GeoS® GNSS modules

Binary Data Protocol

Version 4.0

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Revision History

#	Update description	Notes
Rev. 1.0 12/02/2018		
1	Initial release	
Rev. 1.1 15/06/2018		
1	New columns added to Tables 3 and 4 with marks of supporting specific messages by GeoS-5M and GeoS-5 RTK	
2	Bit 27 added to RSW; bits 27, 25, 24 added to RSW RTK	
3	Messages 0x55, 0x95 length changed	
4	Description of message 0x23 word 20 and message 0x24 word 32 changed	
5	Description of message 0xB3 changed	
6	Value range added to some parameters	
7	Editorial corrections	

Scope

The document is the description of GeoS® Binary Data Protocol v4.0 supported by GeoS-5M, GeoS-5MR, GeoS-5MH, and GeoS-5 RTK GNSS modules.

1 Abbreviations

1PPS:	One Pulse Per Second
2D:	Two-dimensional
3D:	Three-dimensional
AGC:	Auto Gain Control
CNR:	Carrier-to-Noise Ratio
CRC:	Cyclic Redundancy Check
CSW:	Channel Status Word
DLL:	Delay Locked Loop
DGNSS:	Differential GNSS
DOP:	Dilution Of Precision
DR:	Dead Reckoning
ECEF:	Earth-Centered Earth-Fixed
FW:	Firmware
GNSS:	Global Navigation Satellite System
GST:	GALILEO System Time
ICD:	Interface Control Document
ID:	Identifier
LLI:	Loss of Lock Indicator
LSB:	Least Significant Bit
MSB:	Most Significant Bit
PLL:	Phase Locked Loop
PRN:	Pseudo Random Number
PZ-90:	Parametry Zemli (Earth Parameters 1990), GLONASS geodetic datum
QZSS:	Quasi-Zenith Satellite System
RAIM:	Receiver Autonomous Integrity Monitoring
RF:	Radio Frequency
RLM:	Return Link Message
RMS:	Root Mean Square
RSW:	Receiver Status Word
RTC:	Real Time Clock
RTC:	Real Time Kinematic
RTCM:	Radio Technical Commission for Maritime Services
SAR:	Search And Rescue
SBAS:	Space Based Augmentation System
SRAM:	Static Random Acess Memory
SV:	Space Vehicle
T-RAIM:	Time-RAIM
URA:	User Range Accuracy
UTC:	Universal Time Coordinated
WGS-84:	World Geodetic System 1984

2 Message Format

Input and output messages have the same data format.

Endianness: little-endian for both input and output messages.

Message structure:

- **<preamble: 64>:** preamble "GEOSr3PS" (length: 8 bytes; `534F4547 53503372`)
- **<ndat>:** number of 32-bit words in data fields (length: 2 bytes)
- **<ncmd>:** message ID (length: 2 bytes)
- **<dat1, dat2, …, datN>:** data (length: 4 bytes) fields; N=<ndat>
- **<cs>:** check sum (length: 4 bytes); calculated as bit-by-bit "exclusive OR" of all data fields.

Example:

`534F4547 53503372`	preamble
`00060021`	message ID – 0x21, message length – 6 (in 32-bit words)
`8001C0FF 003E4130 0000001A 079F6E51 00000000 15171016`	data
`92AE8986`	check sum

Check sum calculation example:

```
534F4547 ^ 53503372 ^ 00060021 ^ 8001C0FF ^ 003E4130 ^ 0000001A ^
079F6E51 ^ 00000000 ^ 15171016 = 92AE8986
```

Table 1. Data types

Type	Description	Length (bytes)
byte	Unsigned integer, 8 bits	1
short	Signed integer, 16 bits	2
u_short	Unsigned integer, 16 bits	2
int	Signed integer, 32 bits	4
u_int	Unsigned integer, 32 bits	4
float	Signed real, 32 bits	4
double	Signed real, 64 bit	8

3 SV Numbering

SV numbering scheme used in this document can differ from that used in related GNSS ICD (refer to Table 2).

Table 2. SV cross numbering

GNSS	SV number used in this document	System SV number used in ICD	Abbreviation used in ICD
GPS	1…32	1…32	PRN, PRN_a
SBAS	33…64	120…141	PRN
GLONASS	65…88	1…24	n, n^A
GALILEO	101…136	1…36	SVID
QZSS	193…197	193…197	PRN No.

4 Output Messages

The output binary messages are divided into following groups:

1. 0x00…0x3E: automatically generated;
2. 0x3F: response to all settings and, in some cases, can be response to queries and commands;
3. 0x40…0x7F: reserved;
4. 0x80…0xBF: responses to queries;
5. 0xC0…0xFF: responses to commands.

Messages 0x00…0x1F are masked i.e. can be disabled by using appropriate mask (message 0x4F). On default, all automatically generated masked messages are disabled (no output). Messages 0x20…0x3F are unmasked i.e. cannot be disabled. Output messages are summarized in Table 3.

Table 3. The list of output messages

Message ID	Message	GeoS-5M	GeoS-5RTK
	Automatically generated messages		
0x00	GALILEO SAR RLM	•	
0x01…0x07	Reserved		
0x08	GALILEO Almanac	•	
0x09	Reserved		
0x0A	GALILEO Ephemeris	•	
0x0B…0x0D	Reserved		
0x0E	SBAS Satellite Orbit Parameters	•	
0x0F	Reserved for internal use		
0x10	Raw Measurements	•	•
0x11	GPS Sub-frame Data	•	
0x12	GLONASS Sub-frame Data	•	
0x13	Navigation Solution State Vector	•	
0x14	Timing Parameters	•	•
0x15	Geographic Coordinates: Extended Dataset	•	
0x16	SBAS Message	•	
0x17	GALILEO Sub-frame Data	•	
0x18	GPS/QZSS Almanac	•	•(1)
0x19	GLONASS Almanac	•	•
0x1A	GPS/QZSS Ephemeris	•	
0x1B	GLONASS Ephemeris	•	
0x1C	GPS Ionospheric Parameters	•	•
0x1D	GPS Time to UTC Conversion Parameters	•	•
0x1E	GLONASS Time to UTC Conversion Parameters	•	•
0x1F	GST-UTC Conversion Parameters	•	
0x20	Geographic Coordinates: Basic Dataset	•	
0x21	Receiver Telemetry(2)	•	•

Message ID	Message	GeoS-5M	GeoS-5RTK
0x22	In View/Active SVs	•	•
0x23	RTK Output Dataset: ECEF Coordinates		•
0x24	RTK Output Dataset: Geographic Coordinates		•
0x25	RTK Output Dataset: Baseline ECEF Coordinates		•
0x26	Differential Corrections Reception Statistics		•
0x27…0x3D	Reserved		
0x3E	Receiver Power-up Message	•	•
	Responses to settings		
0x3F	Message Reception Acknowledgement	•	•
	Responses to queries		
0x80	Reference ECEF Coordinates	•	•
0x81	Serial Ports Parameters	•	•
0x82	Receiver Operation Mode	•	•
0x83	Navigation Solution Parameters	•	
0x84	Output Data Rate	•	•
0x85	DGNSS Parameters	•	
0x86	SBAS Parameters	•	
0x87	Power-save Modes Parameters	•	
0x88	GPS/QZSS Almanac(1)	•	•
0x89	GLONASS Almanac	•	•
0x8A	GPS/QZSS Ephemeris(1)	•	•
0x8B	GLONASS Ephemeris	•	•
0x8C	1PPS Parameters	•	•
0x8D	Enable/Disable SV Status	•	•
0x8E	NMEA Messages Configuration	•	•
0x8F	Binary Message Mask	•	•
0x90	Data Protocols Configuration	•	•
0x91, 0x92	Reserved		
0x93	Local Time Offset, Leap Second	•	•
0x94	Coordinate System	•	
0x95	Receiver Configuration File	•	
0x96, 0x97	Reserved		
0x98	GALILEO Almanac	•	
0x99	Reserved		
0x9A	GALILEO Ephemeris	•	
0x9B	Reserved		
0x9C	GPS Ionospheric Parameters	•	•
0x9D	GPS Time to UTC Conversion Parameters		

Message ID	Message	GeoS-5M	GeoS-5RTK
0x9E	GLONASS Time to UTC Conversion Parameters	•	•
0x9F	GST-UTC Conversion Parameters	•	
0xA0…0xAD	Reserved		
0xAE	SBAS Satellite Orbit Parameters	•	
0xAF	Received Reference Station Parameters		•
0xB0	RTK Receiver Antenna Parameters		•
0xB1	RTK Receiver Parameters		•
0xB2	Reference Station Differential Corrections Configuration		•
0xB3	RTK Engine Basic Parameters		•
0xB4	RTK Engine Extended Parameters		•
0xB5…0xBF	Reserved		
	Responses to commands		
0xC0	Reserved for internal use		
0xC1	Receiver Type, Firmware Version	•	•
0xC2	Reserved		
0xC3	Storing Data to Flash Report	•	•
0xC4	Response to Enter/Quit Power-save Mode	•	
0xC5	Reserved		
0xC6	Serial Port Number	•	
0xC7	Antenna Power Status	•	•
0xC8…0xCF	Reserved		
0xD0…0xD7	Reserved for internal use		
0xD8…0xFF	Reserved		

Notes:

1. GeoS-5 RTK: GPS Almanac, GPS Ephemeris;
2. Message format for GeoS-5M and GeoS-5 RTK is different.

4.1 0x00: GALILEO SAR RLM

Message length (in 32-bit words: here and hereinafter): 10.

Rate: once per second; immediately after extraction of RLM data from the received GALILEO signal.

Maximum number of messages with different 15HEX IDs: 10.

Word #	Type	Unit	Parameter
1, 2	double	s	Message reception time (UTC). Zero value corresponds to Jan 1st 2008
3	u_int		SVID
4	u_int		Message identifier: 0: short RLM 1: long RLM
5, 6	u_int		15HEX ID (60 LSBs)
7…9	u_int		Message parameters: 16 bits (short RLM); 96 bits (long RLM)
10	u_int		Message code (4 LSBs)

4.2 0x08, 0x98: GALILEO Almanac

Message length: 20.

Rate: immediately after extraction of almanac data from the received GALILEO signal (0x08) or in response to the input message 0x98.

