Application Note AN0030

Binary Messages

Raw Measurement Data Extension

Of

SkyTraq Venus 8 GNSS Receiver

Ver 1.4.32

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Binary Message Protocol

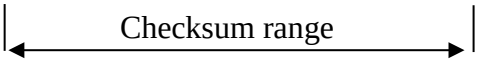
The SkyTraq binary message protocol manual provides the detailed descriptions on the SkyTraq binary protocol serving as a communicating interface between SkyTraq GNSS receivers and an external host such as PC, Notebook and mobile personal device. It is a standard protocol used by all SkyTraq devices and provides users a satisfactory control over the GNSS receivers.

The SkyTraq GNSS receiver outputs standard NMEA messages during normal operation. This NMEA messages may be a scheduled output at a specified rate subject to user's requests. The SkyTraq binary message protocol is designed with cares on reliable transmissions of data, ease & efficiency of implement, and payload independence mechanism which ensure users to retrieve data in a most effective & flexible way. The overall binary protocol messages can be categorized as input and output messages. Input messages provide the functionality to users to control the behavior of the GNSS receiver and to retrieve the detailed information of the GNSS status in real-time. Output messages, on the other hand, are information strings that GNSS receiver responses to requests from hosts and can optionally periodically reports the Position, Velocity and Time (PVT) via NMEA or binary messages.

BINARY MESSAGE STRUCTURE

Message Format

The following picture shows the structure of a binary message.



Start of Sequence	Payload Length (PL)	Payload		Checksum (CS)	End of Sequence
		Message ID	Message Body		
0xA0, 0xA1	Two bytes	Message ID: 1 bytes; Payload up to 65535 bytes		One byte	0x0D, 0x0A

The syntax of the message is shown below.

<0xA0,0xA1><PL><Message ID><Message Body><CS><0x0D,0x0A>

Start of Sequence

This field contains two bytes of values 0xA0, 0xA1 which indicate start of Messages.

Payload Length

The payload length (PL) field contains 16 bits of value which indicates the length of payload.

Payload

The payload field consists of 2 sub-fields, Message ID and Message Body. Message ID field defines the message ID.

Sub-Field	Values
Message ID (ID)	0x01~0xFF
Message Body	Data Bytes

Message Body

The Message Body may further consist of 2 sub-fields, Sub-Message ID (Sub-ID) and Sub-Message Body.

Sub-Field	Values

Sub-Message ID(SID)	0x01~0xFF
Sub-Message Body	Data Bytes

Checksum

Checksum (CS) field is transmitted in all messages. The checksum field is the last field in a message before the end of sequence field. The checksum is the 8-bit exclusive OR of only the payload bytes which start from Message ID until the last byte prior to the checksum byte. A reference to the calculation of CS is provided below,

CS = 0, N=PL;
For n = 0 to N
CS = CS ^ <Payload Byte # n>

End of Sequence

This field contains two bytes of values 0x0D, 0x0A which indicate end of Messages.

Data Byte Ordering

All payloads in binary protocol are transferred in big-endian format. The high order byte is transmitted first followed by the low order byte for data size larger than a byte (e.g. UINT32, DPFP).

Data Type Definition

UINT8	8 bit unsigned integer
UINT16	16 bit unsigned integer
UINT32	32 bit unsigned integer
SINT8	8 bit signed integer
SINT16	16 bit signed integer
SINT32	32 bit signed integer
SPFP	32 bit single precision floating point number
DPFP	64 bit double precision floating point number

MESSAGE FLOW

Host can perform actions to GNSS receiver by issuing a request or a set message. The message flow between Host and GNSS receiver is designed under the considerations of certain reliable transmission. SkyTraq binary message protocol requires an ACK response from the GNSS receiver upon receiving a successful input message and on the other hand, requires a NACK response from the receiver to a failed input message. Figure 1 shows a message flow that a host requests information from GNSS receiver and the GNSS receiver responses with an ACK and information respectively. Figure 2 shows a message flow with un-successful input message. Therefore, all requests (input messages) will have a corresponding ACK or NACK to be related with. However, output messages will not require the host to confirm by an ACK or NACK back in current design.

