ALLYSTAR GNSS Receiver

Binary Protocol Specification

V2.3.6

www.allystar.com

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PERFACE

Protocol Specification is a reference describing the messages used by ALLYSTAR GNSS receiver and is organized by the specific NMEA, BINARY and RTCM messages.

1 NMEA MESSAGES

1.1 Background Information

NMEA messages sent from GNSS receiver follow the standard NMEA 0183 Version 3.01/4.00/4.10. For further information about NMEA messages, please visit http://www.nmea.org/

1.2 ALLYSTAR GNSS Receiver supported messages

ALLYSTAR GNSS receiver supports most of the general NMEA standard messages. They include

GGA, GLL, GSA, GRS, GSV, RMC, VTG, ZDA， GST and TXT.

1.3 Setting message output rate

The default output is GGA, GSA, GSV and RMC in 1 second period. Message output rate for individual NMEA messages can be set through binary message CFG-MSG. Setting output rate to zero is equivalent to disable message output. The group ID for NMEA message is 0xF0. The following table describes the suitable sub ID to use:

Message	Sub ID	Description
GGA	0x00	Position fix information
GLL	0x01	Latitude/Longitude data
GSA	0x02	GNSS Overall satellite data
GRS	0x03	GNSS range residuals
GSV	0x04	GNSS Detailed satellite data
RMC	0x05	Recommended minimal data for GNSS
VTG	0x06	Course over ground and ground speed
ZDA	0x07	Date and time
TXT	0x20	Antenna status message

2 NMEA MESSAGES FORMAT

NMEA is the standard of GNSS protocol. ALLYSTAR GNSS receiver supports several NMEA sentences: GGA, GSV, GSA, RMC, VTG, ZDA, GLL, GRS, GST and TXT. This data set includes the complete PVT (position, velocity, time) solution computed by the GNSS receiver.

Each sentence has a prefix beginning with a '$' and ends with a carriage return/line feed sequence and can be no longer than 80 characters of visible text (plus the line terminators). There is a provision for a checksum at the end of each sentence which may or may not be checked by the unit that reads the data. The checksum field consists of a '*' and two hex digits representing an 8 bit exclusive OR of all characters between, but not including, the '$' and '*'. A checksum is required on some sentences.

Different prefix indicates the global position satellite systems for sentences GRS, GSA and GSV:

- $GP for GPS-QZSS-SBAS
- $BD for BEIDOU-only
- $GL for GLONASS-only
- $GI for INSAT-only
- $GA for GALILEO-only
- $GN is for GNSS, combination of different global position satellite systems.

2.1 GGA - Global Positioning System Fix Data

ID	GGA (support NMEA version 3.01/4.00/4.01/4.10)	
Description	Time, position and fix related data for a GNSS receiver	
Format	$GNGGA,hhmmss.fff,llll.lllll,a,yyyyy.yyyyy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>	
Content (Shown in sequence)	hhmmss.fff	HourMinuteSecond.fraction (UTC)
	llll.lllll	Latitude (HD9300/HD9400 series llll.lllllll)
	a	N or S (North or South)
	yyyyy.yyyyy	Longitude (HD9300/HD9400 series yyyyy.yyyyyyy)
	a	E or W (East or West)
	x	GNSS Quality Indicator - 0 - fix not available - 1 - GNSS fix - 2 - Differential GNSS fix (values above 2 are 2.3 features) - 3 = PPS fix - 4 = Real Time Kinematic - 5 = Float RTK - 6 = estimated (dead reckoning) - 7 = Manual input mode - 8 = Simulation mode
	xx	Number of satellites in use (range: 00-40)
	x.x	Horizontal Dilution of Precision (meters)
	x.x	Antenna Altitude above/below mean-sea-level (geoid) (in meters)
	M	Units of antenna altitude, meters
	x.x	Geoidal separation, the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), "-" means mean-sea-level below ellipsoid
	M	Units of geoidal separation, meters
	x	Age of differential GNSS data, time in seconds since Last SC104, type 1 or 9 update, null field when DGPS is not used
	xxxx	Differential reference station ID, 0000-1023
	hh	Checksum
Example	$GNGGA,175722.000,0045.94406,N,00028.67819,E,1,10,1.19,35.8,M,18.2,M,,*50 $GNGGA,071113.000,3957.7995312,N,11619.0286230,E,4,16,0.99,103.965,M,-8.408,M,1.0,4042*40 (93series)	

2.2 GSA - GNSS DOP and Active Satellites

ID	GSA	
Description	GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA, and DOP values.	
Format (In V3.01)	$GNGSA,a,m,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x*hh<CR><LF>	
Format (In V4.00)	$GPGSA,a,m,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x,h*hh<CR><LF> $BDGSA,a,m,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x,h*hh<CR><LF> $GAGSA,a,m,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x,h*hh<CR><LF> $GLGSA,a,m,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x,h*hh<CR><LF> $GIGSA,a,m,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x,h*hh<CR><LF>	
Format (In V4.01)	$GNGSA,a,m,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x*hh<CR><LF>	
Format (In V4.10)	$GNGSA,a,m,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x,h*hh<CR><LF>	
Content (Shown in sequence)	a	Selection mode M=Manual, forced to operate in 2D or 3D, A=Automatic, 3D/2D
	m	Mode (1 = no fix, 2 = 2D fix, 3 = 3D fix) **Note: 2D fix hint that the receiver position error meets the 2D level. Maybe under this condition the used satellite number is little more than 4.**
	x	ID of 1st satellite used for fix
	x	ID of 2nd satellite used for fix
	x	ID of 3rd satellite used for fix
	x	ID of 4th satellite used for fix
	x	ID of 5th satellite used for fix
	x	ID of 6th satellite used for fix
	x	ID of 7th satellite used for fix
	x	ID of 8th satellite used for fix
	x	ID of 9th satellite used for fix
	x	ID of 10th satellite used for fix
	x	ID of 11th satellite used for fix
	x	ID of 12th satellite used for fix
	x.x	PDOP
	x.x	HDOP
	x.x	VDOP
	h	System ID **Note: NMEA v4.10 and V4.00**
	hh	Checksum

ID	GSA
Example NMEA version 3.01	$GNGSA,A,3,19,17,208,06,212,213,193,203,201,217,202,210,1.34,0.79,1.08*20 **Note: SVID_GPS: 01~32** **SVID_GLONASS: 65~96** **SVID_GALILEO: 301~336** **SVID_BEIDOU: 201~ 263** **SVID_IRNSS: 901~918** **SVID_QZSS: 193~199** **SVID_SBAS: 40~54**
Example NMEA version 4.00	$GPGSA,A,3,19,17,06,193,02,12,28,23,09,,,,1.46,0.82,1.21,1*24 $BDGSA,A,3,220,203,229,201,213,204,230,208,202,235,206,,1.25,0.69,1.05,4*30 $GLGSA,A,3,88,65,87,72,79,78,81,,,,,,1.51,0.86,1.24,2*0D $GAGSA,A,3,315,303,327,330,,,,,,,,,1.25,0.69,1.05,3*00 $GIGSA,A,3,904,907,903,909,902,905,,,,,,,1.52,0.86,1.26,6*02 **Note: SVID_GPS: 01~32** **SVID_GLONASS: 65~96** **SVID_GALILEO: 301~336** **SVID_BEIDOU : 201~263** **SVID_IRNSS: 901~918** **SVID_QZSS: 193~199** **SVID_SBAS: 40~54** **ID System** **1 GPS** **2 GLONASS** **3 GALILEO** **4 BEIDOU** **6 IRNSS**
Example NMEA version 4.01	$GNGSA,A,3,06,02,05,12,195,193,199,25,,,,,1.25,0.69,1.04*22 $GNGSA,A,3,81,66,88,65,79,,,,,,,,1.25,0.69,1.04*14 $GNGSA,A,3,315,303,327,330,,,,,,,,,1.25,0.69,1.04*11 $GNGSA,A,3,229,220,208,213,203,230,235,201,204,202,206,,1.25,0.69,1.04*26 **Note: SVID_GPS: 01~32** **SVID_GLONASS: 65~96** **SVID_GALILEO: 301~336** **SVID_BEIDOU : 201~263** **SVID_IRNSS: 901~918** **SVID_QZSS: 193~199** **SVID_SBAS: 40~54**

ID	GSA
Example NMEA version 4.10	$GNGSA,A,3,19,17,06,193,02,12,28,23,09,,,,1.48,0.83,1.22,1*36 (GPS) $GNGSA,A,3,81,88,66,65,79,,,,,,,,1.39,0.76,1.17,2*0B (GlONASS) $GNGSA,A,3,12,19,24,11,04,,,,,,,,1.48,0.86,1.21,3*0B(GALILEO) $GNGSA,A,3,08,12,13,03,01,17,02,10,04,05,07,,1.48,0.83,1.22,4*0B(BEIDOU) $GNGSA,A,3,04,07,03,09,05,02,,,,,,,2.41,1.40,1.96,6*04 (IRNSS) **Note: SVID_GPS: 1~32** **SVID_GLONASS: 65~96** **SVID_GALILEO: 1~36** **SVID_BEIDOU: 1~ 63** **SVID_IRNSS: 1~18** **SVID_QZSS: 193~199** **SVID_SBAS: 40~54** **System ID Identification Table** **ID System** **1 GPS** **2 GLONASS** **3 GALILEO** **4 BEIDOU** **6 IRNSS**

2.3 GRS - GNSS Range Residuals

ID	GRS	
Description	GNSS Satellite Range Residuals information	
Format (In V3.01/4.01)	$GNGRS,hhmmss.fff,m,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx*hh<CR><LF>	
Format (In V4.00)	$GPGRS,hhmmss.fff,m,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx*hh<CR><LF> $BDGRS,hhmmss.fff,m,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx*hh<CR><LF>	
Format (V4.10)	$GNGRS,hhmmss.fff,m,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,h,h*hh<CR><LF>	
Content (Shown in sequence)	 hhmmss.fff m xx xx xx xx xx xx xx xx xx xx xx xx h h hh	HourMinuteSecond. fraction (UTC) 0 = residuals were used to calculate the position given in the matching GGA or GNS sentence 1 = residuals were recomputed after the GGA or GNS position was computed Satellite 1 residual in meters Satellite 2 residual in meters Satellite 3 residual in meters Satellite 4 residual in meters Satellite 5 residual in meters Satellite 6 residual in meters Satellite 7 residual in meters Satellite 8 residual in meters Satellite 9 residual in meters Satellite 10 residual in meters Satellite 11 residual in meters Satellite 12 residual in meters (Order must match order of the satellite ID numbers in GSA) System ID **Note: NMEA v4.10 and above only** Signal ID **Note: NMEA v4.10 and above only** Checksum
Example NMEA version 3.01	$GNGRS,020219.00,1,-2.3,0.5,0.2,0.8,-0.0,-0.4,0.4,5.8,2.4,-1.1,-0.4,-1.1*59	
Example NMEA version 4.00	$GPGRS,020019.00,1,-2.5,0.8,-1.0,-0.2,0.3,0.4,-0.6,0.9,2.1,1.1,-0.8,*48 $GLGRS,020019.00,1,6.4,2.6,-1.0,-4.3,-3.6,,,,,,,*5E $GAGRS,020019.00,1,-0.3,-1.1,1.1,0.2,,,,,,,,*54 $BDGRS,020019.00,1,0.9,0.8,0.0,-0.0,-0.4,2.2,0.1,-0.8,-0.5,-1.0,-2.7,1.3*5A	
Example NMEA version 4.01	$GNGRS,020059.00,1,-2.6,0.7,-0.3,-0.4,0.3,0.6,-0.6,0.2,2.4,2.6,-0.6,*5C $GNGRS,020059.00,1,6.0,2.4,-1.2,-4.3,-2.8,,,,,,,*53 $GNGRS,020059.00,1,-0.5,-0.9,1.0,0.5,,,,,,,,*56 $GNGRS,020059.00,1,0.8,0.8,0.0,-0.3,-0.9,2.3,-0.8,0.2,-0.6,-0.9,-2.3,1.6*56	

Example NMEA version 4.10	$GNGRS,020707.00,1,-2.0,1.7,-0.3,0.3,0.4,-0.2,-0.2,-1.0,1.8,-0.9,2.3,,1,0*7A
System ID (only for 4.10)	ID System 1 GPS 2 GLONASS 3 GALILEO 4 BEIDOU 6 IRNSS
Dual frequence Signal ID (only for 4.10)	SIGID_GPS_L1CA (1) SIGID_GPS_L1P (2) SIGID_GPS_L1M (3) SIGID_GPS_L2CM (5) SIGID_GPS_L2CL (6) SIGID_GPS_L5I (7) SIGID_GPS_L5Q (8) SIGID_GPS_L1C (9) SIGID_GPS_L6 (11) SIGID_GLN_G1CA (1) SIGID_GLN_G2CA (3) SIGID_GAL_E5A (1) SIGID_GAL_E5B (2) SIGID_GAL_L1A (6) SIGID_GAL_L1BC (7) SIGID_BDS_B1I (1) SIGID_BDS_B2I (2) SIGID_BDS_B3I (3) SIGID_BDS_B2A (4) SIGID_BDS_B1C (9) SIGID_NAVIC (1) All Signal 0