Word #	Type	Unit	Parameter
1, 2	double	semi-circle	Mean anomaly at reference time M_0
3, 4	double		Eccentricity e
5, 6	double	$\sqrt{M}$	Square root of the semi-major axis $\sqrt{A}$
7, 8	double	semi-circle	Longitude of ascending node of orbit plane at weekly epoch Ω_0
9, 10	double	semi-circle	Inclination angle at reference time i_0
11, 12	double	semi-circle	Argument of perigee ω
13, 14	double	semi-circle/s	Rate of right ascension $\dot{\Omega}$
15, 16	double	s	Polinomial coefficient a_{f0}
17, 18	double	s/s	Polinomial coefficient a_{f1}
19	int	s	Bits 21:0: Reference time almanac t_{oa} to which the t_{oa} is referenced
		week	Bits 31:22: Number of week WN_a
20	u_short		Bits 31:16: SV health
	u_short		Bits 15:0: SVID

4.3 0x0A, 0x9A: GALILEO Ephemeris

Message length: 32.

Rate: immediately after extraction of ephemeris data from the received GALILEO signal (0x0A) or in response to the input message 0x9A.

Word #	Type	Unit	Parameter
1	int	s	Ephemeris reception time (UTC). Zero value corresponds to Jan 1st 2008
2	float	semi-circle/s	Mean motion difference from computed value Δn
3, 4	double	semi-circle	Mean anomaly M_0
5, 6	double		Eccentricity e
7, 8	double	$m^{1/2}$	Square root of the semi-major axis $\sqrt{A}$
9, 10	double	semi-circle	Longitude of ascending node of orbit plane at weekly epoch Ω_0
11, 12	double	semi-circle	Inclination angle at reference time i_0
13, 14	double	semi-circle	Argument of perigee ω
15, 16	double	semi-circle/s	Rate of right ascension $\dot{\Omega}$
17, 18	double	s	Polinomial coefficient a_{f0}
19	float	semi-circle/s	Rate of inclination angle IDOT
20	float	rad	Amplitude of the cosine harmonic correction term to the argument of latitude C_{uc}
21	float	rad	Amplitude of the sine harmonic correction term to the argument of latitude C_{us}
22	float	m	Amplitude of the cosine harmonic correction term to the orbit radius C_{rc}
23	float	m	Amplitude of the cosine harmonic correction term to the orbit radius C_{rs}
24	float	rad	Amplitude of the cosine harmonic correction term to the angle of inclination C_{ic}
25	float	rad	Amplitude of the sine harmonic correction term to the angle of inclination C_{is}
26	float		T_{GD}
27	float	s/s^2	Polinomial coefficient a_{f2}
28	float	s/s	Polinomial coefficient a_{f1}
29	int	s	Reference time ephemerides t_{oe}
30	int	s	Clock data reference time t_{oc}
31	short		Bits 31:16: IODC
	short		Bits 15:0: GST Week Number WN
32	byte		Bits 31:24: IODE
	byte		Bits 23:16: SVID (1…36)
	byte		Bits 15:8: SV health
	byte		Bits 7:0: SV accuracy

4.4 0x0E, 0xAE: SBAS Satellite Orbit Parameters

Message length: 24.

Rate: immediately after extraction of ephemeris data from the received SBAS signal (0x0E) or in response to the input message 0xAE.

Word #	Type	Unit	Parameter
1	int	s	Message reception time (UTC). Zero value corresponds to Jan 1st 2008
2	u_short		Bits 31:16: Reference time t_0 Resolution: 16 s. Value range: 0…86384 s.
	byte		Bits 15:8: URA
	byte		Bits 7:0: PRN (120…141)
3, 4	double	m	SV position X_G at the instant t_0
5, 6	double	m	SV position Y_G at the instant t_0
7, 8	double	m	SV position Z_G at the instant t_0
9, 10	double	m/s	SV X_G rate-of-change at the instant t_0
11, 12	double	m/s	SV Y_G rate-of-change at the instant t_0
13, 14	double	m/s	SV Z_G rate-of-change at the instant t_0
15, 16	double	m/s^2	SV X_G acceleration at the instant t_0
17, 18	double	m/s^2	SV Y_G acceleration at the instant t_0
19, 20	double	m/s^2	SV Z_G acceleration at the instant t_0
21, 22	double	s	SV clock offset a_{Gf0}
23, 24	double	s/s	SV clock drift a_{Gf01}

4.5 0x10: Raw Measurements

Message length: 6 + 14*NSat.

Rate: as per output data rate.

Word #	Type	Unit	Parameter
1, 2	double	s	Receiver time (UTC)(1). Zero value corresponds to Jan 1st 2008
3	int		Number of cycles of 16.369MHz reference clock in current measurement interval(2)
4	u_short		Bits 31:16: Number of SVs for which the measurements are transmitted (NSat)
	u_short	s	Bits 15:0: Current leap second count Δt_{LS}
5, 6	double	m	Clock shift relative to GPS time scale
7…20	structure		Measurements data for the 1st SV
21…34	structure		Measurements data for the 2nd SV
…			…
6+14*NSat	structure		Measurements data for the NSatth SV

Notes:

1. Incremented by 100ms, 200ms, 500ms or 1s according to the output data rate 10, 5, 2 or 1Hz, respectively.
   Relationship between Receiver time and GPS Time:

GPS Time = Receiver time – Clock shift relative to GPS time scale (message 0x13).

2. Measurement interval is 100ms, 200ms, 500ms or 1s according to the output data rate 10, 5, 2 or 1Hz, respectively.

Measurements data (structure):

Word #	Type	Unit	Parameter
1	byte		Bits 31:24: Channel number (0…42)
	byte		Bits 23:16: SV Number
	byte		Bits 15:8: Carrier frequency number H_n (two's complemented code). Value range: from minus 7 to +6. Transmits 0 for GPS, SBAS, GALILEO, QZSS
	byte		Bits 7:6: Carrier phase measurements validity (LLI) flag: 0: valid 1: likely cycle slip happened in current measurement interval 2: likely cycle slip happened in previous measurement interval 3: likely cycle slip happened in both current and previous measurement interval Bits 5:0: Reserved
2	float	dBHz	CNR
3, 4	double	m	Pseudorange(1)
5, 6	double	m/s	Pseudorange rate
7, 8	double	m	Integrated Doppler
9, 10	double	cycles	Carrier phase(2)(3)
11	float	m	Pseudorange error estimate, RMS
12	float	m/s	Pseudorange rate error estimate, RMS
13	float	m	Pseudorange residuals
14	float	m/s	Pseudorange rate residuals

Notes:

1. To align pseudorange measurements to GPS Time, use following formula:

   $PR_{GPS}^{(i)}=PR_{rcv}^{(i)} - \Delta t_{offs\_rcv\_GPS}\cdot c$, where:

   $PR_{GPS}^{(i)}$: pseudorange at GPS Time, in meters
   $PR_{rcv}^{(i)}$: pseudorange at Receiver time, in meters
   $\Delta t_{off\_rcv\_GPS}$: clock shift relative to GPS time scale (message 0x13), in seconds.

2. To align carrier phase measurements to GPS Time, use following formula:

   For GLONASS measurements:
   $Ph_{GPS}^{(i)}=Ph_{rcv}^{(i)} - ((F_{n\_GLN} + H_n\cdot\Delta F_n)\cdot Doppler_{rcv}^{(i)}\cdot\Delta t_{offs\_rcv\_GPS})/c$

   For GPS, GALILEO, QZSS measurements:
   $Ph_{GPS}^{(i)}=Ph_{rcv}^{(i)} - (F_{n\_GPS}\cdot Doppler_{rcv}^{(i)}\cdot\Delta t_{offs\_rcv\_GPS})/c$, where:

   $Ph_{GPS}^{(i)}$: carrier phase at GPS Time, in cycles
   $Ph_{rcv}^{(i)}$: carrier phase at Receiver time, in cycles
   F_{n_GPS}: 1575420000Hz (GPS carrier frequency)
   F_{n_GLN}: 1602000000Hz (carrier frequency of GLONASS 0th frequency number)
   ΔF_n: 562500Hz (GLONASS frequency step)
   H_n: GLONASS carrier frequency number
   $Doppler_{rcv}^{(i)}$: pseudorange rate, in m/s
   c: 299792458m/s (speed of light).

3. Carrier phase is available in GeoS-5MR, GeoS-5 RTK.

4.6 0x11: GPS Sub-frame Data

Message length: 12.

Rate: once per 6 seconds; transmitted from the channel that tracks GPS SV.

Word #	Type	Unit	Parameter
1	byte		Bits 31:24: Channel number (0…42)
	byte		Bits 23:16: PRN (1…32)
	u_short		Bits 15:0: 16 MSBs of the CSW (see below)
2	u_int	s	GPS sub-frame arrival time (time of week that corresponds to arrival of the first word of sub-frame data)
3	u_int		Word #1 (30 LSBs). If Hamming code is OK then relevant bits are 0
4	u_int		Word #2
…			…
12	u_int		Word #10

CSW:

Bits	Parameter
31:30	Carrier phase measurements validity (LLI) flag: 0: valid 1: likely cycle slip happened in current measurement interval 2: likely cycle slip happened in previous measurement interval 3: likely cycle slip happened in both current and previous measurement interval
29	SV use in position fix flag: 0: not used 1: used
28	Multipath detection flag[(1)]: 0: no detected multipath 1: multipath detected
27:24	SV enabled/disabled flag: 0: SV used in fix 2: SV disabled by 0x4D 4: SV disabled by selecting satellite system 7: SV disabled by signal level mask 8: SV disabled by elevation mask
23	Signal measurements ready flag: 0: not ready 1: ready
22	Navigation data frame validity flag: 0: not valid 1: valid
21	Ephemeris extracted from navigation data: 0: unavailable 1: available
20	Time extracted from navigation data: 0: unavailable 1: available
19	Frame sync flag: 0: no sync 1: sync achieved

Bits	Parameter
18	Bit sync flag: 0: no sync 1: sync achieved
17	PLL and DLL lock detect: 0: unlocked 1: locked
16	Signal power detect: 0: no signal 1: signal detected
15:0	Debug data

Notes:

1. For signal level >30dBHz.

4.7 0x12: GLONASS Sub-frame Data

Message length: 8.

Rate: once per 2 seconds; transmitted from the channel that tracks GLONASS SV.

