longitude; in the format of dddmm.mmmmm ddd – Degree mm.mmmmm – Minute
EW	STR	East longitude or west longitude indicator: E – East longitude W – West longitude
altRef	DOUBLE	Ellipsoidal height; unit: m; 3 decimal places; null when unknown

Parameter	Format	Description
navStat	UINT	Positioning mode indicator: 0 – Invalid 1 – Single point positioning 2 – Differential positioning 4 – RTK fixed solution 5 – RTK float solution 6 – Dead reckoning
hAcc	DOUBLE	Horizontal accuracy estimate; unit: m; 1 decimal place; range: 0 ~ 5303301.0
vAcc	DOUBLE	Vertical accuracy estimate; unit: m; 1 decimal place; range: 0 ~ 3750000.0
SOG	DOUBLE	Horizontal speed over ground; unit: km/h; 3 decimal places; null when unknown
COG	DOUBLE	Course over ground, clockwise from north; unit: deg; 2 decimal places; null when unknown
vVel	DOUBLE	Vertical speed, positive: down; unit: m/s; 3 decimal places
diffAge	DOUBLE	Age of differential data; unit: s; 1 decimal place; null for non-differential positioning
HDOP	DOUBLE	Horizontal dilution of precision; range: 0.00 ~ 99.99; outputs 99.99 when position is not available
VDOP	DOUBLE	Vertical dilution of precision; range: 0.00 ~ 99.99; outputs 99.99 when position is not available
TDOP	DOUBLE	Time dilution of precision; range: 0.00 ~ 99.99; outputs 99.99 when position is not available
numSvs	UINT	Number of satellites used in positioning solution
reserved	UINT	Reserved, outputs 0
DR	UINT	Whether DR is used: 0 – No 1 – Yes
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

## 3 Unicore Messages

### 3.1 Message Introduction

The basic format of the Unicore message is:



All messages contain the following parts:

- Message header, starting with '\$' (0x24).
- Data fields, consisting of a number of parameters, with the adjacent data separated by a delimiter ',' (0x2C).
- Checksum, separated from the previous data by '\*' (0x2A).
- Termination characters.

Input messages end with '\r' (0x0D) or '\n' (0x0A) or any combination of the two.

Output messages end with '\r\n'.

In the following tables, the termination characters for input and output messages are omitted.

Letters in the message headers, parameters, and checksums 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) are the checksum, which is the XOR of all characters (excluding '\$' and '\*') from '\$' to '\*' in hexadecimal.

The checksum for the input messages is optional. If the input message contains '\*' followed by two characters, the checksum will be examined. If it is wrong, the command will not be executed, and the receiver will output the \$FAIL message to indicate a checksum error. If the message does not contain a checksum, the command will be executed directly.

The output messages always contain a checksum (except for OSNMA).

## 3.2 General Messages

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### 3.2.1 PDTINFO: Product Information Inquiry

Applicable to: UC7510 series, UM760 series, UM761 series

#### Read Product Information

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

#### Output Product Information

Syntax	\$PDTINFO,pdtName,config,hwVer,fwVer,PN,SN*cs
Example	\$PDTINFO,UM760A-02,G1B1L1E1,V1.0,R7.0.0Build11111,2310414123456,OD12B5222400762*4A
Description	The receiver outputs product information.
Input/ Output	Output

Parameter	Format	Description
pdtName	STR	Product model
config	STR	Flag of satellite system: Gx - GPS Bx - BDS Lx - GLONASS Ex - Galileo 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: UC7510 series, UM760 series, UM761 series

#### 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
Parameter	No parameter

#### Output Complete Product Information

Syntax	\$PRODUCTINFO,pdtName,config,hwVer,fwVer,PN,SN,PTV,RSV,RSV,RSV,RSV*cs
Example	\$PRODUCTINFO,UM760A-02,G1B1L1E1,V1.0,R7.0.0.0Build1111,2310414123456,000101114303845,R1.1,,,,*21

<b>Syntax</b>	\$PRODUCTINFO,pdtName,config,hwVer,fwVer,PN,SN,PTV,RSV,RSV,RSV,RSV*cs
Description	The receiver outputs complete product information.
Input/ Output	Output

Parameter	Format	Description
pdtName	STR	Product model
config	STR	Flag of satellite system: Gx - GPS Bx - BDS Lx - GLONASS Ex - Galileo 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)
PTV	STR	Protocol version
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: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	\$RESET,type,clrMask
Example	\$RESET,0,h01 (warm start)
Description	Receiver reset

Syntax	\$RESET,type,clrMask
Input/Output	Input

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 inertial navigation parameters (applicable to DR products) bit4 - Clear ionosphere correction parameters and UTC parameters bit5 - Reserve2 bit6 - Reserve3 bit7 - Clear almanac Three common start methods: H00 - Hot start H01 - Warm start H85/HFF - Cold start <sup>1</sup>

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

<sup>1</sup> Use H85 or HFF (recommended) for cold start. An incorrect parameter can cause the receiver to start in a wrong state.

### 3.2.4 OK: Message Response Mechanism

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$OK*cs
Example	\$OK*04

<b>Syntax</b>	<b>\$OK*cs</b>
Description	A response that the receiver executed the command correctly. This message only outputs at the port receiving the command.
Input/ Output	Output

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: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	<b>\$FAIL,errorCode*cs</b>
Example	\$FAIL,0*1E
Description	A response that the parameters or the checksum in the input command is incorrect. No response to illegal commands. This message only outputs at the port receiving the command.
Input/ Output	Output

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

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### 3.3.1 CFGPRT: Configure Output Port

Applicable to: UC7510 series, UM760 series, UM761 series

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	Format	Description
portID	UINT	Port number: 0, 1, 4

### Set/Output Port Configuration

Syntax	\$CFGPRT,portID,addr,baud,inPro,outPro
Example	\$CFGPRT,1,0,115200,H581,HA3
Description	Set or output the port configuration.
Input/Output	Input/output

Parameter	Format	Description
portID	UINT	Port number: 0 - I2C* 1 - UART1 2 - reserved 3 - reserved 4 - SPI* If empty, configure the current port.
addr	UINT	UART - fixed at 0 or null I2C - slave address <sup>1</sup> ; fixed at 0x46 when inquiring and null when configuring, otherwise returns FAIL.
baud	UINT	For UART, the baud rate could be set as: 9600/14400/19200/38400/57600/115200/230400/460800/921600 For I2C, the parameter is null when inquiring and configuring, otherwise returns FAIL.
inPro	UINT	Port input protocol; set the corresponding bit to 1 to enable: bit0 - UNICORE bit7 - RTCM3.3 (compatible with RTCM3.2) bit8 - ODODATA input protocol (applicable to UM761 series) bit10 - MAPFB input protocol (applicable to UM761 series)
outPro	UINT	Port output protocol; set the corresponding bit to 1 to enable:

Parameter	Format	Description
		bit0 - UNICORE bit1 - NMEA bit2 - RTCM3.3 (compatible with RTCM3.2) bit5 - Notice messages bit7 - Extended RTCM 4074_DR messages (applicable to UM761 series) bit8 - Extended RTCM 4074_GNSS messages (applicable to UC7510 series, UM760 series, and UM761 series)

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 may cause an abnormal command receiving and returns FAIL.

\* I2C and SPI interfaces require specific firmware support and are not available on DR products. If your firmware does not support I2C and SPI, this message will return \$FAIL,0\*1E when you set or make an inquiry.

<sup>1</sup> The default address of I2C slave is 0x46 which cannot be changed via commands.

### 3.3.2 CFGMSG: Configure Message Output Frequency

Applicable to: UC7510 series, UM760 series, UM761 series

#### 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	Format	Description
msgClass	UINT	Message class; see the table <a href="#">Message Class and ID</a> below
msgID	UINT	Message ID; see the table <a href="#">Message Class and ID</a> below

## Set/Output Message Output Frequency

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

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

## Message Class and ID

Standard NMEA Messages	Class	ID	Rate
GGA	0: Configure three ports or query the current port 100: NMEA messages at I2C port 200: NMEA messages at UART1 port	0	1000/NavRate/ Output frequency
GLL		1	
GSA		2	
GSV		3	

RMC	400: NMEA messages at SPI port	4	
VTG		5	
ZDA		6	
GST		7	
GBS		8	
DTM		10	
<b>Sensor Fusion Messages<sup>1</sup></b>	<b>Class</b>	<b>ID</b>	<b>Rate</b>
GYOACC	4: Configure three ports or query the current port 104: Sensor fusion messages at I2C port 204: Sensor fusion messages at UART1 port 404: Sensor fusion messages at SPI port	0	
SNRSTAT		1	1000/DRNavRate/ Output frequency
SNRSTATEX		9	
NAVATT		2	
IMURAW		3	1000/IMUMeasRate/ Output frequency
INSPVA		4	1000/DRNavRate/ Output frequency
IMUVEH		5	1000/IMUMeasRate/ Output frequency
<b>Misc Messages</b>	<b>Class</b>	<b>ID</b>	<b>Rate</b>
CWOUT <sup>2</sup>	5: Configure three ports or query the current port 105: Misc messages at I2C port 205: Misc messages at UART1 port 405: Misc messages at SPI port	0	0 - disable; 1 - enable
OSNMA <sup>3</sup>		1	0 - disable; 1 - enable
QZQSM <sup>2</sup>		2	0 - disable; 1 - enable
<b>Notice Messages</b>	<b>Class</b>	<b>ID</b>	<b>Rate</b>
General Notice Messages	6: Configure three ports or query the current port 106: Notice messages at I2C port 206: Notice messages at UART1 port 406: Notice messages at SPI port	0	1000/NavRate/ Output frequency
Notice Message Package		1	
Command Echo		2	0 - disable; 1 - enable

ANTSTAT <sup>2</sup>		3	0 - disable; 1 - enable
Ephemeris Lacking		4	0 - disable; 1 - enable
Data Incomplete		5	0 - disable; 1 - enable
<b>Secondary NMEA Output<sup>1</sup></b>	<b>Class</b>	<b>ID</b>	<b>Rate</b>
GGA	7: Configure three ports or query the current port 107: Secondary NMEA Output at I2C port 207: Secondary NMEA Output at UART1 port 407: Secondary NMEA Output at SPI port	0	1000/NavRate/ Output frequency
GLL		1	
GSA		2	
GSV		3	
RMC		4	
VTG		5	
ZDA		6	
GST		7	
GBS		8	
DTM		10	
<b>Extended RTCM Messages<sup>1</sup></b>		<b>Class</b>	
GYOACC	8: Configure three ports or query the current port 108: Observation messages at I2C port 208: Observation messages at UART1 port 408: Observation messages at SPI port	0	1000/DRNavRate/ Output frequency
SNRSTAT		1	
SNRSTATEX		9	
NAVATT		2	1000/IMUMeasRate/ Output frequency
IMURAW		3	
INSPVA		4	1000/DRNavRate/ Output frequency
IMUVEH		5	1000/IMUMeasRate/ Output frequency
DR Protection Level Information		6	0 - disable; 1 - enable, rate =

		ID	Rate
			1000/NavRate
Extended RTCM Messages	Class	ID	Rate
Receiver Information	9: Configure three ports or query the current port 109: Observation messages at I2C port 209: Observation messages at UART1 port 409: Observation messages at SPI port	1	1000/MeasRate/ Output frequency
Signal Information		2	
ANTSTAT		6	
Leap Second Message		7	
Jamming and Spoofing Detection		8	
Protection Level Information		11	0 - disable; 1 - enable, rate = 1000/NavRate
Unicore-Extended NMEA Messages	Class	ID	Rate
PUNICORE	24: Configure three ports or query the current port 124: Unicore-Extended NMEA messages at I2C port 224: Unicore-Extended NMEA messages at UART1 port 324: Unicore-Extended NMEA messages at UART2 port 424: Unicore-Extended NMEA messages at SPI port	0	1000/NavRate/ Output frequency

See section [CFGNAV](#) for the information of NavRate, MeasRate and DRNavRate, and section [CFGIMUMEAS](#) for IMUMeasRate.