2.4 GSV - GNSS Satellites in View

ID	GSV	
Description	Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value.	
Format (In V3.01)	$GNGSV,x,x,x,x,x,x,x,...*hh<CR><LF>	
Format (In V4.00/V4.01)	$GPGSV,x,x,x,x,x,x,x,...*hh<CR><LF> $BDGSV,x,x,x,x,x,x,x,...*hh<CR><LF>	
Format (In V4.10)	$GPGSV,x,x,x,x,x,x,x,...h*hh<CR><LF> $BDGSV,x,x,x,x,x,x,x,...h*hh<CR><LF>	
Content (Shown in sequence)	x x x x x x x ... h hh	Total number of GSV messages to be transmitted in this group Origin number of this GSV message within current group Total number of satellites in view (leading zeros sent) Satellite PRN number (leading zeros sent) Elevation in degrees (00-90) (leading zeros sent) Azimuth in degrees to true north (000-359) (leading zeros sent) SNR in dB (00-99) (leading zeros sent) More satellite info quadruples like 4-7n) ... Signal ID **Note: NMEA v4.10 and above only** Checksum
Example NMEA version 3.01	$GNGSV,6,1,24,19,73,351,51,17,69,86,54,208,68,358,49,6,65,298,55*5E $GNGSV,6,2,24,212,64,331,51,213,60,305,50,193,56,134,48,203,44,190,45*6C $GNGSV,6,3,24,53,38,212,46,201,37,145,44,217,35,140,43,50,35,139,39*6F $GNGSV,6,2,23,193,59,133,46,88,55,351,47,65,55,127,49,319,43,114,36*65 $GNGSV,6,4,22,909,19,255,40,16,25,216,39,50,35,139,38,905,17,189,37*69 **Note: SVID_GPS: 01~32** **SVID_GLONASS: 65~96** **SVID_GALILEO: 301-336** **SVID_BEIDOU: 201~ 263** **SVID_IRNSS: 901~918** **SVID_QZSS: 193~199** **SVID_SBAS: 40~54** **For more please see below in "Dual frequence Sat ID"**	

Example NMEA version 4.00/4.01	$GPGSV,3,2,12,53,38,212,46,50,35,139,42,41,32,226,42,28,25,173,44*77 $GPGSV,3,3,12,2,22,264,42,12,21,318,43,23,17,93,42,9,12,126,37*43 $BDGSV,3,1,12,216,79,57,44,237,67,249,44,220,53,301,44,870,53,301,44*57 $GLGSV,2,2,08,79,24,299,45,78,22,254,49,81,18,303,45,66,10,181,44*6F $GAGSV,2,1,05,12,69,355,46,19,42,115,42,24,30,246,45,11,27,290,40*60 $GIGSV,2,1,06,904,67,205,47,907,45,158,45,903,34,227,44,909,20,257,40*63 **Note: SVID_GPS: 01~32** **SVID_GLONASS: 65~96** **SVID_GALILEO: 301-336** **SVID_BEIDOU: 201~263** **SVID_IRNSS: 901~918** **SVID_QZSS: 193~199** **SVID_SBAS: 40~54** **For more please see below in "Dual frequence Sat ID"**
Example NMEA version 4.10	$GPGSV,3,2,11,19,32,147,42,41,32,226,42,12,27,254,43,25,19,296,39,1*66 $GPGSV,3,4,10,25,17,310,40,8*5C $BDGSV,4,4,16,10,18,213,35,1*4C $BDGSV,4,5,16,29,83,343,45,20,76,109,45,30,38,124,42,4*40 $GLGSV,2,1,06,81,48,335,48,88,61,73,43,66,53,182,38,65,52,44,37,1*73 $GAGSV,2,1,06,15,78,354,48,8,33,201,42,13,28,311,41,5,31,47,27,6*40 $GAGSV,2,2,06,15,78,354,46,13,28,311,41,2*75 $GIGSV,2,1,07,5,75,208,46,7,39,160,43,3,30,225,42,9,14,254,39,1*7D **Note: SVID_GPS: 01~32** **SVID_GLONASS: 65~96** **SVID_GALILEO: 01~36** **SVID_BEIDOU: 01~63** **SVID_IRNSS: 01~18** **SVID_QZSS: 193~199** **SVID_SBAS: 40~54** **For signal ID, please see below "Mutifrequence Signal ID"**

Dual frequency SAT ID (only for 3.01/4.00/4.01)	GN_NMEA_IDBASE_SBAS (87) 127~141 GN_NMEA_IDBASE_GPS (0) 01~32 GN_NMEA_IDBASE_GPSL1C (GN_NMEA_IDBASE_GPS + 400) 401~432 GN_NMEA_IDBASE_GPSL2CM (GN_NMEA_IDBASE_GPS + 500) 501~532 GN_NMEA_IDBASE_GPSL5 (GN_NMEA_IDBASE_GPS + 650) 651~682 GN_NMEA_IDBASE_GLONASS (64) 65~96 GN_NMEA_IDBASE_GLNG2 (GN_NMEA_IDBASE_GLONASS + 500) 565~596 GN_NMEA_IDBASE_BEIDOU (200) 201~ 263 GN_NMEA_IDBASE_BDSB1C (GN_NMEA_IDBASE_BEIDOU + 400) 601~663 GN_NMEA_IDBASE_BDSB2I (GN_NMEA_IDBASE_BEIDOU + 500) 701~763 GN_NMEA_IDBASE_BDSB3I (GN_NMEA_IDBASE_BEIDOU + 600) 801~863 GN_NMEA_IDBASE_BDSB2A (GN_NMEA_IDBASE_BEIDOU + 650) 851~913 GN_NMEA_IDBASE_GALILEO (300) 301-336 GN_NMEA_IDBASE_GALE5A (GN_NMEA_IDBASE_GALILEO + 650) 951~986 GN_NMEA_IDBASE_QZSS (192) 193~199 GN_NMEA_IDBASE_QZSSL5 (GN_NMEA_IDBASE_QZSS+ 650) 843~849 GN_NMEA_IDBASE_IRNSSL5 (GN_NMEA_IDBASE_GPS + 900) 901~917
Multi-frequency Signal ID	SIGID_GPS_L1CA (1) SIGID_GPS_L1P (2) SIGID_GPS_L1M (3) SIGID_GPS_L2CM (5) SIGID_GPS_L2CL (6) SIGID_GPS_L5I (7) SIGID_GPS_L5Q (8) SIGID_GPS_L1C (9) SIGID_GPS_L6 (11) SIGID_GLN_G1CA (1) SIGID_GLN_G2CA (3) SIGID_GAL_E5A (1) SIGID_GAL_E5B (2) SIGID_GAL_L1A (6) SIGID_GAL_L1BC (7) SIGID_BDS_B1I (1) SIGID_BDS_B2I (2) SIGID_BDS_B3I (3) SIGID_BDS_B2A (4) SIGID_BDS_B1C (9) SIGID_NAVIC (1) All Signal 0

2.5 RMC - Recommended Minimum Specific GNSS Data

ID	RMC	
Description	Time, date, position, course and speed data provided by a GNSS navigation receiver.	
Format	$GNRMC,hhmmss.fff,A,llll.lllll,a,yyyyy.yyyyy,a,x.x,x.x,ddmmyy,x.x,a,a*hh<CR><LF>	
Content (Shown in sequence)	hhmmss.fff	HourMinuteSecond. fraction (UTC)
	A	Status, V=Navigation receiver warning A=Valid
	llll.lllll	Latitude (HD9300/HD9400 series llll.lllllll)
	a	N or S
	yyyyy.yyyyy	Longitude (HD9300/HD9400 series yyyyy.yyyyyyy)
	a	E or W
	x.x	Speed over ground, knot
	x.x	Degrees to true north
	ddmmyy	Date
	x.x	Magnetic variation
	a	Degrees E/W
	a	Mode Indicator: V = Invalid, A= Autonomous and D =Differential, F = Float RTK, P = Precise and R=Real Time Kinematic
	a	navStatus **Note: NMEA v4.10 and above only**
	hh	Checksum
Example 3.01/4.00/4.01	$GNRMC,115332.000,A,4006.20852,N,11628.14483,E,0.000,0.50,041215,,,A*48	
Example NMEA version 4.10	$GNRMC,115522.000,A,4006.20885,N,11628.14498,E,0.000,0.50,041215,,,A,S*30	

2.6 VTG - Course over Ground and Ground Speed

ID	VTG (support NMEA version 3.01/4.00/4.10)	
Description	The actual course and speed relative to the ground	
Format	$GNVTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>	
Content (Shown in sequence)	x.x	Track Degrees
	T	True
	x.x	Magnetic Degrees
	M	Magnetic
	x.x	Speed Knots
	N	Knots
	x.x	Speed Kilometers Per Hour
	K	Kilometers Per Hour
	A	Mode Indicator: V = Invalid, A= Autonomous and D =Differential
	hh	Checksum
Example	$GNVTG,0.50,T,,M,0.000,N,0.000,K,A*26	

2.7 ZDA - Time & Date

ID	ZDA (support NMEA version 4.10/3.01/4.00)	
Description	Time & Date - UTC, day, month, year and local time zone	
Format	$GNZDA,hhmmss.fff,dd,mm,yyyy,xx,yy*hh<CR><LF>	
Content (Shown in sequence)	hhmmss.fff	HourMinuteSecond. fraction (UTC)
	dd	Day
	mm	Month
	yyyy	Year
	xx	Local zone hours -13..13
	yy	Local zone minutes 0..59
	hh	Checksum
Example	$GNZDA,072319.000,14,10,2015,-7,45*5F	

2.8 GLL - Geographic Position - Latitude/Longitude

ID	GLL(support NMEA version 4.10/3.01/4.00)	
Description	Latitude and Longitude of vessel position, time of position fix and status.	
Format support	$GNGLL,llll.lllll,a,yyyyy.yyyyy,a,hhmmss.fff,A,a*hh<CR><LF>	
Content (Shown in sequence)	llll.lllll	Latitude (HD9300/HD9400 series llll.lllllll)
	a	N or S (North or South)
	yyyyy.yyyyy	Longitude (HD9300/HD9400 series yyyyy.yyyyyyy)
	a	E or W (East or West)
	hhmmss.fff	HourMinuteSecond.fraction (UTC)
	A	Status A - Data Valid, V - Data Invalid
	a	Mode Indicator: V = Invalid, A= Autonomous and D =Differential
	hh	Checksum
Example	$GNGLL,2225.56149,N,11412.68190,E,074822.001,A,A*44	

2.9 GST- GNSS Pseudorange Error Statistics

ID	GST	
Description	Reports statistical information on the quality of the position solution.	
Format support	$GPGST,hhmmss.fff,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF> $GNGST,hhmmss.fff,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>	
Content (Shown in sequence)	hhmmss.fff	HourMinuteSecond. fraction (UTC)
	x.x	RMS value of the standard deviation of the
	x.x	Standard deviation of semi-major axis
	x.x	Standard deviation of semi-minor axis
	x.x	Orientation of semi-major axis
	x.x	Standard deviation of latitude error
	x.x	Standard deviation of longitude error
	x.x	Standard deviation of altitude error
	hh	Checksum
Example	$GPGST,082356.00,1.8,,,,1.7,1.3,2.2*7E	

2.10 TXT - system or user defined message

ID	TXT(support NMEA version 4.10/3.01/4.00)	
Description	System or user defined message	
Format support	$GNTXT,xx,xx,xx,ccc*hh<CR><LF>	
Content (Shown in sequence)	xx	total number $xxTXT in the current period
	xx	subsequent ID, counting from 01, 02 and so on
	xx	message of system first starting
	ccc	ALLYSTAR or ANT_OK or customer flag
	hh	Checksum

Example	$GNTXT,02,01,01,ALLYSTAR*5F (after hardware reset) $GNTXT,02,01,02,ALLYSTAR*5C (after reset by start command)

2.11 BAS Description

There are several compatible SBAS systems available or in development all around the world:

- WAAS (Wide Area Augmentation System) for North America has been in operation since 2003.
- MSAS (Multi-Functional Satellite Augmentation System) for Asia has been in operation since 2007.
- EGNOS (European Geostationary Navigation Overlay Service) has been in operation since 2009.
- GAGAN (GPS Aided Geo Augmented Navigation)
- SDCM (Difference correction and monitoring system)

The following table shows the PRN value in ALLYSTAR NMEA protocol.