Word #	Type	Unit	Parameter
1	byte		Bits 31:24: Channel number (0…42)
	byte		Bits 23:16: SV system number n (1…24)
	u_short		Bits 15:0: 16 MSBs of the CSW
2	u_int	s	GLONASS sub-frame arrival time (time of day that corresponds to arrival of the first word of sub-frame data)
3	u_int		Data bits (Bits 85:54)
4	u_int		Data bits (Bits 53:22)
5	u_int		Data bits (Bits 21:1); 11 LSBs are filled with 0
6	u_int		Hamming code check results: 0: OK else: failed
7	u_int		String number (1…75)
8	u_int		30-bit time mark decode results: 0 or 0x3FFFFFFF: OK else: failed

4.8 0x13: Navigation Solution State Vector

Message length: 32.

Rate: as per output data rate.

Word #	Type	Unit	Parameter
1, 2	double	m	X: X axis coordinate of the position, WGS-84
3, 4	double	m	Y: Y axis coordinate of the position, WGS-84
5, 6	double	m	Z: Z axis coordinate of the position, WGS-84
7, 8	double	m	Clock shift relative to GPS time scale
9, 10	double	m/s	V_X: X axis user velocity
11, 12	double	m/s	V_Y: Y axis user velocity

Word #	Type	Unit	Parameter
13, 14	double	m/s	V_Z: Z axis user velocity
15, 16	double	m/s	Clock drift
17, 18	double		$PDOP_{norhing}$
19, 20	double		$PDOP_{easting}$
21, 22	double		$PDOP_{up}$
23, 24	double		Reserved
25, 26	double		Reserved
27, 28	double	m	3D position accuracy estimate (RMS)
29, 30	double	m/s	3D velocity accuracy estimate (RMS)
31, 32	double	ns	1PPS accuracy estimate (RMS)

4.9 0x14: Timing Parameters

Message length: 12.

Rate: once per second.

Word #	Type	Unit	Parameter
1, 2	double	s	Receiver time (UTC). Zero value corresponds to Jan 1st 2008
3, 4	double	s	Local time and date
5, 6	double	ns	1PPS accuracy estimate (RMS)
7	u_int	s	GPS time of week
8	u_int	s	GLONASS time of day
9	u_short		Bits 31:16: GPS week rollover
	u_short	week	Bits 15:0: GPS Week Number WN
10	u_short		Bits 31:16: GLONASS number of four-year period N_4
	u_short	day	Bits 15:0: GLONASS calendar day number within the four-year period N_T
11	byte	s	Bits 31:24: Current leap second count Δt_{LS}
	byte	s	Bits 23:16: Future leap second count Δt_{LSF}
	byte		Bits 15:8: Leap second correction notification KP: 0: no correction is scheduled 1: '+1 s' leap second correction is scheduled 2: decision has not been made yet 3: '-1 s' leap second correction is scheduled
	byte		Bits 7:0: Reserved
12	u_int		Reserved

4.10 0x15: Geographic Coordinates: Extended Dataset

Message length: 18.

Rate: as per output data rate.

Word #	Type	Unit	Parameter
1, 2	double	m	Horizontal position accuracy estimate (RMS)
3, 4	double	m	Height accuracy estimate (RMS)
5, 6	double	m/s	Vertical velocity
7, 8	double	rad	Pitch
9, 10	double	m/s	Horizontal velocity accuracy estimate (RMS)
11, 12	double	m/s	Vertical velocity accuracy estimate (RMS)
13, 14	double	m/s^2	Acceleration
15	float	s	Age of GPS differential corrections (RTCM, SBAS). Transmits 9999 if no corrections are received
16	float	s	Age of GLONASS differential corrections (RTCM, SBAS). Transmits 9999 if no corrections are received
17	int		Reference station ID. Transmits 0xFFFFFFFF if no corrections are received
18	int		Reserved

4.11 0x16: SBAS Message

Message length: 11.

Rate: once per second.

Word #	Type	Unit	Parameter
1	byte		Bits 31:24: Channel number (0…42)
	byte		Bits 23:16: PRN (120…141)
	u_short		Bits 15:0: 16 MSBs of the CSW
2	u_int	s	SBAS message arrival time (UTC). Zero value corresponds to Jan 1st 2008
3	u_int		Data bits (Bits 1:32). The first received bit is MSB
4	u_int		Data bits (Bits 33:64)
5	u_int		Data bits (Bits 65:96)
6	u_int		Data bits (Bits 97:128)
7	u_int		Data bits (Bits 129:160)
8	u_int		Data bits (Bits 161:192)
9	u_int		Data bits (Bits 193:224)
10	u_int		Data bits (Bits 225:250); 6 LSBs are filled with 0
11	u_int		CRC check results: 0: OK else: failed

4.12 0x17: GALILEO Sub-frame Data

Message length: 12.

Rate: once per 2 seconds; transmitted from the channel that tracks GALILEO SV.

Word #	Type	Unit	Parameter
1	byte		Bits 31:24: Channel number (0…42)
	byte		Bits 23:16: SVID (1…36)
	u_short		Bits 15:0: 16 MSBs of the CSW
2	u_int	s	GALILEO sub-frame arrival time (time of day that corresponds to arrival of the first word of sub-frame data)
3…9	u_int(7)		Data bits (Bits 1:194)
10			CRC24
11			CRC24 check results: 0: OK else: failed
12	u_int		Reserved

4.13 0x18: GPS/QZSS Almanac

Message length: 20.

Rate: immediately after extraction of almanac data from the received GPS/QZSS signal (0x18) or in response to the input message 0x88.

Word #	Type	Unit	Parameter
1, 2	double	semi-circle	Mean anomaly at reference time M_0
3, 4	double		Eccentricity e
5, 6	double	$\sqrt{M}$	Square root of the semi-major axis $\sqrt{A}$
7, 8	double	semi-circle	Longitude of ascending node of orbit plane at weekly epoch Ω_0
9, 10	double	semi-circle	Inclination angle at reference time i_0
11, 12	double	semi-circle	Argument of perigee ω
13, 14	double	semi-circle/s	Rate of right ascension $\dot{\Omega}$
15, 16	double	s	Polinomial coefficient a_{f0}
17, 18	double	s/s	Polinomial coefficient a_{f1}
19	int	s	Bits 21:0: Reference time almanac t_{oa} to which the t_{oa} is referenced
		week	Bits 31:22: Number of week WN_a
20	u_short		Bits 31:16: SV health
	u_short		Bits 15:0: GPS PRN (1…32)/QZSS PRN No. (193…197)

4.14 0x19, 0x89: GLONASS Almanac

Message length: 18.

Rate: immediately after extraction of almanac data from the received GLONASS signal (0x19) or in response to the input message 0x89.

Word #	Type	Unit	Parameter
1, 2	double		Eccentricity ε_n^A
3, 4	double	s/orbital period^2	Rate of change of Draconian period $\dot{T}_n^A$
5, 6	double	semi-circle	Argument of perigee ω_n^A
7, 8	double	s/orbital period	Correction to the mean value of Draconian period ΔT_n^A
9, 10	double	s	Time of the first ascending node passage within N^A day $t_{\lambda n}^A$
11, 12	double	semi-circle	Longitude of the first ascending node orbit in PZ-90 within N^A day λ_n^A
13, 14	double	semi-circle	Correction to the mean value of inclination Δi_n^A
15, 16	double	s	Coarse value of time correction to GLONASS time τ_n^A
17	u_short	day	Bits 31:16: GLONASS calendar day number within the four-year period related to almanac data N^A
	u_short		Bits 15:0: SV system number n^A (1…24)
18	short		Bits 31:16: Carrier frequency number H_n^A
	u_short		Bits 15:0: Unhealthy flag C_n^A (bit 15), type of GLONASS SV M_n^A (bits 0 and 1)

4.15 0x1A, 0x8A: GPS/QZSS Ephemeris

Message length: 32.

Rate: immediately after extraction of ephemeris data from the received GPS/QZSS signal (0x1A) or in response to the input message 0x8A.

Word #	Type	Unit	Parameter
1	int	s	Ephemeris reception time (UTC). Zero value corresponds to Jan 1st 2008
2	float	semi-circle/s	Mean motion difference from computed value Δn
3, 4	double	semi-circle	Mean anomaly M_0
5, 6	double		Eccentricity e
7, 8	double	$m^{1/2}$	Square root of the semi-major axis $\sqrt{A}$
9, 10	double	semi-circle	Longitude of ascending node of orbit plane at weekly epoch Ω_0
11, 12	double	semi-circle	Inclination angle at reference time i_0
13, 14	double	semi-circle	Argument of perigee ω
15, 16	double	semi-circle/s	Rate of right ascension $\dot{\Omega}$
17, 18	double	s	Polinomial coefficient a_{f0}
19	float	semi-circle/s	Rate of inclination angle IDOT
20	float	rad	Amplitude of the cosine harmonic correction term to the argument of latitude C_{uc}

Word #	Type	Unit	Parameter
21	float	rad	Amplitude of the sine harmonic correction term to the argument of latitude C_{us}
22	float	m	Amplitude of the cosine harmonic correction term to the orbit radius C_{rc}
23	float	m	Amplitude of the cosine harmonic correction term to the orbit radius C_{rs}
24	float	rad	Amplitude of the cosine harmonic correction term to the angle of inclination C_{ic}
25	float	rad	Amplitude of the sine harmonic correction term to the angle of inclination C_{is}
26	float		T_{GD}
27	float	s/s^2	Polinomial coefficient a_{f2}
28	float	s/s	Polinomial coefficient a_{f1}
29	int	s	Reference time ephemerides t_{oe}
30	int	s	Clock data reference time t_{oc}
31	short		Bits 31:16: IODC
	short		Bits 15:0: GPS Week Number WN
32	byte		Bits 31:24: IODE
	byte		Bits 23:16: GPS PRN (1…32)/QZSS PRN No. (193…197)
	byte		Bits 15:8: SV health
	byte		Bits 7:0: SV accuracy

4.16 0x1B, 0x8B: GLONASS Ephemeris

Message length: 30.

Rate: immediately after extraction of ephemeris data from the received GLONASS signal (0x1B) or in response to the input message 0x8B.