<sup>1</sup> Supported by UM761 series only.

<sup>2</sup> Output at constant 1 Hz.

<sup>3</sup> Output at constant 0.5 Hz only when there is no error code in GALILEO messages.

### 3.3.3 CFGNMEA: Read NMEA Configuration

Applicable to: UC7510 series, UM760 series, UM761 series

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
Parameter	No parameter

### 3.3.4 CFGNAV: Configure Positioning Frequency

Applicable to: UC7510 series, UM760 series, UM761 series

#### 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
Parameter	No parameter

#### 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	Format	Description
MeasRate <sup>1</sup>	UINT	Observation interval; unit: ms; 1000 - 1 Hz observation frequency 200 - 5 Hz observation frequency

Parameter	Format	Description
		100 - 10 Hz observation frequency
NavRate	UINT	GNSS positioning interval; unit: ms; 1000 - 1 Hz GNSS positioning frequency 200 - 5 Hz GNSS positioning frequency 100 - 10 Hz GNSS positioning frequency
DRNavRate	UINT	INS positioning interval; unit: ms; 100 - 10 Hz INS positioning frequency 50 - 20 Hz INS positioning frequency 20 - 50 Hz INS positioning frequency This field is valid only for integrated navigation products. For non-integrated navigation products, it should be configured as 0, and a query will also return 0.

When the GNSS positioning frequency is 10 Hz, CFGINS cannot be configured to 2 - Vehicle-mounted mode to enable a secondary NMEA output.

After the configuration of NavRate is finished, GSV will be reset to output at 1 Hz.

After the configuration of DRNavRate is finished, SNRSTAT will be reset to output at 1 Hz.

<sup>1</sup> MeasRate and NavRate must be the same, otherwise a FAIL message will be returned.

### 3.3.5 CFGSYS: Configure Satellite System

Applicable to: UC7510 series, UM760 series, UM761 series

#### Read Satellite System Configuration

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

### Set/Output Satellite System Configuration

<b>Syntax</b>	\$CFGSYS,sysMask
Example	\$CFGSYS,h191111
Description	Set or output satellite system and frequency configuration. The receiver resets automatically after receiving this command, and the enabled frequencies take effect after the reset.
Input/ Output	Input/output

Parameter	Format	Description
sysMask	UINT	Enable frequencies; set the corresponding bit to 1 to enable: bit0 - GPS L1CA bit3 - GPS L1C (reserved) bit4 - BDS B1I bit7 - BDS B1C bit8 - GLONASS L1 bit12 - GALILEO E1 bit16: - QZSS L1CA bit19 - QZSS L1S bit20 - SBAS

The reserved bit is fixed to 0.

SBAS can only function when its corresponding primary system or GPS is enabled..

### 3.3.6 CFGGEOID: Configure Height

Applicable to: UC7510 series, UM760 series, UM761 series

#### Read Height Configuration

<b>Syntax</b>	\$CFGGEOID
Example	\$CFGGEOID
Description	Read the current height configuration. The receiver outputs the CFGGEOID message after receiving this command.
Input/ Output	Input

<b>Syntax</b>	<b>\$CFGGEOID</b>
Parameter	No parameter

### Set/Output Height Configuration

<b>Syntax</b>	<b>\$CFGGEOID,Model</b>
Example	\$CFGGEOID,1
Description	Set or output the height configuration.
Input/Output	Input/output

Parameter	Format	Description
Model	UINT	0 - Output the ellipsoidal height 1 - Output the geoid height

## 3.3.7 CFGSAVE: Save the Configuration

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	<b>\$CFGSAVE</b>
Example	\$CFGSAVE
Description	Save the current configuration to the memory.
Input/Output	Input
Parameter	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.

## 3.3.8 CFGCLR: Clear the Configuration

Applicable to: UC7510 series, UM760 series, UM761 series

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

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

### 3.3.9 AIDTIME: Configure Assistance Time

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	<b>\$AIDTIME,year,month,day,hour,minute,second,millisecond</b>
Example	\$AIDTIME,2018,4,9,17,41,36,200
Description	Input the assistance time, UTC time
Input/Output	Input

Parameter	Format	Description
year	UINT	Year
month	UINT	Month
day	UINT	Day
hour	UINT	Hour
minute	UINT	Minute
second	UINT	Second
millisecond	UINT	Millisecond

### 3.3.10 AIDPOS: Configure Assistance Position

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	<b>\$AIDPOS,Latitude,N,Longitude,E,altitude</b>
Example	\$AIDPOS,4002.229934,N,11618.096855,E,37.254
Description	Input the assistance position

<b>Syntax</b>	<b>\$AIDPOS,Latitude,N,Longitude,E,altitude</b>
Input/Output	Input

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

### 3.3.11 AIDINFO: Configure Assistance Information

Applicable to: UC7510 series, UM760 series, UM761 series

#### Read Assistance Information

<b>Syntax</b>	<b>\$AIDINFO</b>
Example	\$AIDINFO
Description	Read the assistance information. The receiver outputs AIDINFO message after receiving this command.
Input/Output	Input
Parameter	No parameter

#### Output Assistance Information

<b>Syntax</b>	<b>\$AIDINFO,GPSRS,GPSUS,BDSRS,BDSUS,GALRS,GALUS,GLORS,GLOUS,IRNRS,IRNUS,AType*cs</b>
Example	\$AIDINFO,H003FFFFFFF7,H000000FA00,H0000003F7F,H0000001A3F,

<b>Syntax</b>	\$AIDINFO,GPSRS,GPSUS,BDSRS,BDSUS,GALRS,GALUS,GLORS,GLOUS,IRNRS,IRNUS,AType*cs
	H0000000000,H0000000000,H0000000000,H0000000000,,,H0000000F*52
<b>Description</b>	Output the status and types of the assistance information
<b>Input/Output</b>	Output

<b>Parameter</b>	<b>Format</b>	<b>Description</b>
GPSRS	UINT64	Receiving status of the GPS ephemeris; set the corresponding bit to 1 as long as the received data pass the verification; Null when GPS is not enabled
GPSUS	UINT64	Set the corresponding bit to 1 when GPS ephemeris is effective and can be used in positioning; Null when 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; Null when BDS is not enabled.
BDSUS	UINT64	Set the corresponding bit to 1 when BDS ephemeris is effective and can be used in positioning; Null when 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; Null when GAL system is not enabled.
GALUS	UINT64	Set the corresponding bit to 1 when GAL ephemeris is effective and can be used in positioning; Null when 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; Null when GLO system is not enabled
GLOUS	UINT64	Set the corresponding bit to 1 when GLO ephemeris is effective and can be used in positioning; Null when GLO system is not enabled.
RSV	/	Reserved

Parameter	Format	Description
RSV	/	Reserved
Atype	UINT	Assistance type: Bit 0:4 - Corresponding to the GPS/BDS/GAL/GLO assistance ephemeris respectively Bit 5 - Assistance position valid Bit 6 - Using the assistance position Bit 7:8 - Reserved Bit 9 - Assistance time valid Bit 10 - Using the assistance 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

### 3.3.12 CFGTP: Configure PPS

Applicable to: UC7510 series, UM760 series, UM761 series

#### 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	No parameter

#### 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	Format	Description
interval	UINT	Time pulse frequency; unit: $\mu$ s; supports: 1000000, 500000, 200000, 100000

Parameter	Format	Description
length	UINT	Time pulse width; unit: $\mu\text{s}$ ; 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 after the position fix is stable 1 - Output on startup of 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

### 3.3.13 CFGKILOWEEK: Configure GPS Epoch

Applicable to: UC7510 series, UM760 series, UM761 series

#### Read GPS Week Number When Epoch Begins

<b>Syntax</b>	<b>\$CFGKILOWEEK</b>
Example	\$CFGKILOWEEK
Description	Read the GPS week number when the epoch begins.
Input/Output	Input
Parameter	No parameter

#### Set/Output GPS Week Number When Epoch Begins

<b>Syntax</b>	<b>\$CFGKILOWEEK,GpsStartWeekNum</b>
Example	\$CFGKILOWEEK,2243
Description	Read/Output the GPS week number when the epoch begins

<b>Syntax</b>	<b>\$CFGKILOWEEK,GpsStartWeekNum</b>
Input/Output	Input/Output

Parameter	Format	Description
GpsStartWeekNum	UINT	The week number at the beginning of the epoch

### 3.3.14 CFGLEAPSEC: Configure Leap Second

Applicable to: UC7510 series, UM760 series, UM761 series

#### Read Leap Second Configuration

<b>Syntax</b>	<b>\$CFGLEAPSEC</b>
Example	\$CFGLEAPSEC
Description	Read the leap second configuration
Input/Output	Input
Parameter	No parameter

#### Set/Output Leap Second

<b>Syntax</b>	<b>\$CFGLEAPSEC,DefaultMode,NavBitsEnable,GpsLeapSec,BdsLeapSec,Gal LeapSec,RSV</b>
Example	\$CFGLEAPSEC,0,1,18,4,18,0
Description	Set/Output leap second configuration. The leap second parameters set by the user for GPS, BDS, and Galileo systems only take effect when DefaultMode is configured to 1.
Input/Output	Input/Output

Parameter	Format	Description
DefaultMode	UINT	0 - Firmware default 1 - User settings 2 - Automatic
NavBitsEnable	UINT	0 - Do not use the leap second parsed from the navigation message 1 - Use the leap second parsed from the navigation message

Parameter	Format	Description
GpsLeapSec	UINT	GPS leap second set by user
BdsLeapSec	UINT	BDS leap second set by user
GalLeapSec	UINT	GAL leap second set by user
RSV	/	Reserved

### 3.3.15 CFGDYN: Configure Lock Point

Applicable to: UC7510 series, UM760 series, UM761 series

#### Read Lock Point Configuration

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

#### 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	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.

### 3.3.16 CFGFWCHECK: Configure Firmware Check

Applicable to: UC7510 series, UM760 series, UM761 series

#### Configure Random Number

<b>Syntax</b>	<b>\$CFGFWCHECK,CRCIN</b>
Example	\$CFGFWCHECK,HAE1206
Description	Configure the random number for the firmware check.
Input/Output	Input

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 (64 hexadecimal characters at most).