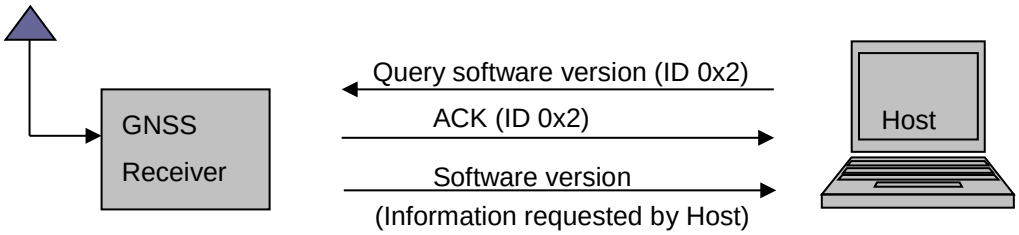


Figure 1

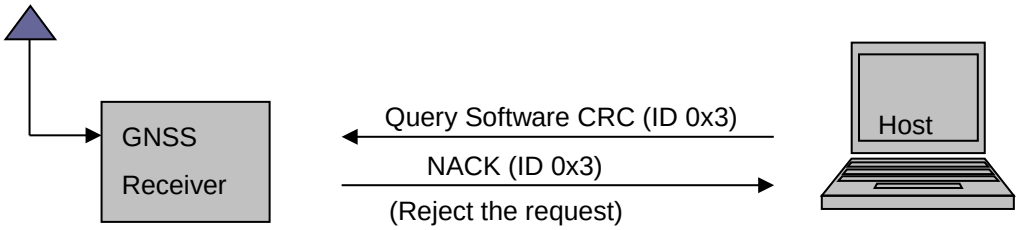


Figure 2

MESSAGE LIST

This section provides brief information about available SkyTraq binary input, output and sub-id messages shown in a tabular list. All the messages are listed by Message ID. Full descriptions of input and output messages will be described in later Sections.

Input System Messages				
ID (Hex)	ID (Decimal)	Attribute	Name	Descriptions
0x9	9	Input	Configure Message Type	Configure and select the output message type
0xE	14	Input	Configure Position Update Rate	Configure the position update rate of GNSS system
0x10	16	Input	Query Position Update Rate	Query the position update rate of GNSS system
0x1E	30	Input	Configure Binary Measurement Data Output	Configure the binary measurement data output of GNSS receiver
0x1F	31	Input	Query Binary Measurement Data Output Status	Query the status of the binary measurement data output of GNSS receiver
Input GNSS Messages				
ID (Hex)	ID (Decimal)	Attribute	Name	Descriptions
0x30	48	Input	Get GPS Ephemeris	Retrieve GPS ephemeris data of the GNSS receiver
0x41	65	Input	Set GPS Ephemeris	Set GPS ephemeris data to the GNSS receiver
0x5B	91	Input	Get GLONASS ephemeris	Retrieve GLONASS ephemeris data in the receiver
0x5C	92	Input	Set GLONASS ephemeris	Set GLONASS ephemeris data to the receiver
Messages with Sub-ID				
ID/Sub-ID (Hex)	ID/Sub-ID (Decimal)	Attribute	Name	Descriptions
0x6A/0x4	106/4	Input	Reset and Re-calculate GLONASS Inter-Frequency Bias (IFB)	Reset and Re-calculate GLONASS Inter-Frequency Bias of Glonass receiver