Word #	Type	Unit	Parameter
1	int		Ephemeris reception time (UTC). Zero value corresponds to Jan 1st 2008
2	u_short	day	Bits 31:16: Calendar day number within the four-year period beginning since the leap year N^A
	u_short		Bits 15:0: Sum of four-year period and day number within the four-year period expressed in days $1461*N_4 + (N_t - 1)$
3, 4	double	m	SV position coordinate on X axis in PZ-90 at the instant t_b (x_n (t_b))
5, 6	double	m	SV position coordinate on Y axis in PZ-90 at the instant t_b (y_n (t_b))
7, 8	double	m	SV position coordinate on Z axis in PZ-90 at the instant t_b (z_n (t_b))
9, 10	double	m/s	SV velocity on X axis in PZ-90 at the instant t_b $(\dot{x}_n(t_b))$
11, 12	double	m/s	SV velocity on Y axis in PZ-90 at the instant t_b $(\dot{y}_n(t_b))$
13, 14	double	m/s	SV velocity on Z axis in PZ-90 at the instant t_b $(\dot{z}_n(t_b))$
15, 16	double	m/s^2	SV acceleration on X axis in PZ-90 at the instant t_b $(\ddot{x}_n(t_b))$

Word #	Type	Unit	Parameter
17, 18	double	m/s^2	SV acceleration on Y axis in PZ-90 at the instant t_b $(\ddot{y}_n(t_b))$
19, 20	double	m/s^2	SV acceleration on Z axis in PZ-90 at the instant t_b $(\ddot{z}_n(t_b))$
21, 22	double		Relative deviation of predicted carrier frequency value of SV from nominal value $\gamma_n(t_b)$
23, 24	double	s	Relative deviation of predicted carrier frequency value of SV from nominal value $\tau_n(t_b)$
25, 26	double	s	GLONASS time scale correction to UTC(SU) time τ_c
27, 28	double	s	Correction of GPS time relative to GLONASS time τ_{GPS}

29	u_short		Flags:
			// Bits 17:16: flag P1
			// Bits 19:18: flag B_n
			// Bit 20: flag P2
			// Bit 21: flag P3
			// Bits 23:22: flag P
			// Bit 24: flag P4
			// Bits 27:25: reserved
			// Bits 29:28: flags M

	u_short		SV health flag:
			// Bit 0: l_n from string 2 of ephemeris
			// Bit 1: l_n from string 3 of ephemeris
			// Bit 2: l_n from string 5 of ephemeris
			// Bit 3: l_n from string 7 of almanac
			// Bit 4: l_n from string 9 of almanac
			// Bit 5: l_n from string 11 of almanac
			// Bit 6: l_n from string 13 of almanac
			// Bit 7: l_n from string 15 of almanac
			// Bit 8: inverse C_n^A of almanac

30	byte		Bits 31:24: SV system number n (1…24)
	byte		Bits 23:16: Parameter of predicted SV URA F_T
	byte	day	Bits 15:8: Age of ephemeris E_n
	byte		Bits 7:0: Index of a 15-minute time interval within current day according to UTC(SU) + 03 hours 00 min t_b

4.17 0x1C, 0x9C: GPS Ionospheric Parameters

Message length: 8.

Rate: immediately after extraction of ionospheric data from the received GPS signal (0x1C) or in response to the input message 0x9C.

Word #	Type	Unit	Parameter
1	float	s	Coefficient α_0
2	float	s/semi-circle	Coefficient α_1
3	float	$s/semi\text{-}circle^2$	Coefficient α_2
4	float	$s/semi\text{-}circle^3$	Coefficient α_3
5	float	s	Coefficient β_0
6	float	s/semi-circle	Coefficient β_1
7	float	$s/semi\text{-}circle^2$	Coefficient β_2
8	float	$s/semi\text{-}circle^3$	Coefficient β_3

4.18 0x1D, 0x9D: GPS Time to UTC Conversion Parameters

Message length: 8.

Rate: immediately after extraction of timing data from the received GPS signal (0x1D) or in response to the input message 0x9D.

Word #	Type	Unit	Parameter
1, 2	double	s	Coefficient A_0
3, 4	double	s/s	Coefficient A_1
5	u_int	s	Time data reference Time of Week t_{ot}
6	u_short	week	Bits 31:16: Time data reference Week Number WN_{ot}
	u_short	s	Bits 15:0: Current leap second count Δt_{LS}
7	u_short	day	Bits 31:16: Leap second reference Day Number DN
	u_short	week	Bits 15:0: Future leap second reference Week Number WN_{LSF}
8	u_short	week	Bits 31:16: GPS Week Number WN
	u_short	s	Bits 15:0: Future leap second count Δt_{LSF}

4.19 0x1E, 0x9E: GLONASS Time to UTC Conversion Parameters

Message length: 10.

Rate: immediately after extraction of timing data from the received GLONASS signal (0x1E) or in response to the input message 0x9E.

Word #	Type	Unit	Parameter
1, 2	double	s	GLONASS time scale correction to UTC(SU) time τ_c
3, 4	double	s	Correction of GPS time relative to GLONASS time τ_{GPS}
5, 6	double	s	Time shift between UT1 and UTC(SU): polinomial coefficient B_1 (bias)
7, 8	double	s/day	Time shift between UT1 and UTC(SU): polinomial coefficient B_2 (drift)
9	u_short	day	Bits 31:16: GLONASS number of four-year period N_4
	u_short		Bits 15:0: GLONASS calendar day number within the four-year period N_T
10	u_short	day	Bits 31:16: GLONASS calendar day number within the four-year period related to almanac data N^A
	u_short		Bits 15:0: Leap second correction notification KP: 0: no correction is scheduled 1: '+1 s' leap second correction is scheduled 2: decision has not been made yet 3: '-1 s' leap second correction is scheduled

4.20 0x1F, 0x9F: GST-UTC Conversion Parameters

Message length: 8.

Rate: immediately after extraction of timing data from the received GALILEO signal (0x1F) or in response to the input message 0x9F.

Word #	Type	Unit	Parameter
1, 2	double	s	Coefficient A_0
3, 4	double	s/s	Coefficient A_1
5	u_int	s	Time data reference Time of Week t_{ot}

Word #	Type	Unit	Parameter
6	u_short	week	Bits 31:16: Time data reference Week Number WN_{ot}
	u_short	s	Bits 15:0: Current UTC-GST leap second count Δt_{LS}
7	u_short	day	Bits 31:16: UTC-GST leap second reference Day Number DN
	u_short	week	Bits 15:0: Future UTC-GST leap second reference Week Number WN_{LSF}
8	u_short	week	Bits 31:16: GST Week Number WN
	u_short	s	Bits 15:0: Future UTC-GST leap second count Δt_{LSF}

4.21 0x20: Geographic Coordinates: Basic Dataset

Message length: 28.

Rate: as per output data rate.

Word #	Type	Unit	Parameter
1, 2	double	s	Receiver time (UTC). Zero value corresponds to Jan 1st 2008
3, 4	double	rad	Latitude
5, 6	double	rad	Longitude
7, 8	double	m	Height above ellipsoid
9, 10	double	m	Geoidal separation
11	u_int		Number of SVs used in position fix
12	u_int		RSW (see below)
13, 14	double		GDOP
15, 16	double		PDOP
17, 18	double		TDOP
19, 20	double		HDOP
21, 22	double		VDOP
23	u_int		Position fix validity indicator: 0: fix valid else: fix not valid
24	u_int		Number of continuous fixes
25, 26	double	m/s	Horizontal velocity
27, 28	double	rad	Course

RSW:

Bit field	Parameter
31	Reserved
30	Saving data to Flash indicator: 0: saving not active 1: saving in progress
29	Reserved
28	Reserved

Bit field	Parameter
27	Calculated and reference position match indicator: 0: delta between calculated and reference coordinates exceeds the threshold and the receiver cannot transit to coordinates hold mode 1: delta between calculated and reference coordinates doesn't exceed the threshold Effective for coordinates hold mode only
26	Survey-in status indicator: 0: disabled or completed 1: in progress
25	Using RTCM corrections in solution indicator: 0: not used 1: used
24	Using RTCM corrections in solution indicator: 0: not used 1: used
23	ACTIVE/SLEEP indicator: 0: SLEEP 1: ACTIVE
22	Differential mode indicator: 0: autonomous mode 1: differential mode
21	DR mode indicator: 0: position fix calculated 1: position fix extrapolated
20	Static navigation indicator: 0: off (the receiver is in motion) 1: on (the receiver is static)
19	Position fix indicator: 0: position fix unavailable 1: position fix available
18	Indicator that at least one position fix has been available after receiver start: 0: unavailable 1: available
17	Reserved
16	2D/3D position fix indicator: 0: 3D 1: 2D
15	Reserved
14	Ionospheric model/UTC data decoded from GPS message availability indicator: 0: unavailable 1: available
13	Date decoded from navigation message availability indicator: 0: unavailable 1: available
12	Time decoded from navigation message availability indicator: 0: unavailable 1: available
11	QZSS almanac availability indicator: 0: unavailable 1: available

Bit field	Parameter
10	GALILEO almanac availability indicator: 0: unavailable 1: available
9	GLONASS almanac availability indicator: 0: unavailable 1: available
8	GPS almanac availability indicator: 0: unavailable 1: available
7:6	Antenna status: 0: not measured 1: overload 2: open 3: OK
5	GLONASS AGC: 0: failed 1: OK
4	GPS AGC: 0: failed 1: OK
3	Reserved
2	RF PLL status: 0: failed 1: OK
1	RTC test results: 0: failed 1: OK
0	Backup SRAM test results: 0: failed 1: OK

4.22 0x21: Receiver Telemetry

Message length: 8.

Rate: once per second.