#### Output Integrity Check Value

<b>Syntax</b>	<b>\$CFGFWCHECK,CRCOUT*cs</b>
Example	\$CFGFWCHECK,H3E9E7680*72
Description	Output the check code.
Input/Output	Output

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

### 3.3.17 CFGLOGLIST: Configure LOGLIST Information

Applicable to: UC7510 series, UM760 series, UM761 series

#### Read LOGLIST Information

<b>Syntax</b>	<b>\$CFGLOGLIST,portID</b>
Example	\$CFGLOGLIST,1
Description	Read LOGLIST information.

<b>Syntax</b>	\$CFGLOGLIST,portID
	The receiver outputs the LOGLIST message of the corresponding port after receiving this command.
Input/ Output	Input

Parameter	Format	Description
portID	UINT	Port ID: 0, 1, 4

### Output LOGLIST Information

<b>Syntax</b>	\$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	Format	Description
LOGLIST	STR	Header
NoMsg	UINT	Total number of the LOGLIST messages; minimum value: 1
MsgNo	UINT	The LOGLIST message number; minimum value: 1
NoSv	UINT	Total number of msg configurations
msgClassX	UINT	Message class; outputs maximum 8 classes; see section <a href="#">CFGMSG</a>
msgIDX	UINT	Message ID; see section <a href="#">CFGMSG</a>
rateX	UINT	Message output rate; see section <a href="#">CFGMSG</a>
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

### 3.3.18 CFGACC: Configure Awakening Command

Applicable to: UM761 series

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

#### 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 this command.
Input/Output	Input
Parameter	No parameter

#### 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	Format	Description
accthreshold	UINT	Configure the accelerometer threshold under the awakening mode; unit: mg; range: 0 to 1500
modeenable	UINT	Enable or disable the awakening function: 0 - Disable 1 - Enable

### 3.3.19 CFGODOFWD: Configure Direction Signal

Applicable to: UM761 series

#### Read Direction Signal Configuration

Syntax	\$CFGODOFWD
Example	\$CFGODOFWD

<b>Syntax</b>	<b>\$CFGODOFWD</b>
Description	Read the configuration of odometer's direction signal
Input/Output	Input
Parameter	No parameter

#### Set/Output Direction Signal Configuration

<b>Syntax</b>	<b>\$CFGODOFWD,FWD</b>
Example	\$CFGODOFWD,1
Description	Set or output the odometer's direction signal in the integrated navigation module.
Input/Output	Input/Output

Parameter	Format	Description
FWD	UINT (optional)	Mode configuration: 0 - Low level forward; high level backward 1 - High level forward; low level backward

### 3.3.20 CFGINS: Configure Integrated Navigation

Applicable to: UM761 series

#### Read Integrated Navigation Configuration

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

#### Set/Output Integrated Navigation Configuration

<b>Syntax</b>	<b>\$CFGINS,mode,ImusrcType,OdosrcType,MapsrcType</b>
Example	\$CFGINS,1,1,1,1
Description	Set or output the integrated navigation mode and IMU input.
Input/Output	Input/Output

Parameter	Format	Description
mode	UINT (Optional)	Mode configuration: 0 - Disable the integrated navigation. The output NMEA messages only contain 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
MapsrcType	UINT (Optional)	0 - Disable map input 1 - Map-matching information input from an external port

### 3.3.21 CFGIMUMEAS: Configure IMU Measurement Interval

Applicable to: UM761 series

#### Read IMU measurement Interval Configuration

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

### Set/Output IMU measurement Interval Configuration

<b>Syntax</b>	<b>\$CFGIMUMEAS,IMUMeasRate</b>
Example	\$CFGIMUMEAS,10
Description	Configure IMURAW measurement output rate
Input/Output	Input/Output

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

### 3.3.22 CFGROTAT: Configure Installation Angle

Applicable to: UM761 series

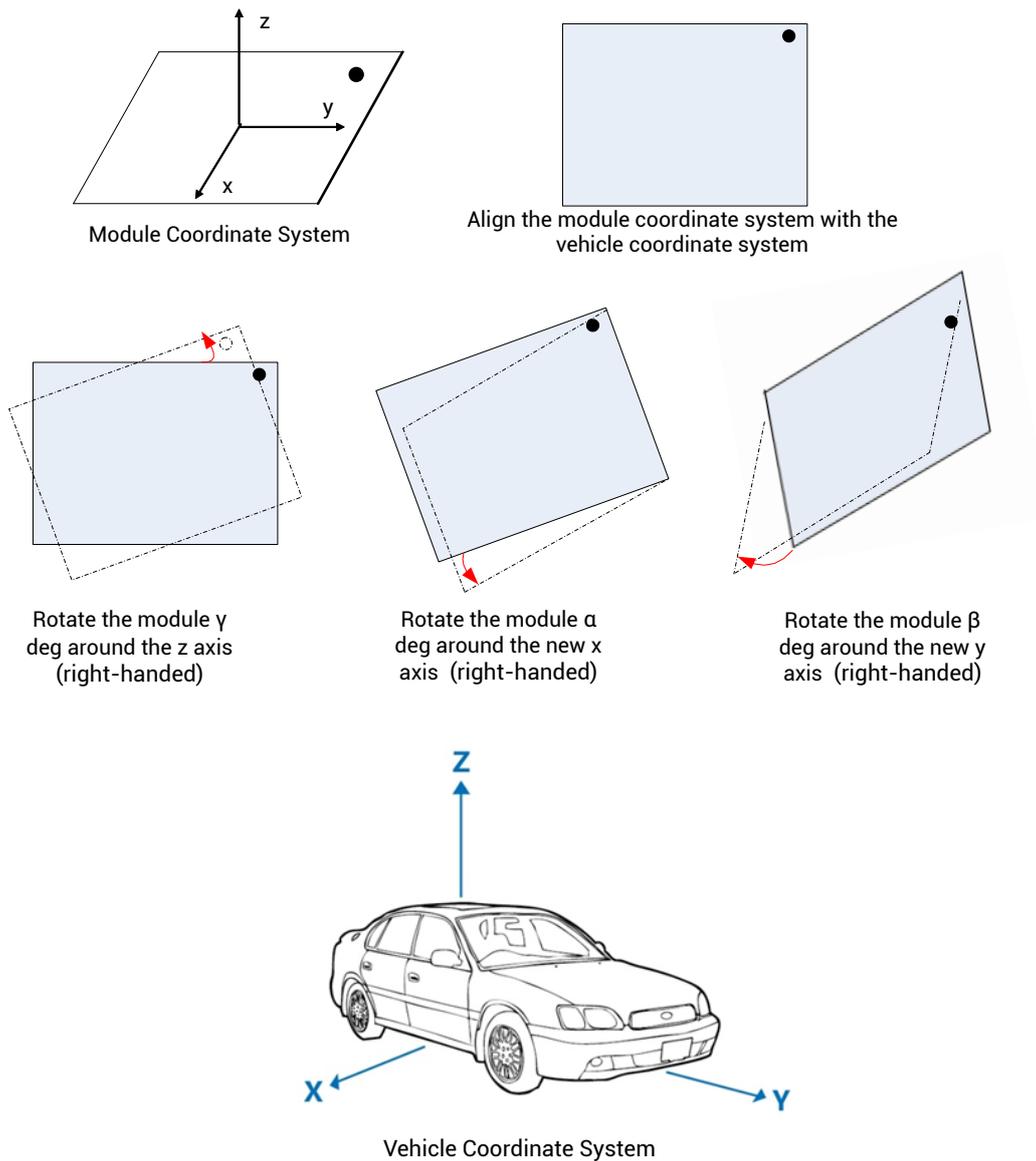
#### Read Configuration of Installation Angle

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

#### Set/Output Configuration of Installation Angle

<b>Syntax</b>	<b>\$CFGROTAT,angleX,angleY,angleZ,mode</b>
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	Format	Description
angleX	UINT (Optional)	Rotation angle of the module X axis relative to the vehicle body coordinate X axis (right-handed); unit: 1e-2 deg; range: 0 to 36000
angleY	UINT (Optional)	Rotation angle of the module Y axis relative to the vehicle body coordinate Y axis (right-handed); unit: 1e-2 deg; range: 0 to 36000
angleZ	UINT (Optional)	Rotation angle of the module Z axis relative to the vehicle body coordinate Z axis (right-handed); unit: 1e-2 deg; range: 0 to 36000
mode	UINT (Optional)	Configuration mode of the installation angle: 0 - General installation mode; the accuracy of the 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



### 3.3.23 CFGCOG: Configure Heading Angle

Applicable to: UM761 series

#### Read Configuration of Heading Angle

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

## Set/Output Configuration of Heading Angle

<b>Syntax</b>	<b>\$CFGCOG,mode</b>
Example	\$CFGCOG,0
Description	Set or output heading angle configuration
Input/Output	Input/Output

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

When the mode is set to "1 – Heading angle is aligned with the driving direction", the vehicle's heading angle varies according to the forward or reverse motion, as shown in the figure below. The details are explained as follows:

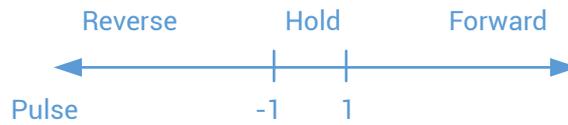
### 1. If the GNSS module is connected to an odometer:

- (1) When the vehicle moves forward with the odometer pulse count greater than 1, the heading angle is the clockwise angle from true north to the forward direction.
- (2) When the vehicle reverses with the odometer pulse count greater than 1, the heading angle is the clockwise angle from true north to the reverse direction.
- (3) When the odometer pulse count is 1 or lower, regardless of moving forward or reversing, the heading angle remains in a hold state, retaining the last calculated heading when the pulse count was greater than 1.