Output System/GNSS Messages				
ID (Hex)	ID (Decimal)	Attribute	Name	Descriptions
0x80	128	Output	Software Version	Software revision of the receiver
0x81	129	Output	Software CRC	Software CRC of the receiver
0x82	130	Output	Reserved	Reserved
0x83	131	Output	ACK	ACK to a successful input message
0x84	132	Output	NACK	Response to an unsuccessful input message
0x86	134	Output	Position Update Rate	Position update rate of GNSS system
0x89	137	Output	Binary Measurement Data Output Status	Status of binary measurement data output
0x90	144	Output	GLONASS ephemeris	GLONASS ephemeris data
Output GNSS Messages				
ID (Hex)	ID (Decimal)	Attribute	Name	Descriptions
0xB1	177	Output	GPS Ephemeris Data	GPS Ephemeris Data of the GNSS receiver
0xDC	220	Output	Measurement Epoch	Epoch of raw measurement
0xDD	221	Output	Raw Measurement	Satellite’s raw measurements
0xDE	222	Output	SV and channel status	SV and Channel status information
0xDF	223	Output	Navigation state	Receiver’s navigation state
0xE0	224	Output	GPS Subframe Data	GPS subframe buffer data
0xE1	225	Output	GLONASS String	Glonass string data bits
0xE2	226	Output	Beidou2 D1 Subframe Data	Beidou2 D1 subframe buffer data
0xE3	227	Output	Beidou2 D2 Subframe Data	Beidou2 D2 subframe buffer data
0xE5	229	Output	Extended Raw Measurement Data v.1	Satellite’s extended raw measurements

INPUT MESSAGES

CONFIGURE MESSAGE TYPE – Configure and select output message type (0x9)

This is a request message which will change the GNSS receiver output message type. This command is issued from the host to GNSS receiver and GNSS receiver should respond with an ACK or NACK. The payload length is 3 bytes.

Structure:

<0xA0,0xA1>< PL><09>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 09 00 00 09 0D 0A

1 2 3

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	09		UINT8	
2	Type	00	00 : No output 01 : NMEA message 02 : Binary Message	UINT8	
3	Attributes	00	0: update to SRAM 1: update to both SRAM & FLASH	UINT8	
Payload Length : 3 bytes					

CONFIGURE SYSTEM POSITION RATE – Configure the position update rate of GNSS system (0xE)

This is a request message which is issued from the host to GNSS receiver to configure the system position update rate. Receivers with position rate 4 or higher needs to configure baud rate to 38400 or higher value. The GNSS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The payload length is 3 bytes.

Structure:

<0xA0,0xA1>< PL><0E>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 03 0E 01 00 0F 0D 0A

1 2 3

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	0E		UINT8	
2	Rate	01	Value with 1, 2, 4, 5, 8, 10, 20, 25, 40, 50 01: 1Hz update rate Note: value with 4 ~10 should work with baud rate 38400 or higher, value with 20 should work with baud rate 115200 or higher, value with 40, 50 should work with 230400	UINT8	
3	Attributes	00	0: update to SRAM 1: update to both SRAM & FLASH	UINT8	
Payload Length : 3 bytes					

QUERY POSITION UPDATE RATE – Query the position update rate of GNSS system (0x10)

This is a request message which is issued from the host to GNSS receiver to query position update rate. The GNSS receiver should respond with an ACK along with information of position update rate, ***"POSITION UPDATE RATE, ID: 0x86"***, when succeeded and should respond with an NACK when failed. The payload length is 1 byte.

Structure:

<0xA0,0xA1>< PL><10>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 01 10 10 0D 0A

1

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	10		UINT8	
Payload Length : 1 byte					

CONFIGURE BINARY MEASUREMENT DATA OUTPUT – Configure binary measurement data output (0x1E)

This is a request message which will set binary output message rate configuration. This command is issued from the host to the receiver and the receiver should respond with an ACK or NACK. The payload length is 9 bytes. Currently the output rate configuration supports 1Hz / 2Hz / 4Hz / 5Hz / 10Hz / 20Hz.