Word #	Type	Unit	Parameter
1	u_int		RSW
2	u_int		Receiver Configuration Word #1 (see below)
3	u_int		Receiver Configuration Word #2 (see below)
4	u_int	s	Time elapsed since last restart
5	u_int	s	Receiver time (UTC). Zero value corresponds to Jan 1st 2008
6	float		Reserved
7	u_short		Bits 31:16: reserved
	u_short	s	Bits 15:0: Time left to completing survey-in
8	byte		Bits 31:24: Number of SVs in view
	byte		Bits 23:16: Number of the receiver busy channels
	byte		Bits 15:8: Number of SVs used in position fix
	byte		Bits 7:0: Number of SVs being tracked

Receiver Configuration Word #1:

Bit field	Parameter
31	Reserved
30	Antenna power: 0: off 1: on
29	Reserved
28	Operation mode: 0: autonomous or differential 1: coordinates hold
27	RAIM (T-RAIM): 0: off 1: on
26	Pseudorange measurements in message 0x10: 0: unsmoothed 1: smoothed
25	Power-save mode: 0: RELAXED FIX® 1: FIX-BY-REQUEST®
24	Power-save modes: 0: disabled 1: enabled
23:21	User dynamics profile: 0: auto select 1: pedestrian-car 2: marine 3: airborne 4: high-dynamic(1)
20	Reserved
19:18	Output data rate, Hz: 0: 10 1: 5 2: 2 3: 1
17:16	Reserved
15	Kalman filter: 0: off 1: on
14	2D for the first fix: 0: enabled 1: disabled
13	2D mode: 0: disabled 1: enabled
12	Pseudorange measurements used in solution: 0: unsmoothed 1: smoothed

Bit field	Parameter
11:9	1PPS synchronization time scale: 0: GPS 1: UTC 2: GLONASS 3: UTC(SU) 4…7: reserved
8	1PPS polarity: 0: positive 1: negative
7	1PPS output: 0: disabled 1: enabled
6	Signal search if GNSS is disabled: 0: disabled 1: enabled
5	Reserved
4	SBAS system: 0: disabled 1: enabled
3	QZSS system: 0: disabled 1: enabled
2	GALILEO system: 0: disabled 1: enabled
1	GPS system: 0: disabled 1: enabled
0	GLONASS system: 0: disabled 1: enabled

Notes:

1. For GeoS-5MH only.

Receiver Configuration Word #2:

Bit field	Parameter
31:16	Receiver type: 0xF7FF: GeoS-5M 0xF7FE: GeoS-5MR 0xF7FD: GeoS-5MH
15:14	Coordinate system: 0: WGS-84 1: PZ-90.11 2: user-defined
13:9	Reserved
8	Differential mode: 0: disabled 1: enabled
7:5	Reserved

Bit field	Parameter
4	Using corrections if SBAS SV operates in test mode: 0: disabled 1: enabled
3	Using SVs in position fix if SBAS corrections are available: 0: only those SVs for which corrections are available 1: all available SVs
2	PRN SBAS: 0: user-defined 1: auto select
1:0	Reserved

4.22.10x21: Receiver Telemetry (GeoS-5 RTK)

Message length: 8.

Rate: once per second.

Word #	Type	Unit	Parameter
1	u_int		RSW RTK (see below)
2	u_int		RTK Receiver Configuration Word #1 (see below)
3	u_int		RTK Receiver Configuration Word #2 (see below)
4	u_int	s	Time elapsed since last restart
5	u_int	s	Receiver time (UTC). Zero value corresponds to Jan 1st 2008
6	float		Reserved
7	u_short		Bits 31:16: reserved
	u_short	s	Bits 15:0: Time left to completing survey-in
8	byte		Bits 31:24: Number of SVs in view
	byte		Bits 23:16: Number of the receiver busy channels
	byte		Bits 15:8: Number of SVs used in position fix
	byte		Bits 7:0: Number of SVs being tracked

RSW RTK:

Bit field	Parameter
31	Receiver configuration: 0: rover 1: reference station
30	Saving data to Flash indicator: 0: inactive 1: in progress
29:28	Reserved
27	Calculated and reference position match indicator: 0: delta between calculated and reference coordinates exceeds the threshold and the receiver cannot transit to coordinates hold mode 1: delta between calculated and reference coordinates doesn't exceed the threshold Effective for coordinates hold mode only

Bit field	Parameter
26	Survey-in status: 0: disabled or completed 1: in progress
25	Differential corrections extrapolation indicator: 0: inactive 1: in progress
24	Smoothing solution transitions indicator: 0: inactive 1: in progress
23:10	Reserved
9	GLONASS almanac availability indicator: 0: unavailable 1: available
8	GPS almanac availability indicator: 0: unavailable 1: available
7:6	Antenna status: 0: not measured 1: overload 2: open 3: OK
5	GLONASS AGC: 0: failed 1: OK
4	GPS AGC: 0: failed 1: OK
3	Reserved
2	RF PLL status: 0: failed 1: OK
1	RTC test results: 0: failed 1: OK
0	Backup SRAM test results: 0: failed 1: OK

RTK Receiver Configuration Word #1:

Bit field	Parameter
31	Reserved
30	Antenna power: 0: off 1: on
29:28	Operation mode: 0: autonomous or differential 1: coordinates hold 2: survey-in 3: reserved
27:24	Reserved

Bit field	Parameter
23:21	User dynamics profile: 0: auto select 1: pedestrian-car 2: marine 3: airborne 4: reserved
20	Reserved
19:18	Output data rate, Hz: 0: reserved 1: 5 2: 2 3: 1
17:13	Reserved
12	Pseudorange smoothing: 0: off 1: on
11:9	1PPS synchronization time scale: 0: GPS 1: UTC 2: GLONASS 3: UTC(SU) 4…7: reserved
8	1PPS polarity: 0: positive 1: negative
7	1PPS output: 0: disabled 1: enabled
6:2	Reserved
1	GPS system: 0: disabled 1: enabled
0	GLONASS system: 0: disabled 1: enabled

RTK Receiver Configuration Word #2:

Bits	Parameter
31:16	Receiver type: 0xE7FE: GeoS-5 RTK
15:9	Reserved
8:7	Differential mode: 0: RTK extrapolated 1: reserved 2: DGNSS (code-differential) 3: disabled
6:0	Reserved

4.23 0x22: In View/Active SVs

Message length: 1 + 5*NSat.

Rate: once per second.

Word #	Type	Unit	Parameter
1	u_int		Number of SVs for which the data is transmitted (NSat)
2…6	structure		1st SV data
…			…
-3+5*NSat …1+5*NSat	structure		NSatth SV data

SV data (structure):

Word #	Type	Unit	Parameter
1	byte		Bits 31:24: Channel number (0…42). Transmits 0xFF if SV is not in track
	byte		Bits 23:16: SV number
	short		Bits 15:0: Carrier frequency number H_n (two's complemented code). Value range: from minus 7 to +6. Transmits 0 for GPS, SBAS, GALILEO, QZSS
2	u_int		SV status: 0: SV is not in track else: bit 29=0 – SV is in track, bit 29=1 – SV is used in position fix
3	float	dBHz	CNR. Transmits 0 if SV is not in track
4	float	rad	Elevation angle
5	float	rad	Azimuth

4.24 0x23: RTK Output Dataset: ECEF Coordinates

Message length: 29.

Rate: as per output data rate.

Word #	Type	Unit	Parameter
1, 2	double	s	Receiver time (UTC). Zero value corresponds to Jan 1st 2008
3, 4	double	m	X: X axis coordinate of the position, WGS-84
5, 6	double	m	Y: Y axis coordinate of the position, WGS-84
7, 8	double	m	Z: Z axis coordinate of the position, WGS-84
9, 10	double	m/s	V_X: X axis user velocity
11, 12	double	m/s	V_Y: Y axis user velocity
13, 14	double	m/s	V_Z: Z axis user velocity
15, 16	double	m	3D position accuracy estimate (RMS)
17, 18	double	m/s	3D velocity accuracy estimate (RMS)
19	u_int		Number of SVs used in solution
20	u_short		Bit 16: RTK extrapolation status 0: in progress 1: inactive

Word #	Type	Unit	Parameter
	u_short		Bits 15:0: Solution type 0: not valid or unavailable 1: autonomous (standard accuracy) 2: code-differential 3: coordinates hold 4: fixed RTK 5: float RTK
21, 22	double	m	Clock shift relative to GPS time scale
23, 24	double	m/s	Clock drift
25, 26	double	m	Rover clock shift relative to reference station time scale
27	float	s	Age of differential corrections
28, 29			Reserved

4.25 0x24: RTK Output Dataset: Geographic Coordinates

Message length: 34.

Rate: as per output data rate.

Word #	Type	Unit	Parameter
1, 2	double	s	Receiver time (UTC). Zero value corresponds to Jan 1st 2008
3, 4	double	rad	Latitude
5, 6	double	rad	Longitude
7, 8	double	m	Height above ellipsoid
9, 10	double	m	Geoidal separation
11, 12	double	m/s	Horizontal velocity
13, 14	double	m/s	Vertical velocity
15, 16	double	rad	Course
17, 18	double		GDOP
19, 20	double		PDOP
21, 22	double		TDOP
23, 24	double		HDOP
25, 26	double		VDOP
27, 28	double	m	Horizontal position accuracy estimate (RMS)
29, 30	double	m	Height accuracy estimate (RMS)
31	u_int		Number of SVs used in solution
32	u_short		Bit 16: RTK extrapolation status 0: in progress 1: inactive
	u_short		Bits 15:0: Solution type 0: not valid or unavailable 1: autonomous (standard accuracy) 2: code-differential 3: coordinates hold 4: fixed RTK 5: float RTK
33, 34			Reserved

4.26 0x25: RTK Output Dataset: Baseline ECEF Coordinates

Message length: 6.

Rate: as per output data rate.

Word #	Type	Unit	Parameter
1, 2	double	m	dX: X axis rover coordinate relative to reference coordinates, WGS-84
3, 4	double	m	dY: Y axis rover coordinate relative to reference coordinates, WGS-84
5, 6	double	m	dZ: Z axis rover coordinate relative to reference coordinates, WGS-84

4.27 0x26: Differential Corrections Reception Statistics

Message length: 3.

Maximum number of analyzed RTCM messages per second: 10.

Word #	Type	Unit	Parameter
1	u_short	ms	Message reception latency relative to integer second of receiver time
	u_short		Message type[(1)]. Value range: 0…4095
2	u_int	s	GNSS Epoch Time (UTC)
3	u_short		Reference station ID[(1)]. Value range: 0…4095
	u_short		Number of SVs for which differential corrections have been received[(1)]. Transmits 0x00FF if data is unavailable

Notes:

1. Transmits 0xFFFF if CRC check is failed.

4.28 0x3E: Receiver Power-up Message

Message length: 3.

Rate: once per second during first 5 seconds after receiver power-up.

Word #	Type	Unit	Parameter
1	u_int		Results of backup SRAM integrity test: 0: OK 1: failed
2	u_int		UTC data taken from backup SRAM: 0: data failed 1: data valid
3	u_int		UTC data taken from RTC

4.29 0x3F: Message Reception Acknowledgement

Message length: 2.