### 2. If the GNSS module is not connected to an odometer:

- (1) When the vehicle moves forward at a speed greater than 0.5 m/s, the heading angle is the clockwise angle from true north to the forward direction.
- (2) When the vehicle reverses at a speed greater than 0.5 m/s, the heading angle is the clockwise angle from true north to the reverse direction.
- (3) When the vehicle speed is 0.5 m/s or lower, regardless of moving forward or reversing, the heading angle remains in a hold state, retaining the last calculated heading when the speed was greater than 0.5 m/s.

Odometer Connected:



No Odometer Connected:



### 3.3.24 CFGGLARM: Configure the GNSS Lever Arm

Applicable to: UM761 series

#### Read GNSS Lever Arm Configuration

Syntax	\$CFGGLARM
Example	\$CFGGLARM
Description	Read the lever arm configuration used in GNSS navigation.
Input/Output	Input
Parameter	No parameter

#### Set/Output GNSS Lever Arm Configuration

Syntax	\$CFGGLARM,flag,AntlStX,AntlStY,AntlStZ,ImulStX,ImulStY,ImulStZ
Example	\$CFGGLARM,1,12,19,33,123,-18,90
Description	Set or output the lever arm configuration used in GNSS navigation.
Input/Output	Input/Output

Parameter	Format	Description
flag	UINT (optional)	Validity flag of GNSS lever arm configuration 0 - invalid 1 - valid
AntlStX	INT	The X-axis coordinate of the antenna in the vehicle coordinate system; positive: right; unit: 0.01 m; range: $\pm 2000$

Parameter	Format	Description
AntlstY	INT	The Y-axis coordinate of the antenna in the vehicle coordinate system; positive: forward; unit: 0.01 m; range: $\pm 2000$
AntlstZ	INT	The Z-axis coordinate of the antenna in the vehicle coordinate system; positive: up; unit: 0.01 m; range: $\pm 2000$
ImulstX	INT	The X-axis coordinate of the IMU in the vehicle coordinate system; positive: right; unit: 0.01 m; range: $\pm 2000$
ImulstY	INT	The Y-axis coordinate of the IMU in the vehicle coordinate system; positive: forward; unit: 0.01 m; range: $\pm 2000$
ImulstZ	INT	The Z-axis coordinate of the IMU in the vehicle coordinate system; positive: up; unit: 0.01 m; range: $\pm 2000$

### 3.3.25 CFGILARM: Configure the DR Lever Arm

Applicable to: UM761 series

#### Read DR Lever Arm Configuration

Syntax	\$CFGILARM
Example	\$CFGILARM
Description	Read the lever arm configuration used in DR navigation.
Input/Output	Input
Parameter	No parameter

#### Set/Output DR Lever Arm Configuration

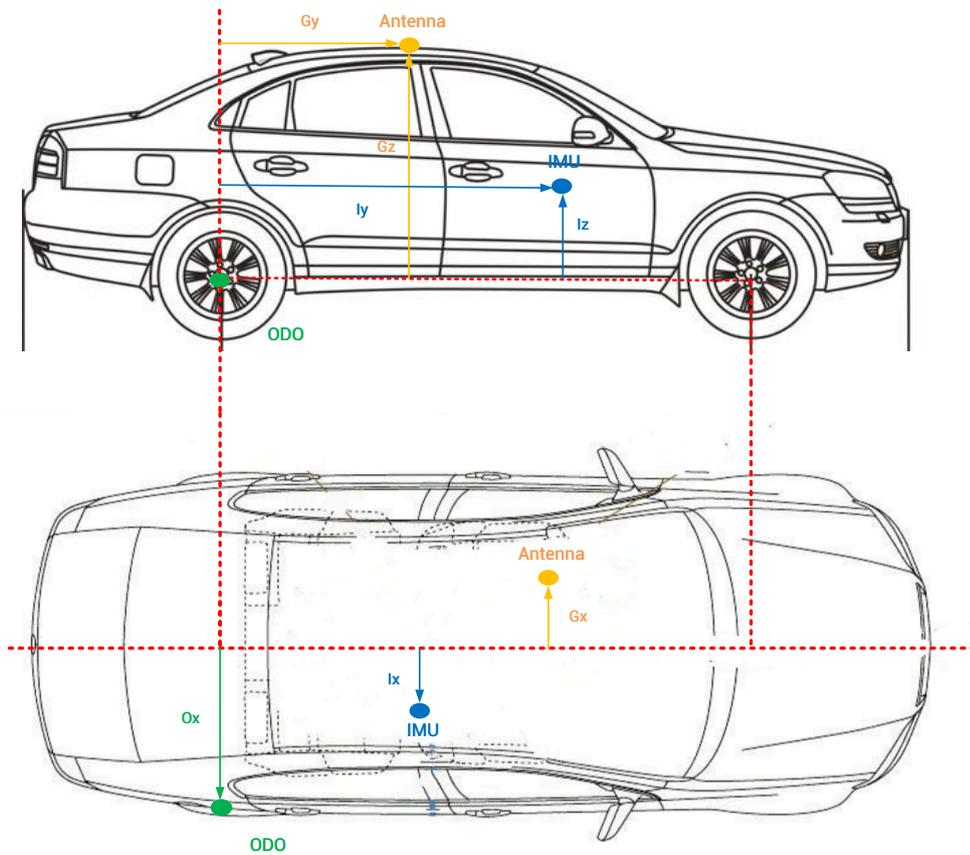
<b>Syntax</b>	<b>\$CFGILARM,flag,OdolstX,OdolstY,OdolstZ,ImulstX,ImulstY,ImulstZ</b>
Example	\$CFGILARM,1,12,19,33,123,-18,90
Description	Set or output the lever arm configuration used in DR navigation.
Input/Output	Input/Output

Parameter	Format	Description
flag	UINT (optional)	Validity flag of DR lever arm configuration 0 - invalid 1 - valid
OdolstX	INT	The X-axis coordinate of the odometer in the vehicle coordinate system; positive: right; unit: 0.01 m; range: $\pm 2000$
OdolstY	INT	The Y-axis coordinate of the odometer in the vehicle coordinate system; positive: forward; unit: 0.01 m; range: $\pm 2000$
OdolstZ	INT	The Z-axis coordinate of the odometer in the vehicle coordinate system; positive: up; unit: 0.01 m; range: $\pm 2000$
ImulstX	INT	The X-axis coordinate of the IMU in the vehicle coordinate system; positive: right; unit: 0.01 m; range: $\pm 2000$
ImulstY	INT	The Y-axis coordinate of the IMU in the vehicle coordinate system; positive: forward; unit: 0.01 m; range: $\pm 2000$
ImulstZ	INT	The Z-axis coordinate of the IMU in the vehicle coordinate system; positive: up; unit: 0.01 m; range: $\pm 2000$

The figure below is a schematic diagram of the lever arm configurations, and the vehicle coordinate system is defined as follows:

- The center of the rear axle of the vehicle is the origin of the coordinate system;
- The longitudinal direction of the vehicle is the Y axis, which points forward;
- The lateral direction of the vehicle is the X axis, which points right;
- The vertical direction of the vehicle is the Z axis, which points up.

The lever arm configurations contain the coordinates of the antenna, IMU and Odometer.



## 3.4 Sensor Fusion Messages

### 3.4.1 GYOACC

Applicable to: UM761 series

Output MEMS Sensor Data

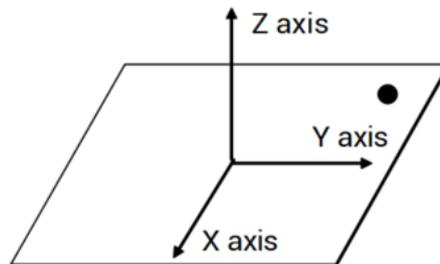
<b>Syntax</b>	<b>\$GYOACC,date,time,gyroX,gyroY,gyroZ,gyroPeriod,accX,accY,accZ,accPeriod,temp,speed,pulsePeriod,fwd*cs</b>
Example	\$GYOACC,081118,053152.000,0.017618,0.031686,0.019729,200,6.489322,-6.913150,2.960812,200,0,5,200,1*01
Description	Output the sensor data of MEMS and odometer etc.
Input/Output	Output

Parameter	Format	Description
date	STR	UTC date; in the format of ddmmyy: dd - Day mm - Month yy - Year 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 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 <sup>2</sup>
accY	DOUBLE	Y-axis acceleration of the built-in accelerometer; unit: m/s <sup>2</sup>
accZ	DOUBLE	Z-axis acceleration of the built-in accelerometer; unit: m/s <sup>2</sup>
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.
pulsePeriod	UINT	Output interval of pulses; unit: ms; no meaning if not accessing the pulse signal.
fwd	UINT	Vehicle direction signal:

Parameter	Format	Description
		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 the GYOACC message at 10 Hz, the baud rate of the serial port 1 needs to be set at 230400 bps and above.
- GYOACC message is based on the module coordinate defined as follows (see the figure):
  - Positive X axis: right-hand direction to the module's identification mark, horizontal.
  - Positive Y axis: forward direction to the module's identification mark, horizontal.
  - Positive Z axis: Vertical to the module plane, upward.