Structure:

<0xA0,0xA1>< PL><1E>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 09 1E 00 00 00 01 01 03 01 01 1D 0D 0A

1 2 3 4 5 6 7 8 9

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	1E		UINT8	
2	Binary measurement output rate for Meas_time / Raw_meas / SV_CH_Status	00	00: 1Hz 01: 2Hz 02: 4Hz 03: 5Hz 04: 10Hz 05: 20Hz Others: 20Hz	UINT8	
3	Meas_time Enabling	00	00: Disable 01: Enable	UINT8	
4	Raw_meas Enabling	00	00: Disable 01: Enable	UINT8	
5	SV_CH_Staus Enabling	00	00: Disable 01: Enable	UINT8	
6	RCV_State Enabling	01	00: Disable 01: Enable This message supports only 1Hz.	UINT8	
7	Subframe Enabling of different constellation	03	Bit 0: GPS, 0: Disable; 1: Enable Bit 1: Glonass, 0: Disable; 1: Enable Bit 2: Galileo, 0: Disable; 1: Enable Bit 3: Beidou, 0: Disable; 1: Enable	UINT8	
8	Extended_ Raw_Meas Enabling*1	01	00: Disable 01: Enable	UINT8	
9	Attributes	01	0: update to SRAM 1: update to both SRAM & FLASH	UINT8	
Payload Length : 9 bytes					

*1: supported only after version 1.4.32

QUERY BINARY MEASUREMENT DATA OUTPUT STATUS – Query the status of binary measurement data output (0x1F)

This is a request message which is issued from the host to the receiver to retrieve the status of the binary measurement data output. The receiver should respond with an ACK along with status of binary measurement output rate, ***"BINARY MEASUREMENT DATA OUTPUT STATUS, ID: 0x89"***, when succeeded and should respond with an NACK when failed. The payload length is 1 byte.

Structure:

<0xA0,0xA1>< PL><1F><CS><0x0D,0x0A>

Example:

A0 A1 00 01 1F 1F 0D 0A

1

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	1F		UINT8	
Payload Length : 1 byte					

GET GPS EPHEMERIS – Get GPS ephemeris used of GNSS receiver (0x30)

This is a request message which is issued from the host to GNSS receiver to retrieve GPS ephemeris data. The GNSS receiver should respond with an ACK along with information of ephemeris, ***"GPS EPHEMERIS DATA, ID: 0xB1"***, when succeeded and should respond with an NACK when failed. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><30>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 30 00 30 0D 0A

1 2

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	30		UINT8	
2	SV #	00	0: means all SVs 1~32 : mean for the particular SV	UINT8	
Payload Length : 2 bytes					

SET GPS EPHEMERIS – Set GPS ephemeris to GNSS receiver (0x41)

This is a request message which is issued from the host to GNSS receiver to set GPS ephemeris data (open an ephemeris file) to GNSS receiver. The GNSS receiver should respond with an ACK when succeeded and should respond with an NACK when failed. The payload length is 87 bytes.

Structure:

<0xA0,0xA1>< PL><41>< message body><CS><0x0D,0x0A>

Example:

A0	A1	00	57	41	00	02	00	77	88	04	61	10	00	00	00	00	00	00	00	00	00	00	00	00	DB	DF	59	A6	00	00	1E
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

0A	47	7C	00	77	88	88	DF	FD	2E	35	A9	CD	B0	F0	9F	FD	A7	04	8E	CC	A8	10	2C	A1	0E	22	31	59	A6	74	00
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

77	89	0C	FF	A3	59	86	C7	77	FF	F8	26	97	E3	B9	1C	60	59	C3	07	44	FF	A6	37	DF	F0	B0	2E	0D	0A
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87			