Response to either setting message and, in some cases, to queries and commands.

Word #	Type	Unit	Parameter
1	u_int		Message ID
2	u_int		Acknowledgement code: 0: reception is OK 1: incorrect check sum 2: incorrect number of data received 3: incorrect message ID 4: incorrect value 5: the message can't be processed at the time of reception

4.30 0x80: Reference ECEF Coordinates

Message length: 7.

Response to the input message 0x80.

Word #	Type	Unit	Parameter
1, 2	double	m	X: X axis reference coordinate, WGS-84
3, 4	double	m	Y: Y axis reference coordinate, WGS-84
5, 6	double	m	Z: Z axis reference coordinate, WGS-84
7	u_int		Reference station ID[(1)]. Value range: 0…4095

Notes:

1. For GeoS-5 RTK only.

4.31 0x81: Serial Ports Parameters

Message length: 4.

Response to the input message 0x81.

Word #	Type	Unit	Parameter
1	u_int		Port number: 0: Port #0 1: Port #1
2	u_int	bit/s	Baud rate: 0: 4800 1: 9600 2: 19200 3: 38400 4: 57600 5: 115200 6: 230400 7: 460800 8: 921600
3	u_int		Stop bits: 0: 1 1: 2

Word #	Type	Unit	Parameter
4	u_int		Parity: 0: no parity 1: even 2: odd 3: space 4: mark

4.32 0x82: Receiver Operation Mode

Message length: 2.

Response to the input message 0x82.

Word #	Type	Unit	Parameter
1	u_int		GNSS constellation (0: disabled; 1: enabled)[(1)]: Bit 0: GLONASS Bit 1: GPS Bit 2: GALILEO Bit 3: QZSS Bit 4: SBAS Bit 5…30: reserved Bit 31: signal search if GNSS is disabled (0: disabled; 1: enabled)
2	u_short	minute	Bits 31:16: Survey-in interval. Value range: 15…1440 minutes
	u_short		Bits 15:0: Operation mode: 0: autonomous or differential 1: coordinates hold 2: survey-in

Notes:

1. Bits 2…31 are not applicable to GeoS-5 RTK.

4.33 0x83: Navigation Solution Parameters

Message length: 9.

Response to the input message 0x83.

Word #	Type	Unit	Parameter
1	u_int		User dynamics profile: 0: auto select 1: pedestrian-car 2: marine 3: airborne 4: high-dynamic[(1)]
2	float		GDOP mask. Value range: 5-50
3	float	rad	Elevation angle mask. Value range: 0…0.52 rad (0…30 degree)
4	float	dBHz	Signal level mask. Value range: 5…40 dBHz
5	u_int		2D mode control: 0: 2D not allowed 1: 2D not allowed for the first fix 2: 2D allowed

Word #	Type	Unit	Parameter
6	u_int	s	DR time duration. Value range: 0…10 s. Zero value means DR is disabled
7	u_int		Bit 0: Pseudorange measurements used in solution 0: unsmoothed 1: smoothed Bit 1: Kalman filter 0: off 1: on Bit 2: Pseudorange measurements in message 0x10 0: unsmoothed 1: smoothed Bit 3: RAIM (T-RAIM) 0: off 1: on
8	float	m/s	Static navigation threshold. Value range: 0…0.5 m/s. Zero value means static navigation is disabled
9	u_int	s	Pseudorange measurements smoothing interval. Value range: 1…600 s

Notes:

1. For GeoS-5MH only.

4.34 0x84: Output Data Rate

Message length: 1.

Response to the input message 0x84.

Word #	Type	Unit	Parameter
1	u_int	Hz	Output data rate: 0: 10 1: 5 2: 2 3: 1

4.35 0x85: DGNSS Parameters

Message length: 1.

Response to the input message 0x85.

Word #	Type	Unit	Parameter
1	u_short	s	Bits 31:16: DGNSS time-out period Value range: 30…90 s
	u_short		Bit 0: DGNSS control 0: disabled 1: enabled

4.36 0x86: SBAS Parameters

Message length: 4.

Response to the input message 0x86.

Word #	Type	Unit	Parameter
1	u_short		Bit 16: PRN SBAS 0: user-defined 1: auto select Bit 17: Using SVs in position fix if SBAS corrections are available 0: only those SVs for which corrections are available 1: all available SVs Bit 18: Using SBAS corrections if SV operates in test mode 0: disabled 1: enabled
	u_short	s	Bits 15:0: SBAS time-out period Value range: 60…180 s
2	u_int		PRN for the first receiver SBAS channel (if PRN is user-defined): 120…141 else: SBAS disabled for given channel
3	u_int		PRN for the second receiver SBAS channel (if PRN is user-defined): 120…141 else: SBAS disabled for given channel
4	u_int		PRN for the third receiver SBAS channel (if PRN is user-defined): 120…141 else: SBAS disabled for given channel

4.37 0x87: Power-save Modes Parameters

Message length: 5.

Response to the input message 0x87.

Word #	Type	Unit	Parameter
1	u_int		Power-save mode: 0: RELAXED FIX® 1: FIX-BY-REQUEST®
2	u_int	s	Minimum ACTIVE time (T_{ACT_MIN}). Minimum value: 2s
3	u_int	s	Maximum ACTIVE time (T_{ACT_MAX}). Cannot be less than T_{ACT_MIN}.
4	u_int	s	Time interval between ACTIVE states for RELAXED FIX® ($T_{ACT\text{-}ACT}$). Cannot be less than $T_{ACT\ MAX}$ and ($T_{ACT\ MIN}$ + $T_{ACT\ FIX}$). Value range: 10…120s
5	u_int	s	ACTIVE time after the first fix (T_{ACT_FIX}). Minimum value: 0

4.38 0x8C: 1PPS Parameters

Message length: 6.

Response to the input message 0x8C.

Word #	Type	Unit	Parameter
1	u_int		1PPS: 0: off 1: on
2	u_int		1PPS polarity: 0: positive 1: negative
3	u_int		1PPS synchronization time scale: 0: GPS 1: UTC 2: GLONASS 3: UTC(SU)
4	float	us	1PPS duration. Value range: 10…2000 us
5, 6	double	ns	1PPS offset. Value range: ±500000000 ns

4.39 0x8D: Enable/Disable SV Status

Message length: 2.

Response to the input message 0x8D.

Word #	Type	Unit	Parameter
1	u_int		SV number
2	u_int		SV status: 0: disabled for use in solution 1: enabled for use in solution

4.40 0x8E: NMEA Messages Configuration

Message length: 2.

Response to the input message 0x8E.

Word #	Type	Unit	Parameter
1	u_int		Port number: 0: Port #0 1: Port #1
2	u_int		Bits 8:0: NMEA message mask (0: disabled; 1: enabled) Bit 0: GGA/GNS mask Bit 1: GSA mask Bit 2: GSV mask Bit 3: RMC mask Bit 4: VTG mask Bit 5: GLL mask Bit 6: ZDA mask Bit 7: DTM mask Bit 8: RLM mask Bits 13:9: reserved Bit 14: NMEA 0183 version 0: v2.x 1: v4.10 Bit 15: reserved

4.41 0x8F: Binary Message Mask

Message length: 1.

Response to the input message 0x8F.

Word #	Type	Unit	Parameter
1	u_int		Binary message mask (0: disabled; 1: enabled): Bit 0: 0x00 mask Bit 1: 0x01 mask Bit 2: 0x02 mask … Bit 31: маска сообщения 0x1F

4.42 0x90: Data Protocols Configuration

Message length: 1.

Response to the input message 0x90.

Word #	Type	Unit	Parameter
1	u_int		Data protocol assignment: 0: Port #0: binary; Port #1: NMEA in/out 1: Порт #0: NMEA in/out, Port #1: binary 2: Port #0: NMEA in/out, Port #1: NMEA in/out 3: Port #0: binary; Port #1: RTCM in 4: Port #0: NMEA in/out; Port #1: RTCM in 5: Port #0: binary; Port #1: user-specific 6[(1)]: Port #0: binary; Port #1: RTCM out 7[(1)]: Port #0: binary; Port #1: RTCM in + NMEA out

Notes:

1. For GeoS-5 RTK only.

4.43 0x93: Local Time Offset, Leap Second

Message length: 2.

Response to the input message 0x93.

Word #	Type	Unit	Parameter
1	int	s	Current leap second count
2	int	minute	Local time offset relative to UTC. Value range: ±(0…780) minutes

4.44 0x94: Coordinate System

Message length: 10.

Response to the input message 0x94.

Word #	Type	Unit	Parameter
1	u_int		Coordinate system: 0: WGS-84 1: PZ-90.11 2: user-defined (refer to words #2…10 for parameter definitions)
2	float	m	Semi-major axis
3	float		Flattening
4	float	m	X axis shift at the origin
5	float	m	Y axis shift at the origin
6	float	m	Z axis shift at the origin
7	float	rad	Rotation around X axis
8	float	rad	Rotation around Y axis
9	float	rad	Rotation around Z axis
10	float		Scale change

4.45 0x95: Receiver Configuration File

Message length: 64.

Response to the input message 0x95.