NMEA Version	WAAS		EGNOS		GAGAN		MSAS		SDCM	
	ORIGINAL-PRN	AS PRN	ORIGINAL-PRN	AS PRN	ORIGINAL-PRN	AS PRN	ORIGINAL-PRN	AS PRN	ORIGINAL-PRN	AS PRN
3.01	135	48	120	33	127	40	129	42	140	53
	138	51	124	37	128	41	137	50	125	38
	133	46	126	39	-	-	-	-	-	-
	-	-	136	49	-	-	-	-	-	-
4.00	135	135	120	120	127	127	129	129	140	140
	138	138	124	124	128	128	137	137	125	125
	133	133	126	126	-	-	-	-	-	-
	-	-	136	136	-	-	-	-	-	-
4.10	135	48	120	33	127	40	129	42	140	53
	138	51	124	37	128	41	137	50	125	38
	133	46	126	39	-	-	-	-	-	-
	-	-	136	49	-	-	-	-	-	-

* *In NMEA V3.01 and 4.10 the SBAS PRN offset value set with -87, and in the V4.00 the SBAS PRN offset value set with 0.*

3 BINARY MESSAGES

All binary messages start with a fixed start sequence followed by a message ID in order to identify the packet type. Some message has payload with dynamic length, therefore a payload length is included to locate the payload region. At the same time, a 16-bit checksum will be padded after payload for message integrity.

ALLYSTAR Binary message packet							
Start sequence		Message ID		Payload length	Payload	End sequence
Dec 241 Hex F1	Dec 217 Hex D9	Group ID (1 byte)	Sub ID (1 byte)	Length in Little Endian (2 bytes)	Message dependant (0 - N bytes)	16 Bit checksum {CK1, CK2} (2 bytes)

3.1 Packet field description

3.1.1 Start Sequence

Start sequences is needed for every binary message packet in order to distinguish the start of a message.

3.1.2 Message ID

Message ID is divided into group ID and sub ID. Messages in the same group are with similar content for multipurpose usage while sub ID are used to distinguish between different packets.
The following table describes each group:

Symbol	ID(HEX)	Description
NAV	0x01	Receiver status information
ACK	0x05	Response packets for CFG type packets
CFG	0x06	Configure receiver's options
MON	0x0A	Monitoring receiver status
AID	0x0B	GNSS aiding information

3.1.3 Payload Length

This is a 2-byte long field describing length of the payload. It does not include any length other than the payload (Start sequence, Message ID, etc.). Which means the smallest possible value of payload length can be zero. The 2 byte payload length is aligned with little endian format.

3.1.4 Payload

Payload refers to the content of a message. Payload content and their respective details will be discussed later.

3.1.5 End Sequence

End sequence includes a 16-Bit checksum. Its calculation is the 8-Bit Fletcher Algorithm. The checksum value is calculated from the start byte of Message ID to the last byte of payload content, start sequence is ignored when calculating checksum.
Algorithm:

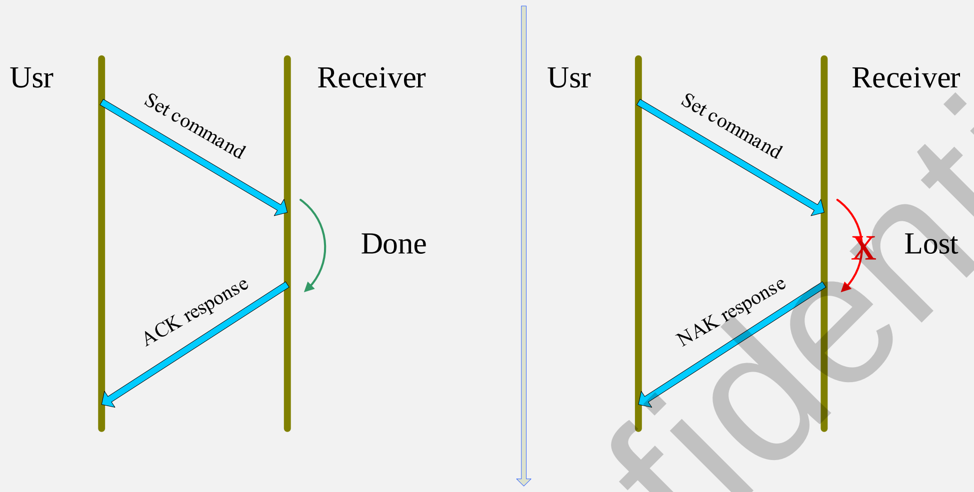
1 Ckecksum1 = 0
2 Checksum2 = 0
3 For each byte **B** from Message ID to last byte of payload
4 Ckecksum1 = Ckecksum1 + **B**
5 Checksum2 = Checksum2 + Ckecksum1
6 Mask Ckecksum1 with 0xFF
7 Mask Checksum2 with 0xFF

* *The result 2 bytes checksum sequence would be {Checksum1, Checksum2}.*

3.2 Protocol data transfer

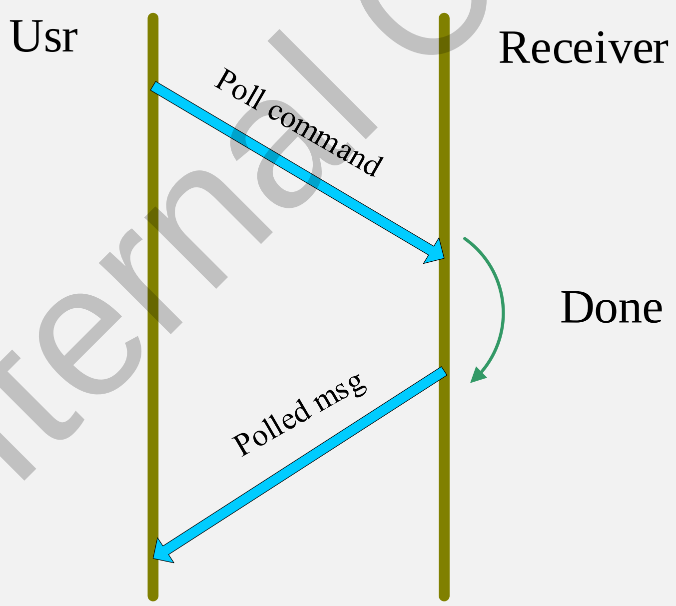
3.2.1 CFG Packet Scenario

An Acknowledge (ACK) or a NOT Acknowledge (NACK) packet will be sent back to sender after any set action of the CFG group command received. Implication of the ACK/NACK packet is message dependent. ACK/NACK message is ONLY sent when CFG message received.



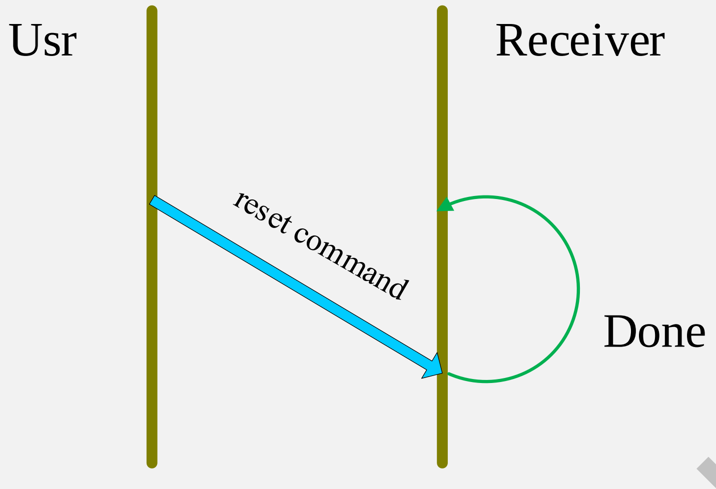
3.2.2 Poll Packet Scenario

Some of the packet can be polled through sending a poll packet. The poll packet is also a standard binary message and has the same group ID and sub ID with the packet being polled. Unless specified, a poll packet usually contains empty payload.



3.2.3 Others

For some other packets, ALLYSTAR GNSS receiver would neither ACK nor response to sender.



4 BINARY PACKET OVERVIEW

Name	Msg. ID	Length	Type	Description
NAV-POSECEF	0x01 0x01	0	Poll	Position solution in ECEF
NAV-POSECEF	0x01 0x01	20	Get	Position solution in ECEF
NAV-POSLLH	0x01 0x02	0	Poll	Geodetic Position
NAV-POSLLH	0x01 0x02	28	Get	Geodetic Position
NAV-DOP	0x01 0x04	0	Poll	Dilution of precision
NAV-DOP	0x01 0x04	18	Get	Dilution of precision
NAV-CLOCK	0x01 0x22	0	Poll	Clock solution
NAV-CLOCK	0x01 0x22	20	Get	Clock solution
NAV-SVINFO	0x01 0x30	0	Poll	Satellite information
NAV-SVINFO	0x01 0x30	8 + 24N	Get	Satellite information
NAV-TIME	0x01 0x05	1	Poll	Time solution command
NAV-TIME	0x01 0x05	16	Polled	GNSS (GPS or BD) Time solution message
ACK-NACK	0x05 0x00	2	Response	Message not-acknowledge
ACK-ACK	0x05 0x01	2	Response	Message acknowledge
CFG-PRT	0x06 0x00	1	Poll	Port Configuration
CFG-PRT	0x06 0x00	8	Polled / Set	Port Configuration
CFG-MSG	0x06 0x01	2	Poll	Message Rate Configuration
CFG-MSG	0x06 0x01	3	Polled / Set	Message Rate Configuration
CFG-PPS	0x06 0x07	0	Poll	Pulse per second
CFG-PPS	0x06 0x07	5	Polled / Set	Pulse per second
CFG-DOP	0x06 0x0A	0	Poll	DOP mask for navigation use
CFG-DOP	0x06 0x0A	4	Polled / Set	DOP mask for navigation use
CFG-ELEV	0x06 0x0B	0	Poll	Elevation mask for navigation use
CFG-ELEV	0x06 0x0B	4	Polled / Set	Elevation mask for navigation use
CFG-NAVSAT	0x06 0x0C	0	Poll	Navigation satellite mask
CFG-NAVSAT	0x06 0x0C	4	Polled/Set	Navigation satellite mask
CFG-HEIGHT	0x06 0x0D	0	Poll	Get the height limitation
CFG-HEIGHT	0x06 0x0D	16	Polled/Set	Config the height limitation
CFG-SBAS	0x06 0x0E	26	Poll	SBAS status for use
CFG-SBAS	0x06 0x0E	26	Polled / Set	SBAS status configuration
CFG-SPDHOLD	0x06 0x0F	0	Poll	Query static hold speed for navigation use
CFG-SPDHOLD	0x06 0x0F	2	Polled / Set	Configuration static hold speed for navigation use
CFG-SIMPLERST	0x06 0x40	1	Set	Simple startup command
CFG-NMEAVER	0x06 0x43	0	Poll	Get the version of NMEA
CFG-NMEAVER	0x06 0x43	1	Polled/Set	Set the version of NMEA
MON-VER	0x0A 0x04	0	Poll	Software/Hardware version

Name	Msg. ID	Length	Type	Description
MON-VER	0x0A 0x04	32	Polled	Software/Hardware version
MON-INFO	0x0A 0x05	0	Poll	Special customized information
MON-INFO	0x0A 0x05	2+N	Polled/Set	Special customized information
AID-INI	0x0B 0x01	0	Poll	Initial Aiding Data
AID-INI	0x0B 0x01	48	Polled / Set	Initial Aiding Data
AID-EPH-GPS	0x0B 0x32	1	Poll	Ephemeris Data for particular svid (if 0, for all GPS)
AID-EPH-GPS	0x0B 0x32	65	Polled / Set	Ephemeris Data
AID-EPH-BD	0x0B 0x33	1	Poll	Ephemeris Data for particular svid (if 0, for all BD)
AID-EPH-BD	0x0B 0x33	92	Polled / Set	Ephemeris Data

5 DETAILED PACKET DESCRIPTION

In this section, all binary messages content will be discussed in details.
In the payload contents sections of the following tables, byte offset refers to the byte offset starting from the first byte in the payload.
To abbreviate data type names, we have the following definitions table for data type.