Module Coordinate

### 3.4.2 SNRSTAT

Applicable to: UM761 series

Syntax	<code>\$\$SNRSTAT,insstatus,odostatus,InstallState,mapstat*cs</code>
Example	<code>\$\$SNRSTAT,3,0,0,2*5C</code>
Description	Output initialization status
Input/Output	Output

Parameter	Format	Description
insstatus	INT	INS initialization status: -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	Installation angle estimation status: -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	Map information status: -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 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 SNRSTATEX

Applicable to: UM761 series

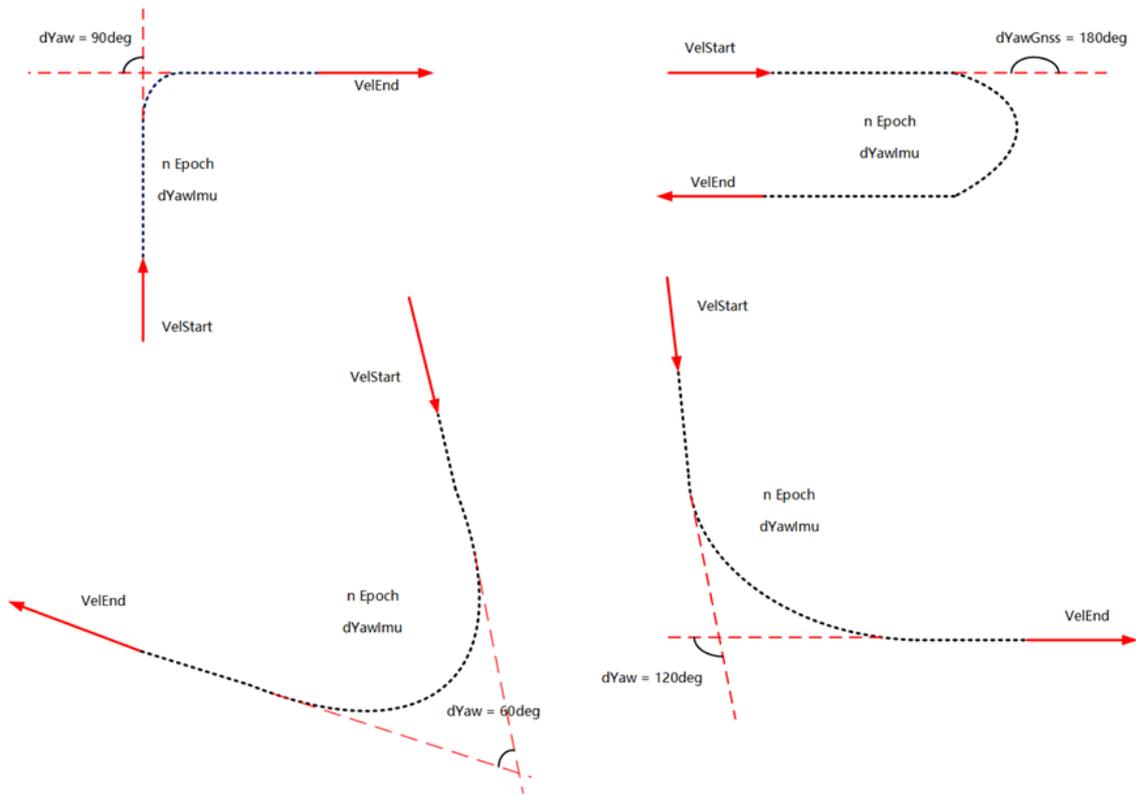
<b>Syntax</b>	<b>\$SNRSTATEX,insstatus,odostatus,InstallState,mapstat,gyrState,gyrCaliCnt*cs</b>
Example	\$SNRSTATEX,3,0,0,2,2,7*44
Description	Output initialization status
Input/ Output	Output

Parameter	Format	Description
insstatus	INT	INS initialization status: -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	Installation angle estimation status: -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	Map information status: -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 2 - The MAP information is received and applied to the integrated navigation
gyrstat	INT	Gyroscope calibration status: 0 - Gyroscope multiplicative errors not calibrated

Parameter	Format	Description
		1 – Gyroscope multiplicative errors being estimated during installation angle alignment 2 – Gyroscope multiplicative errors calibrated
gyrCaliCnt	INT	Number of nodes involved in gyroscope multiplicative error estimation
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

### Conditions of Completing Self-Calibration

- After power-on and the start of self-calibration, it's recommended to keep the vehicle stationary for more than 3 minutes.
- Maintain good satellite visibility during self-calibration (with at least 6 visible satellites and CNO above 30 dB). Better satellite observations will lead to faster calibration.
- Execute at least five 90-degree turns during normal driving (not required for fixed installation). For best calibration results, cover varied turning scenarios as shown in the figure below.
- Accelerate during straight-line driving and maintain a speed above 36km/h. More frequent acceleration cycles (with acceleration  $> 0.5 \text{ m/s}^2$  for at least 10 times) and longer periods of high-speed driving will lead to faster calibration.



### 3.4.4 NAVATT

Applicable to: UM761 series

<b>Syntax</b>	<b>\$NAVATT,time,quality, roll_v,pitch_v,yaw_v,roll_acc,pitch_acc,yaw_acc*cs</b>
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	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 2 - Valid
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

Parameter	Format	Description
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 IMURAW

Applicable to: UM761 series

<b>Syntax</b>	<b>\$IMURAW,date,time,gyroX,gyroY,gyroZ,accX,accY,accZ,speed*cs</b>
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 in module coordinate system
Input/ Output	Output

Parameter	Format	Description
date	STR	UTC date; in the format of ddmmyy: dd - Day mm - Month yy - Year 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 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 <sup>2</sup>
accY	DOUBLE	Y-axis acceleration of the built-in accelerometer; unit: m/s <sup>2</sup>

Parameter	Format	Description
accZ	DOUBLE	Z-axis acceleration of the built-in accelerometer; unit: m/s <sup>2</sup>
speed	INT	Vehicle speed pulses; > 0 means forward and < 0 means backward; this 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

### 3.4.6 INSPVA

Applicable to: UM761 series

<b>Syntax</b>	<b>\$INSPVA,date,time,Lon,Lat,Hae,Vel_E,Vel_N,Vel_U, roll_v,pitch_v,yaw_v*cs</b>
Example	\$INSPVA,020822,111025.10,40.08652241,116.21819501,34.011,0.000,0,0.001,-0.002,-0.801,0.416,291.386*30
Description	Output the dead reckoning position, velocity and attitude.
Input/ Output	Output

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 time fails, this field is null.
Lon	DOUBLE	Longitude; unit: deg; positive means east and negative means west; 8 decimal places
Lat	DOUBLE	Latitude; unit: deg; positive means north and negative means south; 8 decimal places
Hae	DOUBLE	Ellipsoidal height; unit: m; 3 decimal places
Vel_E	DOUBLE	East velocity in ENU coordinate system; unit: m/s; 3 decimal

Parameter	Format	Description
		places
Vel_N	DOUBLE	North velocity in ENU coordinate system; unit: m/s; 3 decimal places
Vel_U	DOUBLE	Up velocity in ENU coordinate system; unit: m/s; 3 decimal places
roll_v	DOUBLE	Roll; unit: deg; 3 decimal places
pitch_v	DOUBLE	Pitch; unit: deg; 3 decimal places
yaw_v	DOUBLE	Yaw; unit: deg; 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

### 3.4.7 IMUVEH

Applicable to: UM761 series

<b>Syntax</b>	<b>\$IMUVEH,date,time,gyroX,gyroY,gyroZ,accX,accY,accZ,speed*cs</b>
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

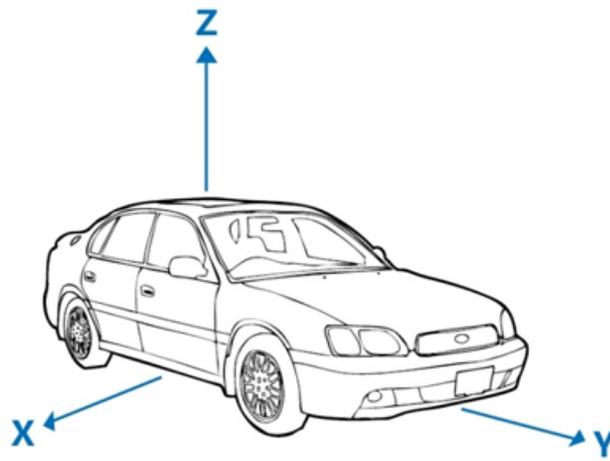
Parameter	Format	Description
date	STR	UTC date; in the format of ddmmyy: dd - Day mm - Month yy - Year Null if no exact year, month and day are parsed
time	STR	UTC time; in the format of hhmmss.sss: hh - Hour mm - Minute ss.sss - Second Null if no exact hour, minute and second are parsed
gyroX	DOUBLE	X-axis angular velocity of the built-in gyroscope in vehicle

Parameter	Format	Description
		body coordinate system; unit: rad/s; null before the finish of MEMS calibration
gyroY	DOUBLE	Y-axis angular velocity of the built-in gyroscope in vehicle body coordinate system; unit: rad/s; null before the finish of MEMS calibration
gyroZ	DOUBLE	Z-axis angular velocity of the built-in gyroscope in vehicle body coordinate system; unit: rad/s; null before the finish of MEMS calibration
accX	DOUBLE	X-axis acceleration of the built-in accelerometer in vehicle body coordinate system; unit: m/s <sup>2</sup> ; null before the finish of MEMS calibration
accY	DOUBLE	Y-axis acceleration of the built-in accelerometer in vehicle body coordinate system; unit: m/s <sup>2</sup> ; null before the finish of MEMS calibration
accZ	DOUBLE	Z-axis acceleration of the built-in accelerometer in vehicle body coordinate system; unit: m/s <sup>2</sup> ; null before the finish of MEMS calibration
speed	INT	Vehicle speed pulses; > 0 means forward and < 0 means backward; null if no vehicle pulse signal input.
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 vehicle body coordinate defined as follows:

- Positive X axis: Driver's right-hand direction, horizontal.
- Positive Y axis: Vehicle forward direction, horizontal.
- Positive Z axis: Vertical to the vehicle body plane, upward.



Vehicle Coordinate System

### 3.4.8 INSTALL

Applicable to: UM761 series

#### Read Installation Angle Information

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

#### Output Installation Angle Information

Syntax	<code>\$INSTALL,angleX,angleY,angleZ,valid*cs</code>
Example	<code>\$INSTALL,100,100,100,1*41</code>
Description	Output the calculated installation angle of the module.
Input/Output	Output

Parameter	Format	Description
angleX	UINT	Rotation angle of the module X axis relative to the vehicle body coordinate X axis (right-handed); unit: 1e-2 deg; range: 0 to 36000

Parameter	Format	Description
angleY	UINT	Rotation angle of the module Y axis relative to the vehicle body coordinate Y axis (right-handed); unit: 1e-2 deg; range: 0 to 36000
angleZ	UINT	Rotation angle of the module Z axis relative to the vehicle body coordinate Z axis (right-handed); 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

### 3.4.9 MAPFB

Applicable to: UM761 series

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	Format	Description
hhmmss.sss	STR	UTC timestamp when the GNSS module reports NMEA messages (For example: If the current NMEA time output by the module is 082324.00, the externally input MAPFB time should also be 082324.000.)
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

Parameter	Format	Description
		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

This 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.