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	41		UINT8	
2-3	SV id	0x1	Satellite id	UINT16	
4	SubFrameData[0][0]	00	Eph data subframe 1	UINT8	
5	SubFrameData[0][1]	00	Eph data subframe 1	UINT8	
6	SubFrameData[0][2]	00	Eph data subframe 1	UINT8	
7	SubFrameData[0][3]	00	Eph data subframe 1	UINT8	
8	SubFrameData[0][4]	00	Eph data subframe 1	UINT8	
9	SubFrameData[0][5]	00	Eph data subframe 1	UINT8	
10	SubFrameData[0][6]	00	Eph data subframe 1	UINT8	
11	SubFrameData[0][7]	00	Eph data subframe 1	UINT8	
12	SubFrameData[0][8]	00	Eph data subframe 1	UINT8	
13	SubFrameData[0][9]	00	Eph data subframe 1	UINT8	
14	SubFrameData[0][10]	00	Eph data subframe 1	UINT8	
15	SubFrameData[0][11]	00	Eph data subframe 1	UINT8	
16	SubFrameData[0][12]	00	Eph data subframe 1	UINT8	
17	SubFrameData[0][13]	00	Eph data subframe 1	UINT8	
18	SubFrameData[0][14]	00	Eph data subframe 1	UINT8	
19	SubFrameData[0][15]	00	Eph data subframe 1	UINT8	
20	SubFrameData[0][16]	00	Eph data subframe 1	UINT8	
21	SubFrameData[0][17]	00	Eph data subframe 1	UINT8	

22	SubFrameData[0][18]	00	Eph data subframe 1	UINT8	
23	SubFrameData[0][19]	00	Eph data subframe 1	UINT8	
24	SubFrameData[0][20]	00	Eph data subframe 1	UINT8	
25	SubFrameData[0][21]	00	Eph data subframe 1	UINT8	
26	SubFrameData[0][22]	00	Eph data subframe 1	UINT8	
27	SubFrameData[0][23]	00	Eph data subframe 1	UINT8	
28	SubFrameData[0][24]	00	Eph data subframe 1	UINT8	
29	SubFrameData[0][25]	00	Eph data subframe 1	UINT8	
30	SubFrameData[0][26]	00	Eph data subframe 1	UINT8	
31	SubFrameData[0][27]	00	Eph data subframe 1	UINT8	
32~59	SubFrameData[1][0~27]	00	Eph data subframe 2, same as field 4-31	UINT8	
60-87	SubFrameData[2][0~27]	00	Eph data subframe 3, same as field 4-31	UINT8	
Payload Length : 87 bytes					

GET GLONASS EPHEMERIS – Get GLONASS ephemeris used in the GNSS receiver (0x5B)

This is a request message which is issued from the host to GNSS receiver to retrieve Glonass is data. The GNSS receiver should respond with an ACK along with information of ephemeris, ***"GLONASS EPHEMERIS DATA, ID: 0x90"*** when succeeded and should respond with an NACK when failed. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><5B>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 01 5B 00 5B 0D 0A

1 2

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	5B		UINT8	
2	GLONASS SV slot number	01	0: means all SVs 1~32 : mean for the particular SV	UINT8	
Payload Length : 2 bytes					

SET GLONASS EPHEMERIS – Set GLONASS ephemeris to the GNSS receiver (0x5C)

This is a request message which is issued from the host to the receiver to set GLONASS ephemeris data (open an ephemeris file) to the receiver. The receiver should respond with an ACK when succeeded and should respond with a NACK when failed. The payload length is 43 bytes.

Structure:

<0xA0,0xA1>< PL><5C>< message body><CS><0x0D,0x0A>

Example:

A0	A1	00	2B	5C	02	FC	01	02	57	07	56	1C	9D	2F	E6	84	02	12	60	99	5C	B8	0A	7A	7D	33	03	80	26	30	C3
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

9B	A1	78	6A	18	04	83	4C	84	C0	00	02	A1	6D	89	F6	0D	0A
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43			