Symbol	Name	Size in bytes
U1	Unsigned char	1
S1	Signed char	1
U2	Unsigned short	2
S2	Signed short	2
U4	Unsigned integer	4
S4	Signed integer	4
R4	float	4

* *The examples after binary message descriptions table are hexadecimals. Spaces between two hexadecimals (e.g. space between F1 D9) are delimiters for better present, and they should not be included when communicating with GNSS receivers.*

5.1 Navigation messages (NAV)

5.1.1 NAV-POSECEF

MESSAGE	NAV-POSECEF				
Description	Position solution in ECEF				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x01	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current Position solution in ECEF

F1 D9 01 01 00 00 02 07

MESSAGE	NAV-POSECEF				
Description	Position solution in ECEF				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x01	20	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	S4		ecefX	cm	ECEF X coordinate

8	S4		ecefY	cm	ECEF Y coordinate
12	S4		ecefZ	cm	ECEF Z coordinate
16	U4		pAcc	cm	Position Accuracy Estimate

5.1.2 NAV-POSLLH

MESSAGE	NAV-POSLLH				
Description	Position solution in LLA				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x02	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current Position solution in LLA

F1 D9 01 02 00 00 03 0A

MESSAGE	NAV-POSLLH				
Description	Position solution in LLA				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x02	28	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	S4	1e-7	lon	degrees	Longitude
8	S4	1e-7	lat	degrees	Latitude
12	S4		height	mm	Height above Ellipsoid
16	S4		hMSL	mm	Height above mean sea level
20	U4		hAcc	mm	Horizontal Accuracy Estimate
24	U4		vAcc	mm	Vertical Accuracy Estimate

5.1.3 NAV-DOP

MESSAGE	NAV-DOP				
Description	Dilution of precision				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x04	0	See below	CK_1 CK_2
No Payload					

MESSAGE	NAV-DOP				
Description	Dilution of precision				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x04	18	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	U2	0.01	gDOP		Geometric DOP
6	U2	0.01	pDOP		Position DOP
8	U2	0.01	tDOP		Time DOP
10	U2	0.01	vDOP		Vertical DOP
12	U2	0.01	hDOP		Horizontal DOP
14	U2	0.01	nDOP		Northing DOP
16	U2	0.01	eDOP		Easting DOP

5.1.4 NAV-TIME

MESSAGE	NAV-TIME				
Description	GNSS time solution				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x05	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		navSys		0 : GPS 1 : BD 2: Glonass 3: Galileo

Example:

Poll current GPS time message

F1 D9 01 05 01 00 00 07 1C

MESSAGE	NAV-TIME				
Description	GNSS Time solution message				
Type	Polled				
Comment					
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x05	16	See below	CK_1 CK_2
Payload Contents:					

Byte Offset	Data Type	Name	Unit	Description
0	U1	navSys		0: GPS 1: BD 2: Glonass 3: Galileo
1	U1	flag		1: valid 0: invalid Bit0 : week Bit1: second Bit2: Leapsecond
2	S2	Fractow	ns	Fraction part of GNSS Time of week
4	U4	refTow	ms	Reference GNSS Time
8	U2	Week		Week in GNSS time
10	S2	leapSec	s	Leap second to UTC
12	U4	timeErr	ns	Possible error in time

Example:

Get the GPS time

F1 D9 01 05 10 00 00 07 2C 79 FF 55 3E 16 10 00 12 00 06 00 00 00 92 5A

5.1.5 NAV-VELECEF

MESSAGE	NAV-VELECEF				
Description	Velocity solution in ECEF				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x11	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current Velocity solution in ECEF

F1 D9 01 11 00 00 12 37

MESSAGE	NAV-VELECEF				
Description	Velocity solution in ECEF				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x11	20	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	S4		ecefVX	cm/s	ECEF X velocity
8	S4		ecefVY	cm/s	ECEF Y velocity
12	S4		ecefVZ	cm/s	ECEF Z velocity
16	U4		sAcc	cm/s	Speed Accuracy Estimate

5.1.6 NAV-VELNED

MESSAGE	NAV-VELNED				
Description	Velocity solution in NED				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x12	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current Velocity solution in NED

F1 D9 01 12 00 00 13 3A

MESSAGE	NAV-VELNED				
Description	Velocity solution in NED				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x12	36	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	S4		velN	Cm/s	North velocity
8	S4		velE	Cm/s	East velocity
12	S4		velD	Cm/s	Down velocity
16	U4		speed	Cm/s	Speed(3D)
20	U4		gSpeed	Cm/s	Ground speed (2D)
24	S4	1e-5	heading	deg	Heading of motion (2D)
28	U4		sAcc	Cm/s	Speed Accuracy Estimate
32	U4	1e-5	cAcc	deg	Course/Heading Accuracy Estimate

5.1.7 NAV-TIMEUTC

MESSAGE	NAV-TIMEUTC				
Description	UTC Time Solution				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x21	0	See below	CK_1 CK_2
No Payload					

MESSAGE	NAV-TIMEUTC				
Description	UTC Time Solution				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x21	20	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	U4		tAcc	ns	Time Accuracy Estimate
8	S4		nano	ns	Nanoseconds of second, range -500000000~500000000 (UTC)
12	U2		year	y	Year, range 1999~2099 (UTC)
14	U1		month	m	Month, range 1~12 (UTC)
15	U1		day	d	Day of Month, range 1~31 (UTC)
16	U1		hour	h	Hour of Day, range 0~23 (UTC)
17	U1		min	m	Minute of Hour, range 0~59 (UTC)
18	U1		sec	s	Second of Min, range 0~59 (UTC)
19	U1		ValidFlag		Please see below

ValidFlag bit description		
Bit number	**ValidFlag**	**Description**
0	Valid TOW	1 means valid time of week
1	Valid WKN	1 means valid week number
2	Valid UTC	1 means valid UTC time
3	reserved	reserved
7~4	utcStandard	UTC standard identifier (four bits make the value from 0~15). 0: Information not available 1: National Time Service Center, China (NTSC) 2: U.S. Naval Observatory (USNO) 4: European Laboratory (EUL) 5: Former Soviet Union (SU) 6: India(INDIA) Others : Unknown

5.1.8 NAV-CLOCK

MESSAGE	NAV-CLOCK				
Description	Clock Solution				
Type	Poll				
Comment	Get the clock status when the receiver position, the value of clock drift/1000 is the clock error. If the TXCO SPEC is 0.5 ppm, the value should not be larger than it.				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x22	0	See below	CK_1 CK_2
No Payload					

MESSAGE	NAV-CLOCK				
Description	Clock Solution				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x22	20	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	S4		clkB	ns	Clock bias in nanoseconds
8	S4		clkD	ns/s	Clock drift in nanoseconds per second
12	U4		tAcc	ns	Time Accuracy Estimate
16	U4		fAcc	ps/s	Frequency Accuracy Estimate

5.1.9 NAV-CLOCK2

MESSAGE	NAV-CLOCK2				
Description	Satellite clock Solution extention				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x23	0	See below	CK_1 CK_2
No Payload					

Example:

Poll Satellite system clock Solution extention

F1 D9 01 23 00 00 24 6D

MESSAGE	NAV-CLOCK2
Description	Satellite clock solution extention
Type	Polled

Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x23	8+12N	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	U4		numClk		Number of satellite clock
Start of repeated block (n>=0)					
8 + 12*n	U4		sysmask		Bit Mask of signal bias GPS_L1 = 0x00000001 QZSS_L1 = 0x00000020 SBAS_L1 = 0x00000040 GALILEO_E1 = 0x00000010 BEIDOU_B1 = 0x00000004 GLONASS_G1 = 0x00000002 NAVIC_L5 = 0x00000080 GPS_L1C = 0x00000100 GPS_L5 = 0x00000200 GPS_L2C = 0x00000400 GLONASS_G2 = 0x00002000 BEIDOU_B1C = 0x00004000 BEIDOU_B2A = 0x00008000 BEIDOU_B3I = 0x00010000 BEIDOU_B5 = 0x00020000 BEIDOU_B2 = 0x00040000 GALILEO_E5A = 0x00100000 GALILEO_E5B = 0x00200000 GALILEO_E6 = 0x00400000 QZSS_L6 = 0x01000000, QZSS_L1C = 0x02000000 QZSS_L5 = 0x04000000 QZSS_L2C = 0x08000000 QZSS_L1S = 0x00000008
12 + 12*n	S4		clkB	ns	Clock bias in nanoseconds
16 + 12*n	U4		tAcc	ns	Time Accuracy Estimate

5.1.10 NAV-PVERR

MESSAGE	NAV-PVERR				
Description	Positioning velocity error estimation				
Type	Poll				
Comment	-				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x01 0x26	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current positioning velocity error estimation

F1 D9 01 26 00 00 27 76

MESSAGE	NAV-PVERR				
Description	Positioning velocity error estimation				
Type	Polled				
Comment	-				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x01 0x26	28	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	U4		stdlat	mm	Latitude 1 sigma error
8	U4		stdlon	mm	Longitude 1 sigma error
12	U4		stdalt	mm	Altitude 1 sigma error
16	U4		stdve	mm/s	East velocity 1 sigma error
20	U4		stdvn	mm/s	North velocity 1 sigma error
24	U4		stdvu	mm/s	Up velocity 1 sigma error

5.1.11 NAV- SVINFO

MESSAGE	NAV-SVINFO				
Description	Request Space Vehicle Information				
Type	Poll				
Comment	-				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x01 0x30	0	See below	CK_1 CK_2
No Payload					

MESSAGE	NAV-SVINFO				
Description	Space Vehicle Information				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x30	8+ 24N	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	U4		numCh		Number of channels
Start of repeated block (n>=0)					
8+24*n	U2		svid		Satellite ID
10+24*n	S1		flags		Bitmask (Refer to manual)
11+24*n	S1		quality		Bitfield (Refer to manual)
12+24*n	U1		cno	dbHz	Carrier to Noise Ratio (Signal Strength)
13+24*n	S1		elev	degrees	Elevation in integer degrees
14+24*n	S2		azim	degrees	Azimuth in integer degrees
16+24*n	S4		prRes	cm	Pseudo range residual in centimetres
20+24*n	R4		pseudorangeRate	m/s	Pseudo range rate
24+24*n	R8		pseudorange	m	Pseudo range

5.1.12 NAV- SVSTATE

MESSAGE	NAV-SVSTATE				
Description	Request satellite status				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x32	0	See below	CK_1 CK_2
No Payload					

MESSAGE	NAV-SVSTATE				
Description	Satellite status Information				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0x32	8+ 4N	See below	CK_1 CK_2
Payload Contents:					

Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	U4		numSV		Number of satellites
5	U1		rev		reserved
Start of repeated block (n>=0)					
8+4*N	U2		svid		SVID in NMEA format
10+4*N	U1		eph_state		**4/2/2 :** eph usability / sv visibility / sv health **Definition:** eph usability: // 0 : no longer be used // 1-14: 0.5 to 7 hours // 15 : over 7 hours visibility: // 0: unknown // 1: below horizon // 2: above horizon // 3: above elevation mask health: // 0: unknown // 1: healthy // 2: not healthy
11+4*N	U1		alm_state		**4/2/2 :** alm usability / alm source / eph source **Definition:** alm usability: // 0 : no longer be used // 1-14: 1-14 days // 15 : over 14 days eph/alm source: // 0: not available // 1: GNSS transmission // 2: external adding

5.1.13 NAV- AUTO

MESSAGE	NAV-AUTO				
Description	General GNSS information for automotive application				
Type	Poll				
Comment	-				
Message	Header	ID	Length (Bytes)	Payload	Checksum

Structure	0xF1 0xD9	0x01 0XC0	0	See below	CK_1 CK_2
No Payload					

MESSAGE	NAV-AUTO				
Description	General GNSS information for automotive application				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0XC0	32	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		fixstate		Fix status 0: No fix 1: Aided fix 2: Clock Bias fix 3: 2D fix 4: 3D fix 5: DGNSS fix 6: RTK float integers 7: RTK fixed integers
1	U2		year	year	Year, range 1999..2099 (UTC)
3	U1		month	month	Month, range 1..12 (UTC)
4	U1		day	day	Day of Month, range 1..31 (UTC)
5	U1		hour	hour	Hour of Day, range 0..23 (UTC)
6	U1		min	min	Minute of Hour, range 0..59 (UTC)
7	U1		sec	sec	Seconds of Minute, range 0..59 (UTC)
8	S4	1e-7	lon	degrees	Longitude
12	S4	1e-7	lat	degrees	Latitude
16	S4		alt	mm	Altitude
20	U2		speed	cm/s	Speed (3-D)
22	S2	1e-2	heading	degrees	Heading 2-D, range +-180.00
24	U2	0.01	pDOP		Position DOP
26	U2	0.01	hDOP		Horizontal DOP
28	U2	0.01	vDOP		Vertical DOP
30	U1		satInUse		Satellite in use
31	U1		satInView		Satellite in view

5.1.14 NAV- PVT

MESSAGE	NAV-PVT				
Description	Request PVT message				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0xC1	0	See below	CK_1 CK_2
No Payload					

MESSAGE	NAV-PVT				
Description	PVT message				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x01 0xC1	88	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		iTow	ms	GNSS Millisecond Time of Week
4	U2		year		UTC Year
6	U1		month		UTC month
7	U1		day		UTC day
8	U1		hour		UTC hour
9	U1		min	min	UTC minute
10	U1		sec	s	UTC second
11	U1		valid		Information status
12	U4		tAcc	ns	Time accuracy estimate (UTC)
16	S4		nano	ns	Fraction of second, range -1e9 .. 1e9 (UTC)
20	U1		fixType		GNSSfix Type: 0: no fix 1: dead reckoning only 2: 2D-fix 3: 3D-fix 4: GNSS + dead reckoning combined 5: time only fix
21	U1		res		reserved
22	U1		res		reserved
23	U1		numSV		Number of satellites used in Nav Solution
24	S4	1e-7	Lon	deg	Longitude

28	S4	1e-7	Lat	deg	Latitude
32	S4		Height	mm	Height above ellipsoid
36	S4		hMSL	mm	Height above mean sea level
40	U4		hAcc	mm	Horizontal accuracy estimate
44	U4		vAcc	mm	Vertical accuracy estimate
48	S4		Vel_N	mm/s	North velocity component
52	S4		Vel_E	mm/s	East velocity component
56	S4		Vel_D	mm/s	Down velocity component
60	S4		gSpeed	mm/s	Ground Speed (2-D)
64	S4	1e-5	headMot		Heading of motion (2-D)
68	U4		sAcc		Speed accuracy estimate
72	U4	1e-5	headAcc		Heading accuracy estimate (both motion and vehicle)
76	U2	0.01	pDop		Position DOP
78	U2		Res		reserved
84	S4	1e-5	headVeh		Heading of vehicle (2-D)