### 3.4.10 ODODATA

Applicable to: UM761 series

<b>Syntax</b>	<b>\$ODODATA,time,speed,forward,RSV,RSV,RSV</b>
Example	\$ODODATA,091649.00,10000,1,,
Description	Input odometer information
Input/Output	Input

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

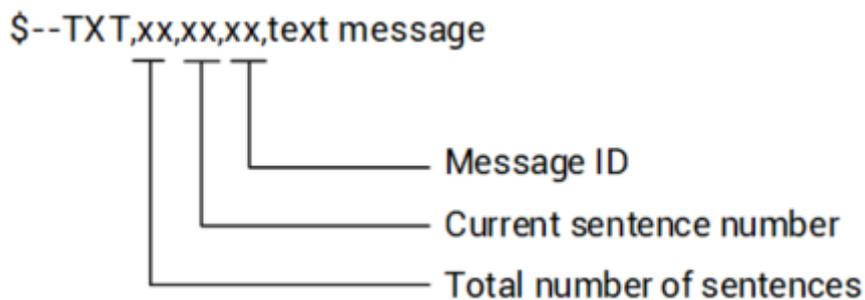
Parameter	Format	Description
RSV	/	Reserved
RSV	/	Reserved

## 3.5 Notice Messages

### 3.5.1 General Notice Message and Notice Message Package

Applicable to: UC7510 series, UM760 series, UM761 series

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



### 3.5.2 Command Echo

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	<code>\$--TXT,01,01,00,command*cs</code>
Example	<code>\$GNTXT,01,01,00,PDTINFO*1F</code>
Description	Output the command input by the user
Input/Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GQ - QZSS standalone positioning GN - Dual or multiple constellations joint positioning

Parameter	Format	Description
01	INT	Total number of sentences
01	INT	Current sentence number
00	INT	Message ID
Command	STR	Unicore command input by the user
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

### 3.5.3 ANTSTAT

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	<b>\$ANTSTAT,status1,status2</b>
Example	\$ANTSTAT,0,0
Description	Output the antenna detection status and the antenna type
Input/Output	Output

Parameter	Format	Description
status1,status2	INT	Antenna detection status: \$ANTSTAT,0,0 - Normal, active antenna \$ANTSTAT,0,1 - Short circuit \$ANTSTAT,1,0 - Open circuit, or passive antenna \$ANTSTAT,1,1 - Hardware exception

Refer to *Hardware Reference Design* for the antenna detection circuit.

### 3.5.4 Ephemeris Lacking

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	<b>\$--TXT,01,01,03,EphLackLevel*cs</b>
Example	\$GNTXT,01,01,03,2*60
Description	Output this message when the ephemeris is insufficient.
Input/Output	Output

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning GI - IRNSS standalone positioning GN - Dual or multiple constellations joint positioning
Total number of sentences	INT	Total number of sentences, fixed to 01
Sentence number	INT	Current sentence number, fixed to 01
Text identifier	INT	Message ID, fixed to 03
EphLackLevel	INT	0 - ephemeris sufficient 1 - ephemeris insufficient 2 - ephemeris severely insufficient
cs	U8	Checksum; two hexadecimal characters obtained by calculating an XOR of all characters between but not including '\$' to '*' in this message

### 3.5.5 Data Incomplete

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$--TXT,01,01,04,The output data is INCOMPLETE. MAX Bytes Per Epoch:1732*cs	
Example	\$GNTXT,01,01,04,The output data is INCOMPLETE. MAX Bytes Per Epoch:1732*1F	
Description	This message indicates that the output data is incomplete because of insufficient bandwidth of the output port.	
Input/Output	Output	

Parameter	Format	Description
--	STR	Positioning system flag GP - GPS standalone positioning GB - BDS standalone positioning GA - Galileo standalone positioning GL - GLONASS standalone positioning

Parameter	Format	Description
		GI - IRNSS standalone positioning GN - Dual or multiple constellations joint positioning
Total number of sentences	INT	Total number of sentences, fixed to 01
Sentence number	INT	Current sentence number, fixed to 01
Text identifier	INT	Message ID, fixed to 04
Text message	STR	Text message: The output data is INCOMPLETE. MAX Bytes Per Epoch:1732
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 Messages

### 3.6.1 CWOUT

Applicable to: UC7510 series, UM760 series, UM761 series

Syntax	\$CWOUT,CWFlagOut,CWToneFreqOut_GPL1,CWRatioOut-GPL1,CWToneFreqOut_GL,CWRatioOut-GL,CWToneFreqOut_BDB1,CWRatioOut-BDB1,RSV,RSV*cs
Example	\$CWOUT,1,1575620,-100,1602100,-80,1561088,-90,,*7E
Description	Output interference detection information
Input/Output	Output

Parameter	Format	Description
CWFlagOut	UINT	Interference flag: 0 - No interference 1 - Interference detected
CWToneFreqOut_GPL1	UINT	GPS L1 interference signal frequency; unit: KHz
CWRatioOut-GPL1	INT	GPS L1 interference strength; unit: dBm; range:

Parameter	Format	Description
		-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
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

### 3.6.2 LSF

Applicable to: UC7510 series, UM760 series, UM761 series

#### Query Leap Seconds Forecast Information

Syntax	\$LSF,system
Example	\$LSF,1
Description	Query leap seconds forecast information of the specified satellite system. The receiver outputs LSF message after receiving this command.
Input/ Output	Input

Parameter	Format	Description
system	UINT	Query the system corresponding to the leap seconds forecast information 0 - GPS (QZSS) 1 - BDS 2 - GLO 3 - GAL

#### Output Leap Seconds Forecast Information

<b>Syntax</b>	\$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	Format	Description
System	UINT	Output the system corresponding to the leap seconds forecast information 0 - GPS (QZSS) 1 - BDS 2 - GLO 3 - GAL
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: this parameter corresponds to GLO UTC A0
utcWN	UINT	UTC reference week number; unit: week (Fill 0 for BDS); GLO system: this parameter corresponds to GLO UTC A1
utcDN	UINT	Days of week when the leap second event occurs; unit: day; GLO system: this parameter corresponds to GLO UTC DN
utcWNLSF	UINT	UTC week number when the leap second event occurs; unit: week; GLO system: this parameter corresponds to GLO UTC KP
utcA0	INT	Constant coefficient A0 of UTC polynomial; unit: 2 <sup>-30</sup> s; GLO system: this parameter corresponds to GLO UTC tc
utcA1	INT	First-order coefficient A1 of UTC polynomial; unit: 2 <sup>-50</sup> ; GLO system: this parameter corresponds to GLO UTC tg
cs	U8	Checksum; two hexadecimal characters obtained by

Parameter	Format	Description
		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:  
 Step 1: Convert the RMC date into GPS week, and convert the GPS week into binary. Set the lower eight bits to zero, and convert it to decimal.  
 Step 2: Add utcWNLSF to the number obtained from step 1.
- Calculating the BDS week when a leap second occurs:  
 Step 1: Convert the RMC date into BDS week, and convert the BDS week into binary. Set the lower eight bits to zero, and convert it to decimal.  
 Step 2: Add utcWNLSF to the number obtained from step 1.
- 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 OSNMA

Applicable to: UC7510 series, UM760 series, UM761 series

<b>Syntax</b>	\$PNAVMSG,svid,wordtype,x1, x2, x3, ..., x30
Example	\$PNAVMSG,1,0,BE,DA,49,72,CB,C3,80,EA,AA,AA,4D,41,0A,3F,40
Description	Output Galileo I/NAV message
Input/Output	Output

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

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

### 3.6.4 QZQSM

Applicable to: UC7510 series, UM760 series, UM761 series

QZSS provides service about disaster and crisis report (DC Report) based on the L1 SAIF signal. When disasters such as earthquake and tsunami happen, QZSS will broadcast the warning information. See the following table for the format and refer to Chapter [Reference](#) for more information.

Field	Value	Character
Message Header	\$QZQSM	6
Field delimiter	,	1
Satellite ID	56,57,61 (PRN184,185,189) 55 (PRN183) <sup>1</sup> 58 (PRN186) <sup>2</sup>	2
Field delimiter	,	1
DC Report Message		63
Field delimiter	*	1
Checksum		2

**Example:**



\$QZQSM,58,53ADF5729180050C30A18754322A864A547DAA8FC952F08000000116717F6C\*05

---

<sup>1</sup> 55 is valid before the QZSS satellite QZS1R (PRN186) begins service.

<sup>2</sup> 58 is valid from the time when the QZSS satellite QZS1R (PRN186) begins service.

# 4 Extended RTCM Messages

## 4.1 Data Structure

The extended RTCM messages obey RTCM3.3 standards, and Unicore defines the **Variable Length Data Message** field. The data transmission uses Big Endian method.

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

### Description of Binary Format

ID	Structure	Description
1	Header	See Table <b>Description of Header</b>
2	Data	Data field, the length is variable for different messages. Please see each message for more information.
3	CRC	CRC24Q check (Header + Data)

### 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 and Sub Message Type

Field	Bits	Unit	Range	Description
Message Type	12	/	/	UINT; Unicore message type = 4074
Sub Message Type	12	/	/	UINT 0x00B: GYOACC 0x00C: SNRSTAT 0x01C: SNRSTATEX 0x00D: NAVATT 0x00E: IMURAW 0x00F: INSPVA 0x010: IMUVEH 0x014: DR Protection level Information 0x0FF: Receiver Information

Field	Bits	Unit	Range	Description
				0x0FE: Signal Information 0x0F9: Protection Level Information 0x0EB: ANTSTAT 0x0EA: Leap Second Message 0x0E9: Jamming and Spoofing Detection

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

```

U32 Crc24Q_U8(U8 *src, int len)
{
  int i;
  U32 crc = 0;
  for (i = 0; i < len; i++)
    crc = (crc << 8) ^ CRC24Q_Table[src[i] ^ (U8)(crc >> 16)];
  return crc & 0xFFFFF;
}

```

## 4.2 Message Definition

### 4.2.1 Sensor Fusion Messages

#### 4.2.1.1 GYOACC (Sub ID 0x00B)

Applicable to: UM761 series

This message outputs MEMS and odometer 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)	1	5

ID	Field	Type	Description	Bytes	Byte Offset
			0xFF means invalid		
6	mSec	U16	Millisecond 0xFFFF means invalid	2	6
7	gyroX	S32	X-axis angular velocity of the built-in gyroscope; unit: 2 <sup>-16</sup> rad/s	4	8
8	gyroY	S32	Y-axis angular velocity of the built-in gyroscope; unit: 2 <sup>-16</sup> rad/s	4	12
9	gyroZ	S32	Z-axis angular velocity of the built-in gyroscope; unit: 2 <sup>-16</sup> 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 <sup>-16</sup> m/s <sup>2</sup>	4	21
12	accY	S32	Y-axis acceleration of the built-in accelerometer; unit: 2 <sup>-16</sup> m/s <sup>2</sup>	4	25
13	accZ	S32	Z-axis acceleration of the built-in accelerometer; unit: 2 <sup>-16</sup> m/s <sup>2</sup>	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

ID	Field	Type	Description	Bytes	Byte Offset
18	fwd	U8	Vehicle direction signal: 0 - Forward 1 - Backward; output 0xFF if not accessing the odometer signal, meaning invalid	1	37
Total				39	

#### 4.2.1.2 SNRSTAT (Sub ID 0x00C)

Applicable to: UM761 series

This message outputs initialization status information.