Word #	Type	Unit	Parameter
1	u_int		Reserved
2	u_int		Receiver Configuration Word #1
3	u_int		Receiver Configuration Word #2

Word #	Type	Unit	Parameter
4	u_short		Port #1 parameters: Bit 16: Stop bits 0: 1 1: 2 Bits 19:17: Parity 0, 2, 4, 6: no parity 1: even 3: odd 5: space 7: mark Bits 23:20: Baud rate 0: 4800 1: 9600 2: 19200 3: 38400 4:57600 5: 115200 6: 230400 7: 460800 8: 921600 Bits 26:24: Data protocol 1: binary 2: NMEA in/out 3: RTCM in 4: user-specific 5: RTCM out 6: RTCM in + NMEA out
	u_short		Port #0 parameters: Bit 0: Stop bits 0: 1 1: 2 Bits 3:1: Parity 0, 2, 4, 6: no parity 1: even 3: odd 5: space 7: mark Bits 7:4: Baud rate 0: 4800 1: 9600 2: 19200 3: 38400 4:57600 5: 115200 6: 230400 7: 460800 8: 921600 Bits 10:8: Data protocol 1: binary 2: NMEA in/out 3: RTCM in 4: user-specific 5: RTCM out 6: RTCM in + NMEA out
5, 6	double	m	X: X axis reference coordinate, WGS-84
7, 8	double	m	Y: Y axis reference coordinate, WGS-84

Word #	Type	Unit	Parameter
9, 10	double	m	Z: Z axis reference coordinate, WGS-84
11	int	s	Local time offset relative to UTC
12	float	rad	Elevation angle mask
13	float		GDOP mask
14	float	dBHz	Signal level mask
15	float	m/s	Static navigation threshold
16	float	s	Pseudorange measurements smoothing interval
17, 18	double	ns	1PPS offset
19	float	us	1PPS duration
20	u_short	s	Bits 31:16: DR time duration
	u_short		Bits 15:0: PRN for the first receiver SBAS channel (if PRN is user-defined) 120…141 else: SBAS disabled for given channel
21	u_short		Bits 31:16: PRN for the first receiver SBAS channel (if PRN is user-defined) 120…141 else: SBAS disabled for given channel
	u_short		Bits 15:0: PRN for the first receiver SBAS channel (if PRN is user-defined) 120…141 else: SBAS disabled for given channel
22	u_int		Binary message mask (0: disabled; 1: enabled): Bit 0: 0x00 mask Bit 1: 0x01 mask Bit 2: 0x02 mask … Bit 31: 0x1F mask
23	u_short		Bits 24:16: Port #1 NMEA message mask (0: disabled; 1: enabled) Bit 16: GGA/GNS mask Bit 17: GSA mask Bit 18: GSV mask Bit 19: RMC mask Bit 20: VTG mask Bit 21: GLL mask Bit 22: ZDA mask Bit 23: DTM mask Bit 24: RLM mask Bits 29:25: reserved Bit 30: NMEA 0183 version 0: v2.x 1: v4.10 Bit 31: reserved

Word #	Type	Unit	Parameter
	u_short		Bits 8:0: Port #0 NMEA message mask (0: disabled; 1: enabled) Bit 0: GGA/GNS Bit 1: GSA mask Bit 2: GSV mask Bit 3: RMC mask Bit 4: VTG mask Bit 5: GLL mask Bit 6: ZDA mask Bit 7: DTM mask Bit 8: RLM mask Bits 13:9: reserved Bit 14: NMEA 0183 version 0: v2.x 1: v4.10 Bit 15: reserved
24	byte	s	Bits 31:24: Time interval between ACTIVE states (RELAXED FIX®)
	byte	s	Bits 25:16: Minimum ACTIVE time
	byte	s	Bits 15:8: Maximum ACTIVE time
	byte	s	Bits 7:0: ACTIVE time after the first fix
25	u_short	s	DGNSS time-out period
	u_short	s	SBAS time-out period
26	u_int	minute	Survey-in interval
27	float	m	Semi-major axis
28	float		Flattening
29	float	m	X axis shift at the origin
30	float	m	Y axis shift at the origin
31	float	m	Z axis shift at the origin
32	float	rad	Rotation around X axis
33	float	rad	Rotation around Y axis
34	float	rad	Rotation around Z axis
35	float		Scale change
36…64			Reserved

4.46 0xAF: Received Reference Station Parameters

Message length: 16.

Response to the input message 0xAF.

Word #	Type	Unit	Parameter
1, 2	double	m	X: X axis reference coordinate, WGS-84
3, 4	double	m	Y: Y axis reference coordinate, WGS-84
5, 6	double	m	Z: Z axis reference coordinate, WGS-84
7…14	byte(32)		Reference station antenna descriptor, 31 ASCII characters. If not used the data is filled with 0
15, 16	double	m	Reference station antenna height

4.47 0xB0: RTK Receiver Antenna Parameters

Message length: 19.

Response to the input message 0xB0.

Word #	Type	Unit	Parameter
1, 2	double	m	Antenna height. Value range: 0…6.5535 m
3…10	byte(32)		Antenna descriptor, 31 ASCII characters. If not used the data is filled with 0
11[(1)]	u_int		Antenna setup ID
12…19[(1)]	byte(32)		Antenna serial number, 31 ASCII characters. If not used the data is filled with 0

Notes:

1. Words #11…19 are not applicable if GeoS-5 RTK is configured as rover.

4.48 0xB1: RTK Receiver Parameters

Message length: 6.

Response to the input message 0xB1.

Word #	Type	Unit	Parameter
1	float	rad	Elevation angle mask. Value range: 0…0.52 rad (0…30 degree)
2	float	dBHz	Signal level mask. Value range: 5…40 dBHz
3	u_int		Bit 0: Pseudorange smoothing 0: off 1: on
4	u_int	s	Pseudorange measurements smoothing interval. Value range: 1…600 s
5, 6			Reserved

4.49 0xB2: Reference Station Differential Corrections Configuration

Message length: 3.

Response to the input message 0xB2.

Word #	Type	Unit	Parameter
1			Reserved
2	u_int		RTCM v3.2 message type select: 0: MSM1 (1071/1081/1006/1033) 1: MSM5 (1075/1085/1006/1033/1230) 2: MSM7 (1077/1087/1006/1033/1230)
3	byte	s	Type 107x/108x message rate: 0: reserved 1: 0.2 2: 0.5 3: 1
	byte	s	Type 1006 message rate. Value range: 1…10 s

Word #	Type	Unit	Parameter
	byte	s	Type 1033 message rate. Value range: 1…10 s
	byte	s	Type 1230 message rate. Value range: 1…10 s

4.50 0xB3: RTK Engine Basic Parameters

Message length: 4.

Response to the input message 0xB3.

Word #	Type	Unit	Parameter
1	u_short	s	Bits 31:16: RTK/DGNSS time-out period RTK time-out period: in case of no receiving differential corrections, time interval during which the receiver extrapolates differential corrections and produces RTK solution. Effective in Differential mode: RTK extrapolated. Value range: 1…15 s DGNSS time-out period: in case of no receiving differential corrections, time interval during which the receiver applies the latest valid differential corrections and produces code-differential solution. Effective in Differential mode: DGNSS. Value range: 30…90 s
	u_short		Bits 15:0: Differential mode 0: RTK extrapolated 1: reserved 2: DGNSS (code-differential) 3: disabled
2	u_short	s	Bits 31:16: Transition time from less accurate solution (autonomous) to more accurate solution (RTK). Used for smoothing jumps during transition from one type of solution to other one. Value range: 0…60 s. Zero value means instant transition between solutions (smoothing is off)
	u_short	s	Bits 15:0: Transition time from more accurate solution (RTK) to less accurate solution (autonomous). Used for smoothing jumps during transition from one type of solution to other one. Value range: 0…60 s. Zero value means instant transition between solutions (smoothing is off)
3, 4			Reserved

4.51 0xB4: RTK Engine Extended Parameters

Message length: 8.

Response to the input message 0xB4.

Word #	Type	Unit	Parameter
1			Reserved
2			Reserved
3			Reserved
4			Reserved

Word #	Type	Unit	Parameter
5			Reserved
6			Reserved
7			Reserved
8			Reserved

4.52 0xC1: Receiver Type, Firmware Version

Message length: 4.

Response to the input message 0xC1.

Word #	Type	Unit	Parameter
1	u_short		Bits 31:16: FW version, high half-word
	u_short		Bits 15:0: FW version, low half-word
2	u_int		FW date: Bits 23:9: year Bits 8:5: month Bits 4:0: day
3	u_int		Receiver type: 0xF7FF: GeoS-5M 0xF7FE: GeoS-5MR 0xF7FD: GeoS-5MH 0xE7FE: GeoS-5 RTK
4	u_int		FW check sum

4.53 0xC3: Storing Data to Flash Report

Message length: 1.

Transmitted upon completion of saving data to Flash.

Word #	Type	Unit	Parameter
1	u_int		Saving data to Flash report: 0: saving data cannot be completed 1: saving almanacs by command 0xC3 successfully done 2: saving almanacs automatically successfully done 3: saving configuration/FW settings successfully done

4.54 0xC4: Response to Enter/Quit Power-save Mode

Message length: 1.

Response to the input message 0xC4.

Word #	Type	Unit	Parameter
1	u_int		Power-save mode status: 0: power-save mode has been quitted 1: power-save mode has been entered

4.55 0xC6: Serial Port Number

Message length: 1.

Response to the input message 0xC6.

Word #	Type	Unit	Parameter
1	u_int		Port number: 0: Port #0 1: Port #1

4.56 0xC7: Antenna Power Status

Message length: 1.

Response to the input message 0xC7.

Word #	Type	Unit	Parameter
1	u_int		Antenna power: 0: off 1: on

5 Input Messages

Input messages are summarized in Table 4.

1. Messages 0x00…0x3F: reserved
2. Messages 0x40…0x7F: settings
3. Messages 0x80…0xBF: queries
4. Messages 0xC0…0xFF: commands

Table 4. The list of input messages

Message ID	Message	GeoS-5M	GeoS-5RTK
	Settings		
0x40	Set Reference ECEF Coordinates	•	•
0x41	Set Serial Ports Parameters	•	•
0x42	Set Receiver Operation Mode	•	•
0x43	Set Navigation Solution Parameters	•	
0x44	Set Output Data Rate	•	•
0x45	DGNSS Control	•	
0x46	SBAS Control	•	
0x47	Set Power-save Modes Parameters	•	
0x48	Load GPS/QZSS Almanac	•	
0x49	Load GLONASS Almanac	•	
0x4A	Load GPS/QZSS Ephemeris	•	
0x4B	Load GLONASS Ephemeris	•	
0x4C	Set 1PPS Parameters	•	•
0x4D	Enable/Disable SV	•	•
0x4E	Set NMEA Messages Configuration	•	•
0x4F	Set Binary Message Mask	•	•
0x50	Set Data Protocols Configuration	•	•
0x51, 0x52	Reserved		
0x53	Set Local Time Offset and Leap Second	•	•
0x54	Set Coordinate System	•	
0x55	Load Receiver Configuration File	•	
0x56, 0x57	Reserved		
0x58	Load GALILEO Almanac	•	
0x59	Reserved		
0x5A	Load GALILEO Ephemeris	•	
0x5B…0x6F	Reserved		
0x70	Set RTK Receiver Antenna Parameters		•
0x71	Set RTK Receiver Parameters		•
0x72	Set Reference Station Differential Corrections Configuration		•