5.2 Receiver Manager Messages

5.2.1 RXM-DUMPRAW

MESSAGE	RXM-DUMPRAW				
Description	Enable/disable dump rawdata message				
Type	Set				
Comment	Periodic output raw message				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x02 0x01	01	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		type		0: disable 1: enable

Example:

Enable the rawdata output

F1 D9 02 01 01 00 01 05 12
Disable the rawdata output
F1 D9 02 01 01 00 00 04 11

5.3 Message Acknowledge (ACK)

5.3.1 ACK-NAK

MESSAGE	ACK-NAK				
Description	Message not-acknowledge				
Type	Response				
Comment	The response message for a message ID which is invalid or not recognized				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x05 0x00	2	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		groupID		Group ID of the not acknowledge signal
1	U1		subID		Sub ID of the not-acknowledge signal

Example:
Receiver NOT acknowledge message CFG-MSG which include invalid payload content (GroupID: 0x06, SubID: 0x01)
F1 D9 05 00 02 00 06 01 0E 33

5.3.2 ACK-ACK

MESSAGE	ACK-ACK				
Description	Message acknowledge				
Type	Response				
Comment	The response message for a message ID which is valid and recognized				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x05 0x01	2	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		groupID		Group ID of the acknowledge signal
1	U1		subID		Sub ID of the acknowledge signal

Example:
Receiver acknowledge message CFG-SIMPLERST (GroupID: 0x06, SubID: 0x40)
F1 D9 05 01 02 00 06 40 4E 77

5.4 Configuration Input Messages (CFG)

5.4.1 CFG-PRT

MESSAGE	CFG-PRT				
Description	Query communication port configuration				
Type	Poll				
Comment	Support UART0 and UART1				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x00	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		portID		Port Identifier Number 0 : UART0 1 : UART1

Example:

Poll current UART1 configuration

F1 D9 06 00 01 00 00 07 21

MESSAGE	CFG-PRT				
Description	Port Configuration				
Type	Polled/Set				
Comment	Set the configuration (baudrate) of communication port				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x00	8	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		portID		Port Identifier Number 0: UART0 1: UART1
1	U1[3]		res		Reserved
4	U4		baudrate	Bits/s	Baudrate

Example:

To set UART1 at 9600

F1 D9 06 00 08 00 01 00 00 00 80 25 00 00 B4 0F

To set UART0 at 115200

F1 D9 06 00 08 00 00 00 00 00 00 C2 01 00 D1 E0

5.4.2 CFG-MSG

MESSAGE	CFG-MSG				
Description	Query message configurations				
Type	Poll				
Comment	-				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x01	2	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		msggroup		Message Group
1	U1		subID		Message Sub ID

Example:

Poll current message rate of NMEA GGA message

F1 D9 06 01 02 00 F0 00 F9 11

MESSAGE	CFG-MSG				
Description	Message configurations				
Type	Polled/Set				
Comment	-				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x01	3	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		Class ID		Message Group
1	U1		Message ID		Message Sub ID
2	U1		Period		Period of message

Example:

Set NMEA GSV message rate to 1 per 2 seconds

F1 D9 06 01 03 00 F0 04 02 00 19

Set NMEA GLL message rate to 1 per 5 seconds

F1 D9 06 01 03 00 F0 01 05 00 16

Disable NMEA VTG message

F1 D9 06 01 03 00 F0 06 00 00 1B

Set RTCM3 1005 message rate to 5 (per update rate)

F1 D9 06 01 03 00 F8 05 05 0C 36

5.4.3 CFG-PPS

MESSAGE	CFG-PPS				
Description	Query Pulse per second configuration				
Type	Poll				
Comment	-				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x07	0	See below	CK_1 CK_2
No Payload					

Example:

To poll current PPS configuration

F1 D9 06 07 00 00 0D 2D

MESSAGE	CFG-PPS (For Cynosure I)					
Description	Pulse per second					
Type	Polled/Set					
Comment	(FOR CYNOSUE I ONLY)					
Message Structure	Header	ID	Length (Bytes)		Payload	Checksum
	0xF1 0xD9	0x06 0x07	5		See below	CK_1 CK_2
			12			
Payload Contents:						
Byte Offset	Data Type	Scale	Name	Unit	Description	
0	U4		Length	us	Pulse Width in micro-second	
1	R1		Polarity		Pulse polarity at the start of PPS, 0 = falling edge at start of second	

MESSAGE	CFG-PPS (For Cynosure II/III)				
Description	Pulse per second				
Type	Polled/Set				
Comment	Extend to support cynosure II format				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x07	15	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		period	us	One elapsed cycle time of PPS in microsecond
4	S4		Offset	ns	Pulse delay defined by user. The default value is 0 which means the function disabled and the GPIO output low.
8	U4	10-6	Duty Cycle	%	Ratio of Active part in PPS
12	U1		Polarity	-	Pulse polarity at the start of PPS, 0 = falling edge at start of second
13	U1		GPIO		0~15
14	U1		Sync		0- Only output PPS when fixing 1- Keep PPS even there is no position fix

Example:

In cynosure II, to set 1PPS with pulse length 500us and positive polarity high on GPIO13 with PPS output even there is no position fix.

F1 D9 06 07 0F 00 40 42 0F 00 00 00 00 10 27 00 00 01 0D 01 F3 86

The calculator of PPS:

The pulse width of the PPS = $\frac{dutycycle}{10^6} \times \frac{period}{10^6} s$

5.4.4 CFG-CFG

MESSAGE	CFG-CFG				
Description	Clear, Save current configurations				
Type	Set				
Comment	Clear / Write system configuration on/into nonvolatile memory				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x09	8	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		action		0: Save 1: Load 2: Clear
4	U4		mask		Bit 0: Baudrate Bit 1: NMEA message rate Bit 2: Navigation settings Bit 3: Reserved Bit 5: Reserved 0xFFFFFFFF: Factory reset

Example:

Write baudrate and NMEA message rate configuration into involatile memory

F1 D9 06 09 08 00 00 00 00 00 03 00 00 00 1A 07

Write navigation related settings (DOP mask, Elev mask, height limit, satellite to use, nmea version,alt, ecef position,ephemeris saving etc.) into involatile memory

Example: F1 D9 06 09 08 00 00 00 00 00 04 00 00 00 1B 0B

Factory reset:

F1 D9 06 09 08 00 02 00 00 00 FF FF FF FF 15 01

5.4.5 CFG-DOP

MESSAGE	CFG-DOP				
Description	Query DOP mask for navigation use				
Type	Poll				
Comment	Poll current DOP mask configuration				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0A	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current DOP mask configuration

F1 D9 06 0A 00 00 10 36

MESSAGE	CFG-DOP
Description	DOP mask for navigation use
Type	Polled/Set
Comment	Position unfix if DOP value is larger than the mask

Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0A	4	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U2	0.01	pDOP		Position DOP
2	U2	0.01	tDOP		Time DOP

Example:

Configure DOP mask of PDOP and TDOP to 50

F1 D9 06 0A 04 00 88 13 88 13 4A 0A

5.4.6 CFG-ELEV

MESSAGE	CFG-ELEV				
Description	Query satellite elevation mask for navigation use				
Type	Poll				
Comment	Poll current ELEV mask configuration				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x0B	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current ELEV mask configuration

F1 D9 06 0B 00 00 11 39

MESSAGE	CFG-ELEV				
Description	Elevation mask for navigation use				
Type	Polled/Set				
Comment	Satellite is not used in position fix if its elevation angle is less than the mask				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x0B	8	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	R4		trkMask	radian	Track elevation angle mask
4	R4		naviMask	radian	Navigation elevation angle mask

Example:

Configure ELEV with track mask and navigation mask to 0

F1 D9 06 0B 04 00 00 00 00 00 15 95

5.4.7 CFG-NAVSAT

MESSAGE	CFG-NAVSAT				
Description	Control satellites to use in navigation				
Type	Poll				
Comment	Poll current satellite for navigation mask configuration				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x0C	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current satellite for navigation mask

F1 D9 06 0C 00 00 12 3C

MESSAGE	CFG-NAVSAT				
Description	Control satellites to use in navigation				
Type	Polled/Set				
Comment	Select the type of satellites to use				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0C	4	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		enableMask		Bit Mask of enabled satellite type, enabled when bit mask is 1 0x00000001: GPS L1 0x00000002: GLONASS G1 0x00000004: BEIDOU B1 0x00000010: GALILEO E1 0x00000020: QZSS L1 0x00000040: SBAS L1 0x00000080: IRNSS L5 0x00000100: GPS L1C 0x00000400: GPS L2C 0x00000200: GPS L5 0x00002000: GLONASS G2 0x00004000: BEIDOU B1C 0x00040000: BEIDOU B2 0x00008000: BEIDOU B2A 0x00010000: BEIDOU B3I 0x00020000: BEIDOU B5 0x00100000: GALILEO E5A 0x00200000: GALILEO E5B 0x00400000: GALILEO E6 0x08000000: QZSS L2C 0x04000000: QZSS L5 0x02000000: QZSS L1C 0x01000000: QZSS L6

Example:

Set to use GPS L1, BEIDOU B1 GPS L5, BEIDOU B2A

F1 D9 06 0C 04 00 05 82 00 00 9D 36

5.4.8 CFG-HEIGHT

MESSAGE	CFG-HEIGHT				
Description	Query height limitation for position fix				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0D	0	See below	CK_1 CK_2
No Payload					

Example:

Poll height limitation for position fix

F1 D9 06 0D 00 00 13 3F

MESSAGE	CFG-HEIGHT				
Description	Control height limitation for position fix				
Type	Polled/Set				
Comment	Set height limitation for position fix				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0D	16	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	R8		upperLimit	m	Upper limit of height
8	R8		lowerLimit	m	Lower limit of height

Example:

Set height limitation for position fix to -1000 and 20000

F1 D9 06 0D 10 00 00 00 00 00 00 88 D3 40 00 00 00 00 00 40 8F C0 4D 83

5.4.9 CFG-SBAS

MESSAGE	CFG-SBAS				
Description	request SBAS satellites to use in navigation				
Type	Poll				
Comment	Poll current satellite for navigation mask configuration				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0E	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current satellite for navigation mask

F1 D9 06 0E 00 00 14 42

MESSAGE	CFG-SBAS
Description	Control individual SBAS satellites to use in navigation
Type	Polled/Set

Comment	Select the type of satellites to use. This function is only valid when SBAS is turned on, and the satellite with defined PRN is supported. If no, receiver returns NACK.				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0E	2xn	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		PRN		EGNOS INMARSAT3F2 = 120, ARTEMIS = 124, INMARSAT4F2 = 126, SES5 = 136, GAGAN GSAT8 = 127, GSAT10 = 128, MSAS MTSAT1R = 129, MTSAT2 = 137, SDCM LUCH5A = 140, LUCH5B = 125, WAAS GALAXY15 = 135, ANIKF1R = 138, INMARSAT4F3 = 133,
1	U1		flag		0:disable, 1: enable

Example:

Set to enable SBAS satellite GSAT8 and GSAT10

F1 D9 06 0E 14 00 89 00 7F 01 80 01 78 00 7B 00 87 00 8A 00 8C 00 7D 00 8D 00 4C 8C

5.4.10 CFG-SPDHOLD

MESSAGE	CFG-SPDHOLD				
Description	Query static hold speed for navigation use				
Type	Poll				
Comment	Poll current static hold speed configuration				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0F	0	See below	CK_1 CK_2
No Payload					

Example:

Poll static hold speed configuration

F1 D9 06 0F 00 00 15 45

MESSAGE	CFG-SPDHOLD				
Description	Polled/Set static hold speed for navigation use				
Type	Polled/Set				
Comment	Set the static hold speed				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x0F	2	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U2	0.01	static hold speed	Cm/s	static hold speed for navigation

Example:

Configure the static hold speed 0.06m/s-> 6cm/s to nav

F1 D9 06 0F 02 00 06 00 1D 83

5.4.11 CFG-EPHSAVE

MESSAGE	CFG-EPHSAVE				
Description	Query the status of ephemeris saving				
Type	Poll				
Comment	Poll current ephemeris saving configuration				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x10	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current ephemeris saving configuration

F1 D9 06 10 00 00 16 48

MESSAGE	CFG-EPHSAVE				
Description	Polled/Set ephemeris saving status				
Type	Polled/Set				
Comment	Enable or disable the ephemeris saving				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x10	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		Enable or disable		1: enable ephemeris saving 0: disable ephemeris saving

Example:

Enable the ephemeris saving automatically

F1 D9 06 10 01 00 01 18 62

5.4.12 CFG-NUMSV

MESSAGE	CFG-NUMSV				
Description	Query the maximum and minimum number of satellite used in the receiver				
Type	Poll				
Comment	Poll the maximum and minimum number of satellite used in the receiver				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x11	0	See below	CK_1 CK_2
No Payload					