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	5C		UINT8	
2	Slot number	02	GLONASS SV slot number	UINT8	
3	K number	FC	GLONASS SV frequency number (-7 ~ +6)	SINT8	
4	glo_eph_data0_byte0	01	Stuffing zeros and bit 85 - bit 81 (LSB) of string 1	UINT8	
5	glo_eph_data0_byte1	02	bit 80 (MSB)- bit 73 (LSB) of string 1	UINT8	
6	glo_eph_data0_byte2	57	bit 72 (MSB)- bit 65 (LSB) of string 1	UINT8	
7	glo_eph_data0_byte3	07	bit 64 (MSB)- bit 57 (LSB) of string 1	UINT8	
8	glo_eph_data0_byte4	56	bit 56 (MSB)- bit 49 (LSB) of string 1	UINT8	
9	glo_eph_data0_byte5	1C	bit 48 (MSB)- bit 41 (LSB) of string 1	UINT8	
10	glo_eph_data0_byte6	9D	bit 40 (MSB)- bit 33 (LSB) of string 1	UINT8	
11	glo_eph_data0_byte7	2F	bit 32 (MSB)- bit 25 (LSB) of string 1	UINT8	
12	glo_eph_data0_byte8	E6	bit 24 (MSB)- bit 17 (LSB) of string 1	UINT8	
13	glo_eph_data0_byte9	84	bit 16 (MSB)- bit 09 (LSB) of string 1	UINT8	
14	glo_eph_data1_byte0	02	Stuffing zeros and bit 85 - bit 81 (LSB) of string 2	UINT8	
15	glo_eph_data1_byte1	12	bit 80 (MSB)- bit 73 (LSB) of string 2	UINT8	
16	glo_eph_data1_byte2	60	bit 72 (MSB)- bit 65 (LSB) of string 2	UINT8	
17	glo_eph_data1_byte3	99	bit 64 (MSB)- bit 57 (LSB) of string 2	UINT8	
18	glo_eph_data1_byte4	5C	bit 56 (MSB)- bit 49 (LSB) of string 2	UINT8	
19	glo_eph_data1_byte5	B8	bit 48 (MSB)- bit 41 (LSB) of string 2	UINT8	
20	glo_eph_data1_byte6	0A	bit 40 (MSB)- bit 33 (LSB) of string 2	UINT8	

21	glo_eph_data1_byte7	7A	bit 32 (MSB)- bit 25 (LSB) of string 2	UINT8	
22	glo_eph_data1_byte8	7D	bit 24 (MSB)- bit 17 (LSB) of string 2	UINT8	
23	glo_eph_data1_byte9	33	bit 16 (MSB)- bit 09 (LSB) of string 2	UINT8	
24-33	glo_eph_data2_byte0 - glo_eph_data2_byte9		Stuffing-zeros and bit 85 - bit 09 of string 3		
34-43	glo_eph_data3_byte0 – glo_eph_data3_byte9		Stuffing-zeros and bit 85 - bit 09 of string 4		
Payload Length : 43 bytes					

OUTPUT MESSAGES

SOFTWARE VERSION – Software version of the GNSS receiver (0x80)

This is a response message to ***"QUERY SOFTWARE VERSION, ID: 0x2"*** which provides the software version of the GNSS receiver. This message is sent from the GNSS receiver to host. The example below output the SkyTraq software version as 01.01.01-01.03.14-07.01.18 on System image. The payload length is 14 bytes.

Structure:

<0xA0,0xA1>< PL><80>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 0E 80 01 00 01 01 01 00 01 03 0E 00 07 01 12 98 0D 0A

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	80		UINT8	
2	Software Type	00	0: Reserved 1: System code	UINT8	
3-6	Kernel Version	00010101	X1.Y1.Z1 = SkyTraq Kernel Version Ex. X1=01, Y1=00, Z1=01 (1.0.1)	UINT32	
7-10	ODM version	0001030E	X1.Y1.Z1 = SkyTraq Version Ex. X1=01, Y1=03, Z1=01 (1.3.1)	UINT32	
11-14	Revision	00070112	YYMMDD = SkyTraq Revision Ex. YY=06, MM=01, DD=10 (060110)	UINT32	
Payload Length : 14 bytes					

SOFTWARE CRC – Software CRC of the GNSS receiver (0x81)

This is a response message to ***"QUERY SOFTWARE CRC, ID: 0x3"*** which provides the software CRC of the GNSS receiver. This message is sent from the GNSS receiver to host. The payload length is 4 bytes.