Message ID	Message	GeoS-5M	GeoS-5RTK
0x73	Set RTK Engine Basic Parameters		•
0x74	Set RTK Engine Extended Parameters		•
0x75...0x7F	Reserved		
	Queries		
0x80	Query Reference ECEF Coordinates	•	•
0x81	Query Serial Ports Parameters	•	•
0x82	Query Receiver Operation Mode	•	•
0x83	Query Navigation Solution Parameters	•	
0x84	Query Output Data Rate	•	•
0x85	Query DGNSS Parameters	•	
0x86	Query SBAS Parameters	•	
0x87	Query Power-save Modes Parameters	•	
0x88	Query GPS Almanac	•	•
0x89	Query GLONASS Almanac	•	•
0x8A	Query GPS Ephemeris	•	•
0x8B	Query GLONASS Ephemeris	•	•
0x8C	Query 1PPS Parameters	•	•
0x8D	Query Enable/Disable SV Status	•	•
0x8E	Query NMEA Messages Configuration	•	•
0x8F	Query Binary Message Mask	•	•
0x90	Query Data Protocols Configuration	•	•
0x91, 0x92	Reserved		
0x93	Query Local Time Offset and Leap Second	•	•
0x94	Query Coordinate System	•	
0x95	Query Receiver Configuration File	•	
0x96, 0x97	Reserved		
0x98	Query GALILEO Almanac	•	
0x99	Reserved		
0x9A	Query GALILEO Ephemeris	•	
0x9B	Reserved		
0x9C	Query GPS Ionospheric Parameters	•	•
0x9D	Query GPS Time to UTC Conversion Parameters	•	•
0x9E	Query GLONASS Time to UTC Conversion Parameters	•	•
0x9F	Query GST-UTC Conversion Parameters	•	
0xA0...0xAD	Reserved		
0xAE	Query SBAS Satellite Orbit Parameters	•	
0xAF	Query Received Reference Station Parameters		•
0xB0	Query RTK Receiver Antenna Parameters		•

Message ID	Message	GeoS-5M	GeoS-5RTK
0xB1	Query RTK Receiver Parameters		•
0xB2	Query Reference Station Differential Corrections Configuration		•
0xB3	Query RTK Engine Basic Parameters		•
0xB4	Query RTK Engine Extended Parameters		•
0xB5…0xBF	Reserved		
	Commands		
0xC0	Reserved for internal use		
0xC1	Request Receiver Type and Firmware Version	•	•
0xC2	Restart Receiver	•	•
0xC3	Save Almanacs to Flash	•	•
0xC4	Enter/Quit Power-save Mode	•	
0xC5	Switch to NMEA	•	
0xC6	Request Serial Port Number	•	
0xC7	Enable/Disable Antenna Power	•	•
0xC8…0xCF	Reserved		
0xD0…0xD7	Reserved for internal use		
0xD8…0xFF	Reserved		

5.1 0x40: Set Reference ECEF Coordinates

Message length: 7.
Data content is identical to that of output message 0x80.

5.2 0x41: Set Serial Ports Parameters

Message length: 4.
Data content is identical to that of output message 0x81.

5.3 0x42: Set Receiver Operation Mode

Message length: 2.
Data content is identical to that of output message 0x82.

5.4 0x43: Set Navigation Solution Parameters

Message length: 9.
Data content is identical to that of output message 0x83.

5.5 0x44: Set Output Data Rate

Message length: 1.
Data content is identical to that of output message 0x84.

5.6 0x45: DGNSS Control

Message length: 1.
Data content is identical to that of output message 0x85.

5.7 0x46: SBAS Control

Message length: 4.
Data content is identical to that of output message 0x86.

5.8 0x47: Set Power-save Modes Parameters

Message length: 5.
Data content is identical to that of output message 0x87.

5.9 0x48: Load GPS/QZSS Almanac

Message length: 20.
Data content is identical to that of output messages 0x18, 0x88.

5.10 0x49: Load GLONASS Almanac

Message length: 18.
Data content is identical to that of output messages 0x19, 0x89.

5.11 0x4A: Load GPS/QZSS Ephemeris

Message length: 32.
Data content is identical to that of output messages 0x1A, 0x8A.

5.12 0x4B: Load GLONASS Ephemeris

Message length: 30.
Data content is identical to that of output messages 0x1B, 0x8B.

5.13 0x4C: Set 1PPS Parameters

Message length: 6.
Data content is identical to that of output message 0x8C.

5.14 0x4D: Enable/Disable SV

Message length: 2.
Data content is identical to that of output message 0x8D.

5.15 0x4E: Set NMEA Messages Configuration

Message length: 2.
Data content is identical to that of output message 0x8E.

5.16 0x4F: Set Binary Message Mask

Message length: 1.
Data content is identical to that of output message 0x8F.

5.17 0x50: Set Data Protocols Configuration

Message length: 1.
Data content is identical to that of output message 0x90.

5.18 0x53: Set Local Time Offset and Leap Second

Message length: 2.
Data content is identical to that of output message 0x93.

5.19 0x54: Set Coordinate System

Message length: 10.
Data content is identical to that of output message 0x94.

5.20 0x55: Load Receiver Configuration File

Message length: 64.
Data content is identical to that of output message 0x95.

5.21 0x58: Load GALILEO Almanac

Message length: 20.
Data content is identical to that of output messages 0x08, 0x98.

5.22 0x5A: Load GALILEO Ephemeris

Message length: 32.
Data content is identical to that of output messages 0x0A, 0x9A

5.23 0x70: Set RTK Receiver Antenna Parameters

Message length: 19.

Data content is identical to that of output message 0xB0.

5.24 0x71: Set RTK Receiver Parameters

Message length: 6.

Data content is identical to that of output message 0xB1.

5.25 0x72: Set Reference Station Differential Corrections Configuration

Message length: 3.

Data content is identical to that of output message 0xB2.

5.26 0x73: Set RTK Engine Basic Parameters

Message length: 4.

Содержательная часть сообщения аналогична содержательной части выходных сообщений 0xB3.

5.27 0x74: Set RTK Engine Extended Parameters

Message length: 8.

Data content is identical to that of output message 0xB4.

5.28 0x80: Query Reference ECEF Coordinates

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.29 0x81: Query Serial Ports Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Port number: 0: Port #0 1: Port #1

5.30 0x82: Query Receiver Operation Mode

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.31 0x83: Query Navigation Solution Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.32 0x84: Query Output Data Rate

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.33 0x85: Query DGNSS Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.34 0x86: Query SBAS Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.35 0x87: Query Power-save Modes Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.36 0x88: Query GPS/QZSS Almanac

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		GPS PRN (1…32). Zero value corresponds to request of full GPS constellation almanac. QZSS PRN No. (193…197). Value of 100 corresponds to request of full QZSS constellation almanac

5.37 0x89: Query GLONASS Almanac

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		SV system number n (1…24). Zero value corresponds to request of full GLONASS constellation almanac

5.38 0x8A: Query GPS/QZSS Ephemeris

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		GPS PRN (1…32). Zero value corresponds to request of all available GPS ephemeris. QZSS PRN No. (193…197). Value of 100 corresponds to request of all available QZSS ephemeris

5.39 0x8B: Query GLONASS Ephemeris

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		SV system number n (1…24). Zero value corresponds to request of all available GLONASS ephemeris

5.40 0x8C: Query 1PPS Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.41 0x8D: Query Enable/Disable SV Status

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		SV number

5.42 0x8E: Query NMEA Messages Configuration

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Port number: 0: Port #0 1: Port #1

5.43 0x8F: Query Binary Message Mask

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.44 0x90: Query Data Protocols Configuration

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.45 0x93: Query Local Time Offset and Leap Second

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.46 0x94: Query Coordinate System

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.47 0x95: Query Receiver Configuration File

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.48 0x98: Query GALILEO Almanac

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		SVID (1…36). Zero value corresponds to request of full GALILEO constellation almanac

5.49 0x9A: Query GALILEO Ephemeris

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		SVID (1…36). Zero value corresponds to request of all available GALILEO ephemeris

5.50 0x9C: Query GPS Ionospheric Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.51 0x9D: Query GPS Time to UTC Conversion Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.52 0x9E: Query GLONASS Time to UTC Conversion Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.53 0x9F: Query GST-UTC Conversion Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.54 0xAE: Query SBAS Satellite Orbit Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		PRN (120…141)

5.55 0xAF: Query Received Reference Station Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.56 0xB0: Query RTK Receiver Antenna Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.57 0xB1: Query RTK Receiver Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.58 0xB2: Query Reference Station Differential Corrections Configuration

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.59 0xB3: Query RTK Engine Basic Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.60 0xB4: Query RTK Engine Extended Parameters

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.61 0xC1: Request Receiver Type and Firmware Version

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.62 0xC2: Restart Receiver

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Restart receiver and restore default settings command: Bit 2: restore default FW settings 0: has no effect (receiver is operating with current FW settings) 1: restore default settings Bit 1: clear almanacs 0: has no effect 1: clear almanacs Bit 0: clear ephemeris 0: has no effect 1: clear ephemeris 0: hot start 1: warm start 3: cold start

5.63 0xC3: Save Almanacs to Flash

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.64 0xC4: Enter/Quit Power-save Mode

Message length: 1.

Data content is identical to that of output message 0xC4.

5.65 0xC5: Switch to NMEA

Message length: 4.

Word #	Type	Unit	Parameter
1	u_int		Bits 8…0: NMEA message mask (0: disabled; 1: enabled): Bit 0: GGA/GNS mask Bit 1: GSA mask Bit 2: GSV mask Bit 3: RMC mask Bit 4: VTG mask Bit 5: GLL mask Bit 6: ZDA mask Bit 7: DTM mask Bit 8: RLM mask Bits 13:9: reserved Bit 14: NMEA 0183 version 0: v2.x 1: v4.10 Bit 15: reserved

Word #	Type	Unit	Parameter
2	u_int	Bit/c	Baud rate: 0: 4800 1: 9600 2: 19200 3: 38400 4: 57600 5: 115200 6: 230400 7: 460800 8: 921600
3	u_int		Stop bits: 0: 1 1: 2
4	u_int		Parity: 0: no parity 1: even 2: odd 3: space 4: mark

5.66 0xC6: Request Serial Port Number

Message length: 1.

Word #	Type	Unit	Parameter
1	u_int		Any value

5.67 0xC7: Enable/Disable Antenna Power

Message length: 1.

Data content is identical to that of output message 0xC7.