Example:

Poll maximum and minimum number of satellite used in the receiver

F1 D9 06 11 00 00 17 4B

MESSAGE	CFG-NUMSV				
Description	Polled/Set the maximum and minimum number of satellite used in the receiver				
Type	Polled/Set				
Comment	Set the maximum and minimum number of satellite used in the receiver				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x11	2	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		minsv		Minimum number of satellite used
1	U1		maxsv		Maximum number of satellite used

Example:

Set minimum to 4, maximum to 16

F1 D9 06 11 02 00 04 10 2D 99

5.4.13 CFG-SURVEY

MESSAGE	CFG-SURVEY				
Description	Query the duration and accuracy requirement of survey mode **(HD9300/HD9400 series only)**				
Type	Poll				
Comment	Poll the duration and accuracy requirement of survey mode				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x12	0	See below	CK_1 CK_2
No Payload					

Example:

Poll duration and accuracy requirement of survey mode

F1 D9 06 12 00 00 18 4E

MESSAGE	CFG-SURVEY				
Description	Polled/Set the duration and accuracy requirement of survey mode **(HD9300/HD9400 series only)**				
Type	Polled/Set				
Comment	Set the duration and accuracy requirement of survey mode				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x12	8	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		mindur	second	Minimal survey time
4	U4		acclimit	mm	Accuracy requirement

Example:

Set survey time to 5s, accuracy requirement to 100mm

F1 D9 06 12 08 00 05 00 00 00 64 00 00 00 89 16

5.4.14 CFG-FIXEDLLA

MESSAGE	CFG-FIXEDLLA				
Description	Query the constant stationary LLA position **(HD9300/HD9400 series only)**				
Type	Poll				
Comment	Poll the constant stationary LLA position				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x13	0	See below	CK_1 CK_2
No Payload					

Example:

Poll constant stationary LLA position

F1 D9 06 13 00 00 19 51

MESSAGE	CFG-FIXEDLLA				
Description	Polled/Set the constant stationary LLA position **(HD9300/HD9400 series only)**				
Type	Polled/Set				
Comment	Set the constant stationary LLA position				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x13	12	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	S4	10^{-7}	lat	degrees	Latitude
4	S4	10^{-7}	lon	degrees	Longitude
8	S4		alt	cm	Altitude

5.4.15 CFG-FIXEDECEF

MESSAGE	CFG-FIXEDECEF				
Description	Query the constant stationary ECEF position **(HD9300/HD9400 series only)**				
Type	Poll				
Comment	Poll the constant stationary ECEF position				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x14	0	See below	CK_1 CK_2
No Payload					

Example:

Poll constant stationary LLA position

F1 D9 06 14 00 00 1A 54

MESSAGE	CFG-FIXEDECEF				
Description	Polled/Set the constant stationary ECEF position **(HD9300/HD9400 series only)**				
Type	Polled/Set				
Comment	Set the constant stationary ECEF position				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x14	12	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	S4		x	cm	ECEF X coordinate
4	S4		y	cm	ECEF Y coordinate
8	S4		z	cm	ECEF Z coordinate

5.4.16 CFG-ANTIJAM

MESSAGE	CFG-ANTIJAM				
Description	Poll anti-jamming setting				
Type	Poll				
Comment	Poll anti-jamming setting				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x15	0	See below	CK_1 CK_2
No Payload					

Example:

Poll anti-jamming setting

F1 D9 06 15 00 00 1B 57

MESSAGE	CFG-ANTIJAM				
Description	Control anti-jamming satellite system and threshold				
Type	Polled/Set				
Comment	Select the type of satellites to set				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x15	3	See below	CK_1 CK_2
Payload Contents:					

Byte Offset	Data Type	Scale	Name	Unit	Description
0	U2		satsys_mask		Bit Mask of satellite type, enabled when bit mask is 1 0x0002: GPS 0x0004: QZSS 0x0008: SBAS 0x0010: GALILEO 0x0020: BEIDOU 0x0040: GLONASS
2	U1		threshold	dB	Power threshold that activate the anti-jamming mechanic

Example:

Set to GPS threshold 10dB

F1 D9 06 15 03 00 02 00 0A 2A C7

5.4.17 CFG-BDGEO

MESSAGE	CFG-BDGEO				
Description	Request BD-GEO satellites using in navigation				
Type	Poll				
Comment	Poll current satellite for navigation mask configuration				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x16	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current BD-GEO satellites to use in navigation

F1 D9 06 16 00 00 1C 5A

MESSAGE	CFG-BDGEO				
Description	Control individual BD-GEO satellites to use in navigation				
Type	Polled/Set				
Comment	Select the BD GEO satellites to use. This function is only valid when BD is turned on, and the satellite with defined PRN is supported. If no, receiver returns NACK				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x16	2*N	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		PRN		BDGEO PRN: 01~05, 59~63
1	U1		flag		0:disable, 1: enable

Example:

Set to enable BDGEO satellite 1, 2, 3, disable 4, 5

F1 D9 06 16 0C 00 01 01 02 01 03 01 04 00 05 00 3A 5D

5.4.18 CFG-CARRSMOOTH

MESSAGE	CFG-CARRSMOOTH				
Description	Query maximum windows used in carrier smoothing				
Type	Poll				
Comment	Query maximum windows used in carrier smoothing				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x17	0	See below	CK_1 CK_2
No Payload					

Example:

Poll carrier smoothing status

F1 D9 06 17 00 00 1D 5D

MESSAGE	CFG-CARRSMOOTH				
Description	Set maximum windows used in carrier smoothing				
Type	Polled/Set				
Comment	Set maximum windows used in carrier smoothing				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x17	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	S1		windows value		-1: Enable carrier smoothing with auto config 0: Disable carrier smoothing 1 or higher: Enable carrier smoothing with windows value x+1

Example:

Enable carrier smoothing using windows value 2

F1 D9 06 17 01 00 01 1F 7E

5.4.19 CFG-GEOFENCE

MESSAGE	CFG-GEOFENCE				
Description	Geofence configuration				
Type	Poll				
Comment	Poll current configuration for Geofence				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x18	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current geofencing configuration

F1 D9 06 18 00 00 1E 60

MESSAGE	CFG-GEOFENCE				
Description	Geofencing configuration				
Type	Polled/Set				
Comment	Set the geofencing , polled the geofencing configuration				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x18	8+12*N	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		llr_num		Number of input fence position, the max input number is 8
1	U1		Cfg_flag		Required confidence level for the quality of position. This value times the position's standard deviation (sigma) defines the confidence band. 0 = no confidence required 1 = 68% 2 = 95% 3 = 99.7% 4 = 99.99% 5 = 99.9999%
2	U1		gpio_enable		If enabled, the GPIO combined fence state output, 1= Enable
3	U1		polarity		Pulse polarity, 0 = falling edge at top of second
4	U1		gpionum		GPIO pin used to output GEO-fence state
5	U1[3]		res		reserved
8+N*12	S4	1e-7	lat	Deg	Latitude of the geofence circle center
12+N*12	S4	1e-7	lon	Deg	Longitude of the geofence circle center
16+N*12	U4	1e-2	radius	m	Radius of the geofence circle

Example:

Set to enable GPIO0 and polarity = 1 to show geofencing with position lat=40 degree, lon=116 degree,radius=3000m

F1 D9 06 18 14 00 01 02 01 01 00 00 00 00 00 84 D7 17 00 32 24 45 E0 93 04 00 BB 7E

5.4.20 CFG-SIMPLERST

MESSAGE	CFG-SIMPLERST				
Description	Simple startup command				
Type	Set				
Comment	Control GNSS task				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x40	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description

0	U1		Mode		0x00: Reset, 0x01: Cold start, 0x02: Warm start, 0x03: Hot start, 0x10: Stop, 0x11: Start, 0x80: Clear All TRK Channels

Example:

Configure soft reset (as system command, there is NO ACK)

F1 D9 06 40 01 00 00 47 21

Configure a cold start (as system command, there is NO ACK)

F1 D9 06 40 01 00 01 48 22

Configure a warm start (as system command, there is NO ACK)

F1 D9 06 40 01 00 02 49 23

Configure a hot start (as system command, there is NO ACK)

F1 D9 06 40 01 00 03 4A 24

Configure GNSS stop (if successful, it would return ACK, else return NAK)

F1 D9 06 40 01 00 10 57 31

Configure GNSS start (if successful, it would return ACK, else return NAK)

F1 D9 06 40 01 00 11 58 32

Configure Clear All TRK Channels (if successful, it would return ACK, else return NAK)

F1 D9 06 40 01 00 80 C7 A1

5.4.21 CFG-SLEEP

MESSAGE	CFG-SLEEP				
Description	Sleep command				
Type	Set				
Comment	Set GNSS task to sleep and restart after a while defined by period. It is one time command. It is a one-time command				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x41	4	See below	CK_1 CK_2
			5	Cynosure II	
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4		period	ms	Sleep time
Extension to Cynosure II					
4	U1		action		0: sleep 1: deep sleep 2: Reserved 3: power down 4: RTC stand only(cyno3 support only)

Example:

Set GNSS task to deep sleep for 5000ms

F1 D9 06 41 05 00 88 13 00 00 01 E8 56

5.4.22 CFG-PWRCTL

MESSAGE	CFG- PWRCTL				
Description	Query Power control profile				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x42	0	See below	CK_1 CK_2
No Payload					

Example:

Poll message of power control

F1 D9 06 42 00 00 48 DE

MESSAGE	CFG-PWRCTL				
Description	Power control command				
Type	Polled/Set				
Comment	Set receiver power control profile				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x42	20	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		mode		0: Disable (normal) 1: reserved 2: Cyclic short sleep (<=60s) 3: Cyclic long sleep(>60s)
1	U1		fix_cnt		reserved
2	U1		Sat_cnt		reserved
3	U1		padding		reserved
4	U4		sleep_ms	ms	sleep time when fix
8	U4		timeout_ms	ms	reserved
12	U4		timeout_off_ms	ms	reserved
16	U4		tracking_ms	ms	reserved

Example:

Set receiver into cyclic sleep mode

F1 D9 06 42 14 00 00 05 00 00 B8 0B 00 00 60 EA 00 00 D0 07 00 00 00 00 00 00 45 F9

5.4.23 CFG-PWRCTL2

MESSAGE	CFG- PWRCTL2				
Description	Query Periodic sleep Power control profile				
Type	Poll				
Comment	- periodic sleep function				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x44	0	See below	CK_1 CK_2
No Payload					

Example:

Poll message of periodic power control mode

F1 D9 06 44 00 00 4A E4

MESSAGE	CFG-PWRCTL2				
Description	Periodic sleep Power control command				
Type	Polled/Set				
Comment	Set receiver Periodic sleep power control profile				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x06 0x44	16	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		mode		Power mode 0: Disable (normal) 1: reserved 2: Cyclic short sleep(<=60S) 3: Cyclic long sleep(>60S)
1	U1		padding		reserved
2	U2		ontime	ms	The minimum duration in second that won't enter low power mode, must be smaller than update_period_ms
4	S4		fixfreq		Position fix frequency. Negative means the frequency is (1 / fixfreq)
8	U4		Update_period_ms	ms	Position fix period. Receiver will never try to fix if set to 0, wait for external event instead
12	U4		tracking_ms	ms	Minimum tracking time. 0 means auto

Example:

Set receiver into cyclic short sleep mode: fixfreq = 1, update period = 2000, Tracking duration = 200

F1 D9 06 44 10 00 02 00 64 00 01 00 00 00 D0 07 00 00 C8 00 00 00 60 19

5.4.24 CFG-NMEAVER

MESSAGE	CFG- NMEAVER				
Description	Query current NMEA version				
Type	Poll				
Comment	-				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x43	0	See below	CK_1 CK_2
No Payload					

Example:

Poll NMEA version

F1 D9 06 43 00 00 49 E1

MESSAGE	CFG-NMEA-VER				
Description	Set NMEA version				
Type	Polled/Set				
Comment	Select from V3.01, V4.00 and V4.10. All support GNSS and individual Satellite system.				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x43	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		version		0: (not support) 1: V3.01 2: V4.00 3: V4.10

Example:

Set NMEA version to V4.00

F1 D9 06 43 01 00 02 4C 2F

5.4.25 FG-FWUP

MESSAGE	CFG- FWUP				
Description	Start FW update in Y-Modem protocol				
Type	Poll				
Comment	(internal message)				
Message	Header	ID	Length (Bytes)	Payload	Checksum
Structure	0xF1 0xD9	0x06 0x50	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		Freq		Port Identifier Number 0 : 16.369M 1 : 26M

Example:

Set Firmware update

F1 D9 06 50 01 00 01 13 3F

5.5 Monitor Receiver Status (MON)

5.5.1 MON-VER

MESSAGE	MON-VER				
Description	Software/Hardware version				
Type	Poll				
Comment	Poll software/hardware version				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x04	0	See below	CK_1 CK_2
No Payload					