ID	Field	Type	Description	Bytes	Byte Offset
1	insstatus	S8	INS initialization status: -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	Installation angle estimation status: -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	1	2

ID	Field	Type	Description	Bytes	Byte Offset
			3 - The current vehicle speed is too low, and it is required to increase the speed		
4	mapstat	S8	Map information status: -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 2 - The MAP information is received and applied to the integrated navigation	1	3
Total				4	

#### 4.2.1.3 SNRSTATEX (Sub ID 0x01C)

Applicable to: UM761 series

This message outputs initialization status information.

ID	Field	Type	Description	Bytes	Byte Offset
1	insstatus	S8	INS initialization status: -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	1	1

ID	Field	Type	Description	Bytes	Byte Offset
			completed		
3	InstallState	S8	<p>Installation angle estimation status:</p> <ul style="list-style-type: none"> <li>-1 - IMU device failure, unable to estimate the installation angle</li> <li>0 - Calibration in progress</li> <li>1 - The quality of current satellite information is insufficient and better satellite conditions are needed</li> <li>2 - The current vehicle mobility conditions are insufficient, and acceleration is required</li> <li>3 - The current vehicle speed is too low, and it is required to increase the speed</li> </ul>	1	2
4	mapstat	S8	<p>Map information status:</p> <ul style="list-style-type: none"> <li>-2 - Abnormal map data is detected</li> <li>-1 - No port is configured to receive MAP information</li> <li>0 - The port fails to receive MAP information or the MAP information transmission times out</li> <li>1 - The MAP information is received but not applied to the integrated navigation</li> <li>2 - The MAP information is received and applied to the integrated navigation</li> </ul>	1	3
5	gyrstat	S8	<p>Gyroscope calibration status:</p> <ul style="list-style-type: none"> <li>0 - Gyroscope multiplicative errors not calibrated</li> <li>1 - Gyroscope multiplicative errors being estimated during installation angle alignment</li> <li>2 - Gyroscope multiplicative errors calibrated</li> </ul>	1	4
6	gyrCaliCnt	U16	Number of nodes involved in gyroscope multiplicative error	2	5

ID	Field	Type	Description	Bytes	Byte Offset
			estimation		
Total				7	

#### 4.2.1.4 NAVATT (Sub ID 0x00D)

Applicable to: UM761 series

This message outputs the vehicle's attitude and heading information.

ID	Field	Type	Description	Bytes	Byte 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 2 - Valid	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; 0xFFFFFFFF means invalid	4	21
10	yaw_acc	U32	Yaw accuracy; unit: 1e-5 deg; 0xFFFFFFFF means invalid	4	25
Total				29	

#### 4.2.1.5 IMURAW (Sub ID 0x00E)

Applicable to: UM761 series



This message outputs 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: $2^{-16}$ rad/s	4	16
10	accX	S32	X-axis acceleration of the built-in accelerometer; unit: $2^{-16}$ m/s <sup>2</sup>	4	20
11	accY	S32	Y-axis acceleration of the built-in accelerometer; unit: $2^{-16}$ m/s <sup>2</sup>	4	24
12	accZ	S32	Z-axis acceleration of the built-in accelerometer; unit: $2^{-16}$ m/s <sup>2</sup>	4	28
13	Speed	S16	Vehicle speed pulses; > 0 means forward and < 0 means backward; This field is invalid if there is no vehicle pulse signal.	2	32
Total				34	

#### 4.2.1.6 INSPVA (Sub ID 0x00F)

Applicable to: UM761 series

This message outputs the DR position, velocity and attitude.

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	Lon	S64	Longitude; unit: 2 <sup>-32</sup> deg; positive means east, and negative means west; 0x8000000000000000 means invalid	8	8
8	Lat	S64	Latitude; unit: 2 <sup>-32</sup> 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 means invalid	4	32
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

ID	Field	Type	Description	Bytes	Byte Offset
Total				52	

#### 4.2.1.7 IMUVEH (Sub ID 0x010)

Applicable to: UM761 series

This message outputs compensated MEMS data in the Vehicle Coordinate System.

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 in the vehicle body coordinate system; unit: 2 <sup>-16</sup> rad/s; before the calibration of IMU, it is invalid and outputs 0x80000000	4	8
8	gyroY	S32	Y-axis angular velocity of the built-in gyroscope in the vehicle body coordinate system; unit: 2 <sup>-16</sup> rad/s; before the calibration of IMU, it is invalid and outputs 0x80000000	4	12
9	gyroZ	S32	Z-axis angular velocity of the built-in gyroscope in the vehicle body coordinate system; unit: 2 <sup>-16</sup> rad/s; before the calibration of IMU, it is invalid and outputs 0x80000000	4	16
10	accX	S32	X-axis acceleration of the built-in accelerometer in the vehicle body	4	20

ID	Field	Type	Description	Bytes	Byte Offset
			coordinate system; unit: $2^{-16} \text{ m/s}^2$ ; before the calibration of IMU, it is invalid and outputs 0x80000000		
11	accY	S32	Y-axis acceleration of the built-in accelerometer in the vehicle body coordinate system; unit: $2^{-16} \text{ m/s}^2$ ; before the calibration of IMU, it is invalid and outputs 0x80000000	4	24
12	accZ	S32	Z-axis acceleration of the built-in accelerometer in the vehicle body coordinate system; unit: $2^{-16} \text{ m/s}^2$ ; before the calibration of IMU, 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 and outputs 0x8000	2	32
Total				34	

#### 4.2.1.8 DR Protection Level Information (Sub ID 0x014)

Applicable to: UM761 series

This message provides information about the protection level (PL) and the target misleading information risk (TMIR) of each axis. When the value of the protection level is less than the actual error, misleading information happens. Denote TMIR as  $X \text{ [%MI/epoch]}$ , that is, the occurrence possibility of the misleading information every epoch is  $X\%$  and  $X = \text{tmirCoeff} * (10^{\text{TmirExt}})$ . This message delivers the positioning confidence and positioning error estimation.

ID	Field	Type	Description	Bytes	Byte Offset
1	msgVersion	U8	Message version	1	0
2	tmirCoeff	U8	Coefficient integer number of base 10 scientific notation* TMIR = $X \text{ [%MI/epoch]}$	1	1
3	TmirExt	U8	Exponent integer number of base 10 scientific notation*	1	2

ID	Field	Type	Description	Bytes	Byte Offset
			TMIR = X [%MI/epoch]		
4	plPosValid	U8	Position protection level validity: 0 - Invalid (the protection level cannot be used) 1 - Valid	1	3
5	plPosFrame	U8	Position protection level frame: 0 - Invalid (cannot calculate frame conversion) 1 - North - East - Down	1	4
6	plVelValid	U8	Velocity protection level validity: 0 - Invalid (the protection level cannot be used) 1 - Valid	1	5
7	plVelFrame	U8	Velocity protection level frame: 0 - Invalid (cannot calculate frame conversion) 1 - North - East - Down	1	6
8	reserved	U8	Reserved	1	7
9	reserved	U8[4]	Reserved	4	8
10	Week	U16	GPS week, 0xFFFF means invalid	2	12
11	GNSS Epoch Tim	U32	GPS second of week; unit: ms; 0xFFFFFFFF means invalid	4	14
12	plPos1	U32	The first axis of position protection level value; unit: mm; Output 0xFFFFFFFF when plPosValid is invalid	4	18
13	plPos2	U32	The second axis of position protection level value; unit: mm; Output 0xFFFFFFFF when plPosValid is invalid	4	22
14	plPos3	U32	The third axis of position protection level value; unit: mm; Output 0xFFFFFFFF when plPosValid is invalid	4	26
15	plVel1	U32	The first axis of velocity protection level value; unit: mm/	4	30

ID	Field	Type	Description	Bytes	Byte Offset
			s; Output 0xFFFFFFFF when pVelValid is invalid		
16	pVel2	U32	The second axis of velocity protection level value; unit: mm/s; Output 0xFFFFFFFF when pVelValid is invalid	4	34
17	pVel3	U32	The third axis of velocity protection level value; unit: mm/s; Output 0xFFFFFFFF when pVelValid is invalid	4	38
18	reserved	U16	Reserved	2	42
19	reserved	U16	Reserved	2	44
20	reserved	U32	Reserved	4	46
21	reserved	U32	Reserved	4	50
Total				54	

\*  $X = \text{tmirCoeff} * (10^{\text{TmirExt}})$ . For example, if  $\text{tmirCoeff} = 5$  and  $\text{TmirExt} = 0$ , then  $X = 5 * 10^0 = 5$ .

## 4.2.2 GNSS Messages

The messages in this chapter are only available in specific firmware.

### 4.2.2.1 Receiver Information (Sub ID 0x0FF)

Applicable to: UC7510 series, UM760 series, UM761 series

This message contains parameters related to receiver status, including position, speed, positioning quality, DOP values, and clock information. The data transmission uses Big Endian method. See the following table for more details.

ID	Field	Type	Description	Bytes	Byte Offset
1	Version	U8	Message version	1	0

ID	Field	Type	Description	Bytes	Byte Offset
2	Week	U16	GPS week, starting from Jan. 6th, 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 solution; 0xFF means invalid	1	7
5	Lon	S64	Longitude; unit: 2 <sup>-32</sup> deg; positive - East; negative - West; 0x8000000000000000 means invalid	8	8
6	Lat	S64	Latitude; unit: 2 <sup>-32</sup> 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 position and velocity: 0 - Invalid 1 - Single point positioning 2 - Differential positioning 4 - RTK fixed solution 5 - RTK float solution 6 - Dead reckoning	1	56
13	Vel_E	S32	East velocity in ENU coordinate;	4	57

ID	Field	Type	Description	Bytes	Byte Offset
			unit: mm/s; 0x80000000 means invalid.		
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

ID	Field	Type	Description	Bytes	Byte Offset
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 velocity; unit: mm/s; 0xFFFFFFFF means invalid	4	113
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

ID	Field	Type	Description	Bytes	Byte Offset
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	

#### 4.2.2.2 Signal Information (Sub ID 0x0FE)

Applicable to: UC7510 series, UM760 series, UM761 series

This message contains the status information of available satellites, including PRN, CN0, elevation, azimuth, pseudo-range residual, etc. When there are no satellite signals, this message only outputs the header and SatNum, and the SatNum field is set to zero. The data transmission uses Big Endian method. See the following table for more details.