Structure:

<0xA0,0xA1>< PL><81>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 04 81 01 98 76 6E 0D 0A

1 2 3 4

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	81		UINT8	
2	Software Type	00	0: Reserved 1: System code	UINT8	
3-4	CRC	9876	CRC value	UINT16	
Payload Length : 4 bytes					

ACK – Acknowledgement to a Request Message (0x83)

This is a response message which is an acknowledgement to a request message. The payload length is 2 bytes

Structure:

<0xA0,0xA1>< PL><83>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 83 02 81 0D 0A

1 2

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	83		UINT8	
2	ACK ID*1	02	Message ID of the request message	UINT8	
Payload Length : 2 bytes					

*1: ACK ID may further consist of message ID and message sub-ID which will become 3 bytes of ACK message.

NACK – Response to an unsuccessful request message (0x84)

This is a response message which is a response to an unsuccessful request message. This is used to notify the Host that the request message has been rejected. The payload length is 2 bytes

Structure:

<0xA0,0xA1>< PL><84>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 84 01 82 0D 0A

1 2

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	84		UINT8	
2	NACK ID*1	01	Message ID of the request message	UINT8	
Payload Length : 2 bytes					

*1: NACK ID may further consist of message ID and message sub-ID which will become 3 bytes of NACK message.

POSITON UPDATE RATE – Position Update rate of the GNSS system (0x86)

This is a response message to ***"QUERY POSITION UPDATE RATE, ID: 0x10"*** which provides the position update rate of the GNSS receiver. This message is sent from the GNSS receiver to host. The payload length is 2 bytes.

Structure:

<0xA0,0xA1>< PL><86>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 02 86 01 87 0D 0A

1 2

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	86		UINT8	
2	Update Rate	01	01: 1Hz	UINT8	
Payload Length : 2 bytes					

BINARY MEASUREMENT DATA OUTPUT STATUS– Status of Binary Measurement Data output (0x89)

This is a response message to ***"QUERY BINARY MEASUREMENT DATA OUTPUT STATUS, ID: 0x1F"*** which provides the binary measurement data output rate of the GNSS receiver. This message is sent from the GNSS receiver to host. The payload length is 8 bytes.

Structure:

<0xA0,0xA1>< PL><89>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 07 89 00 00 00 01 01 03 01 8B 0D 0A

1 2 3 4 5 6 7 8

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	89		UINT8	
2	Binary measurement output rate	00	Output rate of binary measurement data 00: 1Hz 01: 2Hz 02: 4Hz 03: 5Hz 04: 10Hz 05: 20Hz Others: 20Hz	UINT8	Hz
3	Meas_time Enabling	00	00: Disable 01: Enable	UINT8	
4	Raw_meas Enabling	00	00: Disable 01: Enable	UINT8	
5	SV_CH_Staus Enabling	01	00: Disable 01: Enable	UINT8	
6	RCV_State Enabling	01	00: Disable 01: Enable This message supports only 1Hz.	UINT8	
7	Subframe Enabling of different constellation	03	Bit 0: GPS, 0: Disable; 1: Enable Bit 1: Glonass, 0: Disable; 1: Enable Bit 2: Galileo, 0: Disable; 1: Enable Bit 3: Beidou, 0: Disable; 1: Enable	UINT8	
8	Extended_ Raw_Meas Enabling*1	01	00: Disable 01: Enable	UINT8	
Payload Length : 8 bytes					

*1: supported only after version 1.4.32

GLONASS EPHEMERIS DATA – GLONASS ephemeris data of the GNSS receiver (0x90)

This is a response message to ***"GET GLONASS EPHEMERIS, id 0x5B",*** which provides the GLONASS Ephemeris Data of the receiver to the host. The Host may save the ephemeris data as an ephemeris file. This message is sent from the receiver to host. The payload length is 43 bytes.