Example:

Poll software/hardware version

F1 D9 0A 04 00 00 0E 34

MESSAGE	MON-VER				
Description	Software/Hardware version				
Type	Polled				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x04	32	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	S1[16]		swVersion		Software version string
16	S1[16]		hwVersion		Hardware version string

5.5.2 MON-INFO

MESSAGE	MON-INFO				
Description	Info configuration				
Type	Poll				
Comment	Poll receiver special information				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x05	0	See below	CK_1 CK_2
No Payload					

Example:

Poll receiver special information

F1 D9 0A 05 00 00 0F 37

MESSAGE	MON-INFO
Description	Info configuration
Type	Polled/Set
Comment	Output/Set receiver special information

Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x05	N	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
Start of repeated block					
n	U1		info		Contents, n>=0 n<=16

Example:

Set receiver special information to "Hello"

F1 D9 0A 05 05 00 48 65 6C 6C 6F xx xx

5.5.3 MON-TRKCHAN

MESSAGE	MON- TRKCHAN				
Description	Get the TRACK CHANNEL STATUS				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x08	8	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U2	-	nmeaprn	-	The prn number of the satellite
2	U2		CN0		The test CN0 of the satellite
4	U4		waitime	second	Single channel test time

Example:

Set the parameter for Track

For example: setting waiting 30 second to test SATID 3 with cn0 36

F1 D9 0A 08 08 00 03 00 24 00 1E 00 00 00 5F 88

MESSAGE	MON- TRKCHAN				
Description	TEST STATUS				
Type	Polled				
Comment	Get the track channel test status				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x08	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1	-	Status of TRK channel	-	0: abnormal 1: normal

Example:

Output no error

F1 D9 0A 08 01 00 01 14 56

5.5.4 MON-RCVCLK

MESSAGE	MON- RCVCLK				
Description	Get the current receiver clock measured by the specific satellite				
Type	Poll				
Comment	-				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x09	2	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U2	-	nmeaprn	-	The prn number of the satellite

Example:

Poll the clock of PRN = 5

For example: Poll the clock of PRN =5

F1 D9 0A 09 02 00 05 00 1A 7B

MESSAGE	MON- RCVCLK				
Description	Receiver clock value				
Type	Polled				
Comment	Set the configuration (baudrate) of communication port				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x09	4	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U4	-	clkfreq	-	Receiver true clock frequency

Example:

Return the current receiver clock measured by the given satellite 5

F1 D9 0A 09 04 00 AE BA 8C 01 0C A6

5.5.5 MON-CWI

MESSAGE	MON- CWI				
Description	CWI check				
Type	Poll				
Comment	Poll cwi peak frequency				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x0A	2	See below	CK_1 CK_2
Payload Contents:					

Example:

F1 D9 0A 0A 00 00 14 46

MESSAGE	MON- CWI				
Description	CWI check				
Type	Polled				
Comment	Output CWI check result				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0A 0x0A	8	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	S4		Frequency offset	Hz	Frequency offset from 1575.42MHz
4	S4		Peak value		Measured peak value at peak frequency

Example:

Offset 100Hz, peak value 70000

F1 D9 0A 0A 08 00 64 00 00 00 70 11 01 00 02 4B

5.6 Assistance GNSS Messages (AID)

5.6.1 AID-INI

MESSAGE	AID-INI				
Description	Initial Aiding Data				
Type	Poll				
Comment	Poll current GNSS receiver data				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x01	0	See below	CK_1 CK_2
No Payload					

Example:

Poll current GNSS receiver data

F1 D9 0B 01 00 00 0C 2F

MESSAGE	AID-INI				
Description	Initial Aiding Data				
Type	Polled/Set				
Comment	Get/Set reference for GNSS receiver				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x01	48	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	S4	1e-7	Lat	Degrees	Latitude
4	S4	1e-7	Lon	degrees	Longitude
8	S4		Alt	cm	Altitude

12	U4		posAcc	cm	Position accuracy (stddev)
16	S2				Reserved
18	U2		wn		Actual week number
20	U4		tow	ms	Actual time of week
24	S4		towNs	ns	Sub-millisecond part of time of week
28	U4		tAccMs	ms	Milliseconds part of time accuracy
32	U4		res1		Reserved
36	S4		clkD	ns/s	Clock drift
40	U4		res2		Reserved
44	S4		res3		Reserved

5.6.2 AID-POS

MESSAGE	AID-POS				
Description	Initial Aiding Data (position)				
Type	Set				
Comment	Cynosure II, LLA or ECEF could be selected				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x10	17	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1	-	type	-	Position type (1: LLA, 0: ECEF)
LLA					
1	S4	10^{-7}	Lat	degree	Latitude
5	S4	10^{-7}	Lon	degree	Longitude
9	S4		Alt	cm	Altitude
13	U4		Pos_acc	-	Position accuracy
ECEF					
1	S4		ECEF.x	cm	Position x
5	S4		ECEF.y	cm	Position y
9	S4		ECEF.z	cm	Position z
13	U4		Pos_acc	-	Position accuracy

Example:

Inject position (0x0B10), lat = 22.5006727, lon = 114.2424747, alt = -882.55

Command: F1 D9 0B 10 11 00 01 87 54 69 0D AB 04 18 44 41 A7 FE FF 00 00 00 00 6E 4A

5.6.3 AID-TIME

MESSAGE	AID-TIME				
Description	Initial Aiding Data (time)				
Type	Set				
Comment	Cynosure II, TOW or UTC could be selected				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x11	20	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		Type	-	Time type (1: TOW 0: UTC)
1	U1	-	-	-	Reserved
Tow:					
2	U1		Gnss_id	-	Source of time information 0: GPS time 1: BD time 2: GLONASS time
3	U2		Week_no	-	Week number
5	U4		Tow_s	-	Time of week
9	U4		Tow_ns	-	Nanoseconds time of week, from 0 to 999,999,999
13	U2		Tacc_s	-	Seconds part of time accuracy
15	U4		Tacc_ns	-	Sub-millisecond part of time accuracy
19	U1		Reserved	-	Reserved
UTC					
2	U1		Leap_sec		Number of leap seconds since 1980 (or <0 if unknown)
3	U2		Year		
5	U1		Month		
6	U1		Day		
7	U1		Hour		
8	U1		Minute		
9	U1		Second		
10	U4		Sec_ns		Nanoseconds, from 0 to 999,999,999
14	U2		Tacc_s		Seconds part of time accuracy
16	U4		Tacc_ns		Sub-millisecond part of time accuracy

Example:

Inject time (0x0B11), 2016-6-22 15:56:03.288393, tacc = 0.600796, leapsecond = 17.

Command: F1 D9 0B 11 14 00 00 00 11 E0 07 06 16 0F 38 03 28 87 30 11 00 00 60 6B CF 23 3B A3

5.6.4 AID-PEPH-GPS

MESSAGE	AID-PEPH-GPS				
Description	Request GPS proprietary ephemeris data				
Type	Poll				
Comment	Cynosure II/III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x32	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
1	U1		svid		SV ID defined in each satellite system ,if 0, means all

Example:

Poll ephemeris of all GPS satellites

F1 D9 0B 32 01 00 00 3E 02

MESSAGE	AID-PEPH-GPS				
Description	Proprietary Ephemeris Data for GPS				
Type	Polled/Set				
Comment	Cynosure II/III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x32	65	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		reserved		
1	U1		svid		SV ID defined in GPS Satellite system
2	U4	$2^{\wedge-19}$	sqrtA		Semi-major axis
6	U4	$2^{\wedge-33}$	e		eccentricity
10	S4	$2^{\wedge-31}\pi$	M0		Mean Anomaly (radian)
14	S2	$2^{\wedge-43}\pi$	Delta_n		Mean motion correction (radian/sec)
16	U2	$2^{\wedge4}$	toe		Ref time of Ephemeris
18	S4	$2^{\wedge-31}\pi$	i0		Inclination angle (radian)
22	S2	$2^{\wedge-43}\pi$	iDot		Inclination rate (radian/sec)
24	S4	$2^{\wedge-31}\pi$	Omega0		Longitude of ascending node at weekly epoch (radian)

MESSAGE	AID-PEPH-GPS				
28	S4	$2^{-43}\pi$	OmegaDot		Right Ascension Rate (radian/sec)
32	S4	$2^{-31}\pi$	w		Argument of Perigee (radian)
36	S2	2^{-29}	Cuc		correction coefficients in ICD
38	S2	2^{-29}	Cus		correction coefficients in ICD
40	S2	2^{-5}	Crc		correction coefficients in ICD
42	S2	2^{-5}	Crs		correction coefficients in ICD
44	S2	2^{-29}	Cic		correction coefficients in ICD
46	S2	2^{-29}	Cis		correction coefficients in ICD
48	U2	2^{4}	toc		Ref time of clock
50	S4	2^{-31}	af0		SV clock correction term 0
54	S2	2^{-43}	af1		SV clock correction term 1
56	S1	2^{-55}	af2		SV clock correction term 2
57	S1	2^{-31}	tGD		Group Delay
58	i2		weeknum		Ref. week number
60	U2		IODC		Issue of data, clock
62	U1		IODE		Issue of data Ephemeris
63	U1		ura		User range accuracy
64	U1		health		Usage status

5.6.5 AID-PEPH-BDS

MESSAGE	AID-PEPH-BDS				
Description	Request BDS proprietary ephemeris data				
Type	Poll				
Comment	Allows the delivery of BeiDou ephemeris assistance to a receiver.				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x33	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
1	U1		svid		SV ID defined in each satellite system, if 0, means all

Example:

Poll ephemeris of all BD satellites

F1 D9 0B 33 01 00 00 3B F1

MESSAGE	AID-PEPH-BDS				
Description	Proprietary Ephemeris Data for Beidou				
Type	Polled/Set				
Comment	Allows the delivery of BeiDou ephemeris assistance to a receiver.				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x33	92	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		reserved		
1	U1		svid		SV ID defined in each BDS system
2	U4	2^{-19}	sqrtA		Semi-major axis
6	U4	2^{-33}	e		eccentricity
10	S4	$2^{-31}\pi$	M0		Mean Anomaly (radian)
14	S2	$2^{-43}\pi$	Delta_n		Mean motion correction (radian/sec)
16	U4	2^{3}	toe		Ref time of Ephemeris
20	S4	$2^{-31}\pi$	i0		Inclination angle (radian)
24	S2	$2^{-43}\pi$	iDot		Inclination rate (radian/sec)
26	S4	$2^{-31}\pi$	Omega0		Longitude of ascending node at weekly epoch (radian)
30	S4	$2^{-43}\pi$	OmegaDot		Right Ascension Rate (radian/sec)

MESSAGE	AID-PEPH-BDS				
34	S4	$2^{-31}\pi$	w		Argument of Perigee (radian)
38	S4	2^{-31}	Cuc		correction coefficients in ICD
42	S4	2^{-31}	Cus		correction coefficients in ICD
46	S4	2^{-6}	Crc		correction coefficients in ICD
50	S4	2^{-6}	Crs		correction coefficients in ICD
54	S4	2^{-31}	Cic		correction coefficients in ICD
58	S4	2^{-31}	Cis		correction coefficients in ICD
62	U4	2^{3}	toc		Ref time of clock
66	S4	2^{-33}	af0		SV clock correction term 0
70	S4	2^{-50}	af1		SV clock correction term 1
74	S2	2^{-66}	af2		SV clock correction term 2
76	S2	$0.1e^{-9}$	tGD		Group Delay
78	S1	2^{-30}	Alpha0		coef. for the amplitude of the vertical delay
79	S1	2^{-27}	Alpha1		coef. for the amplitude of the vertical delay
80	S1	2^{-24}	Alpha2		coef. for the amplitude of the vertical delay
81	S1	2^{-24}	Alpha3		coef. for the amplitude of the vertical delay
82	S1	2^{11}	Beta0		coef. for the period of the model
83	S1	2^{14}	Beta1		coef. for the period of the model
84	S1	2^{16}	Beta2		coef. for the period of the model
85	S1	2^{16}	Beta3		coef. for the period of the model
86	U2		weeknum		Ref. week number
88	U1		IODC		Issue of data, clock
89	U1		IODE		Issue of data, Ephemeris
90	U1		ura		User range Accuracy
91	U1		health		Usage status

5.6.6 AID-PALM-GPS

MESSAGE	AID-PALM-GPS				
Description	Request GPS proprietary Almanac data				
Type	Poll				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x22	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
1	U1		svid		SV ID defined in each satellite system ,if 0, means all

Example:

Poll Almanac of all GPS satellites

F1 D9 0B 22 01 00 00 2E C2

MESSAGE	AID-PALM-GPS				
Description	Proprietary Almanac Data for GPS				
Type	Polled/Set				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x22	30	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		svid		SV ID defined in GPS Satellite system
1	U1		health		unhealthy flag, 0 : non-operability, 1: operability(note: it's just opposite between EPH and ALM)
2	U1	2^12	toa	sec	Ref time of Almanac
3	U1		WN	week	Week number
4	U4	2^-11	sqrtA	sqrt(m)	Semi-major axis
8	S4	2^-23π	M0		Mean Anomaly
12	S4	2^-23π	Omega0		Longitude of ascending node at weekly epoch
16	S4	2^-23π	w		Argument of Perigee
20	U2	2^-21	e		eccentricity
22	S2	2^-38π	OmegaDot		Right Ascension Rate (radian/sec)
24	S2	2^-19π	di		Inclination angle correction