ID	Field	Type	Description	Bytes	Byte Offset
1	Version	U8	Message version	1	0
2	Week	U16	GPS week, starting from Jan. 6th, 1980; 0xFFFF means invalid	2	1
3	Tow	U32	GPS time of week; unit: ms; 0xFFFFFFFF means invalid	4	3
4	SatNum	U32	Number of satellites	4	7
5	SatInfo	—	For more information, see the table below.	SatNum * (8+6*N <sub>f</sub> )	11
Total				11+ SatNum * (8+6*N <sub>f</sub> )	

#### Structure of SatInfo

ID	Field	Type	Description	Bytes	Byte Offset
1	Prn	U8	GPS satellite ID 01~32	1	0

ID	Field	Type	Description	Bytes	Byte Offset
			QZSS satellite ID 01~14 GLONASS satellite ID 65~99 BDS satellite ID 01~64 Galileo satellite ID 01~36 SBAS satellite ID 33~51		
2	System	U8	1 - GPS 2 - GLO 3 - GAL 4 - BDS 5 - QZSS 6 - SBAS	1	1
3	El	U16	Elevation; unit: 1e-1 deg; range: 0~900; 0xFFFF means invalid	2	2
4	Az	U16	Azimuth; unit: 1e-1 deg; range: 0~3600; 0xFFFF means invalid	2	4
5	InUse	U8	0 - not in use; 1 - in use	1	6
6	Freq Num (N <sub>f</sub> )	U8	Number of frequencies of the current satellite	1	7
			Repeat from the 7th to the 10th field N <sub>f</sub> times (Field 6)		
7	Freq ID	U8	GPS 2 - GPS L1C/A GLO 2 - G1C/A BDS 2 - B1I 31 - B1C_pilot GAL 2 - E1C no data QZSS 2 - QZSS L1C/A, L1C/B SBAS 2 - SBAS L1C/A	1	2+6*N <sub>f</sub>
8	CNO	U8	Unit: dB.Hz	1	3+6*N <sub>f</sub>
9	PrResi	U16	Pseudo-range residual of each satellite; unit: 1e-1 m; 0xFFFF	2	4+6*N <sub>f</sub>

ID	Field	Type	Description	Bytes	Byte Offset
			means invalid		
10	DpResi	U16	Doppler velocity residual of each satellite; unit: 1e-1 Hz; 0xFFFF means invalid	2	6+6*N <sub>f</sub>
Total				8+6*N <sub>f</sub>	

#### 4.2.2.3 Protection Level Information (Sub ID 0x0F9)

Applicable to: UC7510 series, UM760 series, UM761 series

This message provides the information about the GNSS protection level (PL) and the target misleading information risk (TMIR) of each axis. When the value of the protection level is less than the actual error, the misleading information happens. Denote TMIR as X [%MI/epoch], that is, the occurrence possibility of the misleading information every epoch is X% and  $X = \text{tmirCoeff} * (10^{\text{TmirExt}})$ . This message delivers the positioning confidence and positioning error estimation.

ID	Field	Type	Description	Bytes	Byte Offset
1	msgVersion	U8	Message version	1	0
2	tmirCoeff	U8	Coefficient integer number of base 10 scientific notation* TMIR = X [%MI/epoch]	1	1
3	TmirExt	U8	Exponent integer number of base 10 scientific notation* TMIR = X [%MI/epoch]	1	2
4	plPosValid	U8	Position protection level validity: 0 - Invalid (the protection level cannot be used) 1 - Valid	1	3
5	plPosFrame	U8	Position protection level frame: 0 - Invalid (cannot calculate frame conversion) 1 - North - East - Down	1	4
6	plVelValid	U8	Velocity protection level validity: 0 - Invalid (the protection level cannot be used) 1 - Valid	1	5

ID	Field	Type	Description	Bytes	Byte Offset
7	pVelFrame	U8	Velocity protection level frame: 0 - Invalid (cannot calculate frame conversion) 1 - North - East - Down	1	6
8	reserved	U8	Reserved	1	7
9	reserved	U8[4]	Reserved	4	8
10	Week	U16	GPS week, 0xFFFF means invalid	2	12
11	GNSS Epoch Tim	U32	GPS second of week; unit: ms; 0xFFFFFFFF means invalid	4	14
12	pPos1	U32	The first axis of position protection level value; unit: mm; Output 0xFFFFFFFF when pPosValid is invalid	4	18
13	pPos2	U32	The second axis of position protection level value; unit: mm; Output 0xFFFFFFFF when pPosValid is invalid	4	22
14	pPos3	U32	The third axis of position protection level value; unit: mm; Output 0xFFFFFFFF when pPosValid is invalid	4	26
15	pVel1	U32	The first axis of velocity protection level value; unit: mm/s; Output 0xFFFFFFFF when pVelValid is invalid	4	30
16	pVel2	U32	The second axis of velocity protection level value; unit: mm/s; Output 0xFFFFFFFF when pVelValid is invalid	4	34
17	pVel3	U32	The third axis of velocity protection level value; unit: mm/s; Output 0xFFFFFFFF when pVelValid is invalid	4	38
18	reserved	U16	Reserved	2	42
19	reserved	U16	Reserved	2	44

ID	Field	Type	Description	Bytes	Byte Offset
20	reserved	U32	Reserved	4	46
21	reserved	U32	Reserved	4	50
Total				54	

\*  $X = \text{tmirCoeff} * (10^{\text{TmirExt}})$ . For example, if  $\text{tmirCoeff} = 5$  and  $\text{TmirExt} = 0$ , then  $X = 5 * 10^0 = 5$ .

#### 4.2.2.4 ANTSTAT: Antenna Detection Status (Sub ID 0x0EB)

Applicable to: UC7510 series, UM760 series, UM761 series

ANTSTAT outputs the antenna detection status.

ID	Field	Type	Description	Bytes	Byte Offset
1	Status	U8	Antenna detection status: 0 - Normal, active antenna 1 - Short circuit 2 - Open circuit, or passive antenna 3 - Hardware exception	1	0
Total				1	

#### 4.2.2.5 Leap Second Message (Sub ID 0x0EA)

Applicable to: UC7510 series, UM760 series, UM761 series

Leap second message outputs leap second and leap second prediction information. See the following table for more details.

ID	Field	Type	Description	Bytes	Byte Offset
1	Version	U8	Message version	1	0
2	Week	U16	GPS week, starting from Jan. 6, 1980. 0xFFFF means invalid	2	1
3	Tow	U32	GPS time of week, unit: ms, 0xFFFFFFFF means invalid	4	3

ID	Field	Type	Description	Bytes	Byte Offset
4	srcOfCurrLs	U8	Source of the current leap second: 0 = default (data stored in firmware, maybe out of date) 1 = time difference between GPST and GLONASS time 2 = GPS 3 = SBAS 4 = BeiDou 5 = Galileo 6 = assistance data 7 = configuration 8 = NavIC 255 = unknown	1	7
5	currLs	S8	Current number of leap second since the start of GPST (Jan. 6, 1980), which reflects how much GPST is ahead of UTC time. The leap second of Galileo is as same as that of GPS. The leap second of BeiDou is 14 seconds less than GPS. GLONASS follows UTC time, so it has no leap second. 0x80 means invalid.	1	8
6	srcOfLsChange	U8	Source of the future leap second: 0 = no source 2 = GPS 3 = SBAS 4 = BeiDou 5 = Galileo 6 = GLONASS 7 = NavIC	1	9
7	lsChange	S8	Change of the leap second in the future: +1 = positive leap second -1 = negative leap second 0 = no leap second event in the future or no information available	1	10

ID	Field	Type	Description	Bytes	Byte Offset
			If this value is 0, it indicates that the number of leap second has not changed and the event should be ignored.		
8	timeToLsEvent	S32	Time to the next leap second event, in seconds. If there is no leap second event in the future, it refers to the number of seconds since the last leap second moment. >0 leap second in the future, =0 leap second at present, <0 leap second in the past. 0x80000000 means invalid.	4	11
9	dateOfLsGps WN	U16	GPS week number (WN) when the next leap second occurs. If there is no leap second in the future, it refers to the GPS WN when the last leap second occurred. 0xFFFF means invalid.	2	15
10	dateOfLsGps Dn	U8	GPS day number (DN) of the week when the next leap second occurs. If there is no leap second in the future, it refers to the GPS DN when the last leap second occurred. DN of GPS and Galileo: from 1 = Sunday to 7 = Saturday. DN of BeiDou: from 0 = Sunday to 6 = Saturday 0xFF means invalid	1	17
Total				18	

#### 4.2.2.6 Jamming and Spoofing Detection (SUB ID 0x0E9)

Applicable to: UC7510 series, UM760 series, UM761 series

This message outputs jamming and spoofing information periodically. The detailed structure is shown in the following table.

ID	Field	Type	Description	Bytes	Byte Offset
1	Version	U8	Message version	1	0
2	Week	U16	GPS week, starting from Jan. 6, 1980. 0xFFFF means invalid	2	1
3	Tow	U32	GPS time of week, unit: ms, 0xFFFFFFFF means invalid	4	3
4	jamDetEnabled	U8	Enable or disable jamming detection 0: disable 1: enable	1	7
5	jammingState	S8	Jamming state 0: unknown 1: no jamming 2: warning (jamming detected with good positioning solution) 3: severe (jamming detected without positioning solution)	1	8
6	spfDetEnabled	U8	Enable or disable spoofing detection 0: disable 1: enable	1	9
7	spoofingState	S8	Spoofing state 0: unknown 1: no spoofing 2: spoofing detected Note: The spoofing state only reflects the state in the current navigation epoch. For example, if the value is 1, it does not mean that there is no spoofing signal, but only that the spoofing detector is not triggered in the current epoch.	1	10
8	Reserved	U32	Reserved	4	11
Total				15	

## 4.3 Decoding Example

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### 4.3.1 TOW (U32)

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

### 4.3.2 Lon (S64)

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

### 4.3.3 Vel\_E (S32)

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

### 4.3.4 Year (U16)

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



## 5 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

[3] Quasi-Zenith Satellite System Interface Specification DC Report Service (IS-QZSS-DCR-012)

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