MESSAGE	AID-PALM-GPS				
26	S2	2^{-20}	af0		SV clock correction term 0
28	S2	2^{-38}	af1		SV clock correction term 1

5.6.7 AID-PALM-BD

MESSAGE	AID-PALM-BD				
Description	Request BD proprietary Almanac data				
Type	Poll				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x23	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
1	U1		svid		SV ID defined in each satellite system ,if 0, means all

Example:

Poll Almanac of all BD satellites

F1 D9 0B 23 01 00 00 2F C6

MESSAGE	AID-PALM-BD				
Description	Proprietary Almanac Data for BD				
Type	Polled/Set				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x23	35	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		svid		SV ID defined in BEIDOU Satellite system
1	U1	2^{12}	toa	sec	Ref time of Almanac
2	U2		health		unhealthy flag, 0 : non-operability, 1: operability(note: it's just opposite between EPH and ALM)
4	U4	2^{-11}	sqrtA	sqrt(m)	Semi-major axis
8	U4	2^{-21}	e		eccentricity
12	S4	$2^{-23}\pi$	M0		Mean Anomaly
16	S4	$2^{-23}\pi$	Omega0		Longitude of ascending node at weekly epoch
20	S4	$2^{-38}\pi$	OmegaDot		Right Ascension Rate (radian/sec)

MESSAGE	AID-PALM-BD				
24	S4	$2^{-23}\pi$	w		Argument of Perigee
28	S2	$2^{-19}\pi$	di		Inclination angle correction
30	S2	2^{-20}	af0		SV clock correction term 0
32	S2	2^{-38}	af1		SV clock correction term 1
34	U1		WN	week	Week number

5.6.8 AID-PALM-GLN

MESSAGE	AID-PALM-GLN				
Description	Request GLN proprietary Almanac data				
Type	Poll				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x24	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
1	U1		svid		SV ID defined in each satellite system ,if 0, means all

Example:

Poll Almanac of all GLN satellites

F1 D9 0B 24 01 00 00 30 CA

MESSAGE	AID-PALM-GLN				
Description	Proprietary Almanac Data for GLN				
Type	Polled/Set				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x24	30	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		svid		SV ID defined in GLONASS Satellite system
1	U1		health		unhealthy flag, 0 : non-operability, 1: operability(note: it's just opposite between EPH and ALM)

MESSAGE	AID-PALM-GLN				
2	S1		ha		carrier frequency number of navigation RF signal transmitted(HA always positive , but c_f_number between -7 ~ 6)
3	U1		n4_year		Count of 4-year period since 1996 (N4_year is 1 in 1996), SF = 1, unit = 4-yr interval
4	S1	2^{-14}	dt_dot	Sec/period^2	orbit period rate
5	U1		satid		index of the satellite
6	U2		n_a		day number of 4-year period starting Jan 1 each leap year (Jan 1 of leap year is day 1), SF = 1,
8	S4	$2^{-20}\pi$	lambdaA		Longitude of ascending node at weekly epoch
12	S4	$2^{-20}\pi$	di		Inclination correction
16	U4	2^{-5}	ta	sec	Time of the first ascending node passage
20	S4	2^{-9}	dt	Sec/peroid	Orbital period correction
24	S2		tau_n		satellite time correction to GLONASS time
26	U2	2^{-20}	e	dimensionless	Eccentricity
28	S2		w	week	Week number

5.6.9 AID-PALM-GAL

MESSAGE	AID-PALM-GAL				
Description	Request GAL proprietary Almanac data				
Type	Poll				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x25	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
1	U1		svid		SV ID defined in each satellite system ,if 0, means all

Example:

Poll Almanac of all GAL satellites

F1 D9 0B 25 01 00 00 31 CE

MESSAGE	AID-PALM-GAL				
Description	Proprietary Almanac Data for GAL				
Type	Polled/Set				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x25	24	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		svid		SV ID defined in GALILEO Satellite system
1	U1		health		unhealthy flag, 0 : non-operability, 1: operability(note: it's just opposite between EPH and ALM)
2	S2		DsqrtA		Difference between the square root of the semi-major axis and the square root of the nominal semi-major axis (29 600 km)
4	S2	$2^{-15}\pi$	M0		Mean Anomaly
6	S2	$2^{-15}\pi$	Omega0		Longitude of ascending node at weekly epoch
8	S2	$2^{-15}\pi$	w		Argument of Perigee
10	U2	2^{-16}	e		eccentricity
12	S2	$2^{-33}\pi$	OmegaDot		Right Ascension Rate (radian/sec)
14	S2	$2^{-14}\pi$	di		Inclination angle correction
16	S2	2^{-19}	af0	sec	SV clock correction term 0
18	S2	2^{-38}	af1	Sec/sec	SV clock correction term 1
20	U2		WN	week	Week number
22	U2		toa	sec	Ref time of Almanac, SF = 600

5.6.10 AID-PALM-QZSS

MESSAGE	AID-PALM-QZSS				
Description	Request QZSS proprietary Almanac data				
Type	Poll				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x26	1	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
1	U1		svid		SV ID defined in each satellite system ,if 0, means all

Example:

Poll Almanac of all QZSS satellites

F1 D9 0B 26 01 00 00 32 D2

MESSAGE	AID-PALM-QZSS				
Description	Proprietary Almanac Data for QZSS				
Type	Polled/Set				
Comment	Cynosure III				
Message Structure	Header	ID	Length (Bytes)	Payload	Checksum
	0xF1 0xD9	0x0B 0x26	30	See below	CK_1 CK_2
Payload Contents:					
Byte Offset	Data Type	Scale	Name	Unit	Description
0	U1		svid		SV ID defined in QZSS Satellite system
1	U1		health		unhealthy flag, 0 : non-operability, 1: operability(note: it's just opposite between EPH and ALM)
2	U1	2^{12}	toa	sec	Ref time of Almanac
3	U1		WN	week	Week number
4	U4	2^{-11}	sqrtA	sqrt(m)	Semi-major axis
8	S4	$2^{-23}\pi$	M0		Mean Anomaly
12	S4	$2^{-23}\pi$	Omega0		Longitude of ascending node at weekly epoch
16	S4	$2^{-23}\pi$	w		Argument of Perigee
20	U2	2^{-21}	e		eccentricity
22	S2	$2^{-38}\pi$	OmegaDot		Right Ascension Rate (radian/sec)
24	S2	$2^{-19}\pi$	di		Inclination angle correction
26	S2	2^{-20}	af0		SV clock correction term 0
28	S2	2^{-38}	af1		SV clock correction term 1

6 RTCM PROTOCOL

6.1 Background Information

HD9300/HD9400 series support differential GNSS data according to RTCM version 3 .The messages of RTCM are described as the following table.

6.2 Support messages

HD9300/HD9400 series supports following RTCM3.3 input messages:

Message Type	Description
1005	Stationary RTK Reference Station ARP
1006	Stationary RTK Reference Station ARP with Antenna Height
1074	GPS MSM4
1075	GPS MSM5
1077	GPS MSM7
1084	GLO MSM4
1085	GLO MSM5
1087	GLO MSM7
1094	GAL MSM4
1095	GAL MSM5
1097	GAL MSM7
1114	QZS MSM4
1115	QZS MSM5
1117	QZS MSM7
1124	BDS MSM4
1125	BDS MSM5
1127	BDS MSM7
4065 sub-id 0	Reference station PVT (ALLYSTAR Proprietary RTCM Message)

HD9300/HD9400 series supports following RTCM3.3 output messages:

Message Type	Group ID/ Sub Id	Description
1005	0xF8 ; 0x05	Stationary RTK Reference Sation ARP
1019	0xF8 ; 0x13	GPS Ephemerides
1020	0xF8 ; 0x14	GLO Ephemerides
1042	0xF8 ; 0x2A	BDS Ephemerides
1044	0xF8 ; 0x2C	QZS Ephemerides
1046	0xF8 ; 0x2D	GAL /NAV Ephemerides
1074	TBD	GPS MSM4
1075	TBD	GPS MSM5
1077	0xF8 ; 0x4D	GPS MSM7
1084	TBD	GLO MSM4

1085	TBD	GLO MSM5
1087	0xF8 ; 0x57	GLO MSM7
1094	TBD	GAL MSM4
1095	TBD	GAL MSM5
1097	0xF8 ; 0x61	GAL MSM7
1114	TBD	QZS MSM4
1115	TBD	QZS MSM5
1117	0xF8 ; 0x75	QZS MSM7
1124	TBD	BDS MSM4
1125	TBD	BDS MSM5
1127	0xF8 ; 0x7F	BDS MSM7
4065 sub-id 0	0xF8 ; 0x41	Reference station PVT (ALLYSTAR Proprietary RTCM Message)

6.3 ALLYSTAR proprietary RTCM messages

Message Type	Organization	Contact
4065	ALLYSTAR Technology CO. Ltd	http://www.allystar.com

Approved by RTCM SPECIAL COMMITTEE in 2017

6.3.1 Sub-id

There are different available sub-ids of the RTCM message type 4065. The table below shows the available RTCM 4065 sub-ids.

Message Type	Sub-id Number	Description	Note
0XFE1 (4065)	0x0	Reference Station PVT	For moving base application
	0x1	Navigation PVT Solution	
	0x2	Attitude Determination	By multi-antenna
	0xA	Raw sensor measurements	TBD

The reference message (type 4065, sub-id 0) must be used in combination with MSM7 observation messages.

6.4 Configuration

The RTCM version 3 protocol can be disabled/enabled and set update rate on communication interfaces by CFG-MSG.

7 REVISION HISTORY

Revision	Date	Author	Status / Comments
V1.0	2017-04-24	LH	Initial release
V1.1	2017-05-26	LH	Added the TXT sentence.
V1.2	2017-09-22	LH	Added MON-RCVCLK, EPH-SAVE, CFG-FWUP, NAV-TIME, GPS-EPH, BD-EPH, MON-RCVCLK command, removed POSTIME command, modified the PPS command. Added the description for GLONASS PRN.
V1.3	2017-10-20	Daisy	Format update
V1.4	2018-01-25	Daisy	Add DR command messages
V1.5	2018-01-30	Daisy	Delete NAV-AUTO, NAV-AHTS, CFG-EPHSAVE, MON-BIT, MON-TRK, MON-RCVCLK and BOOT2 ROM BINARY MESSAGES.
V1.6	2018-04-08	Daisy	Add the command CFG-NUMSV, CFG-SURVEY, CFG-FIXEDLLA, CFG-FIXEDECEF; Add the command CFG-ANTIJAM,RAW-DUMPRAW,RXM-GALSAR
V1.7	2018-05-04	Daisy	Delete DR command messages to a basic version.
V1.8	2018-07-25	Xiaoli	Modified the CFG-SBAS, GSV and GSA,CFG-ANTIJAM; Add the cmd MON-INFOADD, MON-BIT, MON-TRK, MON-RCVCLK
V1.9	2018-11-07	Xiaoli	Add CFG-BDGEO, CFG-CARRSMOOTH; Modified CFG-NAVSAT, GSV and GSA for 8040
V1.9.1	2018-11-12	Xiaoli	Modified the cmd demo of CFG-NMEAVER and CFG-PWRCTL
V1.9.2	2019-01-29	Xiaoli	Add NMEA for IRNSS； update the CFG-NMEAVER for IRNSS
V1.9.3	2019-06-27	Charles	Add RTK protocol; Modified descriptive error
V2.2	2019-07-11	Xiaoli	Update the GSA and GSV as 8040 dual frequency V2.2.1 modified some ID error V2.2.2 modified GLONASS ID and notes for system ID
V2.3	2019-08-01	Xiaoli	Add NAV-TIMEUTC,CFG-PWRCTL2,MON-TRKCHAN; modified GNTXT and CFG-NAK
V2.3.1	2019-08-08	Xiaoli	Modified the nav-svinfo of svid to be 2byte
V2.3.2	2019-08-13	Xiaoli	Modified the GRS, remove CFG-PVTLOG
V2.3.3	2019-09-10	Xiaoli	Add AID-PALM-GPS, AID-PALM-BD, AID-PALM-GLN, AID-PALM-GAL, AID-PALM-QZSS, Add GLONASS and Galileo for NAV-TIME Add CFG-GEOFENCE, NAV-SVSTATE Update BD satellite ID to 50
V2.3.4	2020-01-03	Xiaoli	Modified CFG-NAVSAT

V2.3.5	2020-03-31	Xiaoli	Add NAV-VELECEF, NAV-VELNED,NAV-CLOCK2,NAV-PVERR
V2.3.6	2020-10-12	Xiaoli	Add NAV-NAVAUTO，NAV-NAVPVT; Update BD satellite ID to 63

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