Structure:

<0xA0,0xA1>< PL><90>< message body><CS><0x0D,0x0A>

Example:

A0	A1	00	2B	90	02	FC	01	02	D2	81	F4	75	05	16	51	9A	02	12	E0	AD	0F	37	01	7A	D2	06	03	80	26	19	A1
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

22	A2	84	EB	D6	04	83	4C	A8	C0	00	02	A1	6D	89	6D	0D	0A
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43			

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	90		UINT8	
2	Slot number	02	GLONASS SV slot number	UINT8	
3	K number	FC	GLONASS SV frequency number (-7 ~ +6)	SINT8	
4	glo_eph_data0_byte0	01	Stuffing zeros and bit 85 - bit 81 (LSB) of string 1	UINT8	
5	glo_eph_data0_byte1	02	bit 80 (MSB)- bit 73 (LSB) of string 1	UINT8	
6	glo_eph_data0_byte2	D2	bit 72 (MSB)- bit 65 (LSB) of string 1	UINT8	
7	glo_eph_data0_byte3	81	bit 64 (MSB)- bit 57 (LSB) of string 1	UINT8	
8	glo_eph_data0_byte4	F4	bit 56 (MSB)- bit 49 (LSB) of string 1	UINT8	
9	glo_eph_data0_byte5	75	bit 48 (MSB)- bit 41 (LSB) of string 1	UINT8	
10	glo_eph_data0_byte6	05	bit 40 (MSB)- bit 33 (LSB) of string 1	UINT8	
11	glo_eph_data0_byte7	16	bit 32 (MSB)- bit 25 (LSB) of string 1	UINT8	
12	glo_eph_data0_byte8	51	bit 24 (MSB)- bit 17 (LSB) of string 1	UINT8	
13	glo_eph_data0_byte9	9A	bit 16 (MSB)- bit 09 (LSB) of string 1	UINT8	
14	glo_eph_data1_byte0	02	Stuffing zeros and bit 85 - bit 81 (LSB) of string 2	UINT8	
15	glo_eph_data1_byte1	12	bit 80 (MSB)- bit 73 (LSB) of string 2	UINT8	
16	glo_eph_data1_byte2	E0	bit 72 (MSB)- bit 65 (LSB) of string 2	UINT8	
17	glo_eph_data1_byte3	AD	bit 64 (MSB)- bit 57 (LSB) of string 2	UINT8	
18	glo_eph_data1_byte4	0F	bit 56 (MSB)- bit 49 (LSB) of string 2	UINT8	
19	glo_eph_data1_byte5	37	bit 48 (MSB)- bit 41 (LSB) of string 2	UINT8	

20	glo_eph_data1_byte6	01	bit 40 (MSB)- bit 33 (LSB) of string 2	UINT8	
21	glo_eph_data1_byte7	7A	bit 32 (MSB)- bit 25 (LSB) of string 2	UINT8	
22	glo_eph_data1_byte8	D2	bit 24 (MSB)- bit 17 (LSB) of string 2	UINT8	
23	glo_eph_data1_byte9	06	bit 16 (MSB)- bit 09 (LSB) of string 2	UINT8	
24-33	glo_eph_data2_byte0 - glo_eph_data2_byte9		Stuffing-zeros and bit 85 - bit 09 of string 3		
34-43	glo_eph_data3_byte0 – glo_eph_data3_byte9		Stuffing-zeros and bit 85 - bit 09 of string 4		
Payload Length : 43 bytes					

GPS EPHEMERIS DATA – GPS ephemeris data of the GPS receiver (0xB1)

This is a response message to ***"GET GPS EPHEMERIS, ID: 0x30"*** which provides the GPS Ephemeris Data of the GNSS receiver to Host. The Host will save the ephemeris data as an ephemeris file. This message is sent from the GNSS receiver to host. The payload length is 87 bytes.

Structure:

<0xA0,0xA1>< PL><B1>< message body><CS><0x0D,0x0A>

Example:

A0	A1	00	57	B1	00	02	00	77	88	04	61	10	00	00	00	00	00	00	00	00	00	00	00	00	DB	DF	59	A6	00	00	1E
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

0A	47	7C	00	77	88	88	DF	FD	2E	35	A9	CD	B0	F0	9F	FD	A7	04	8E	CC	A8	10	2C	A1	0E	22	31	59	A6	74	00
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

77	89	0C	FF	A3	59	86	C7	77	FF	F8	26	97	E3	B9	1C	60	59	C3	07	44	FF	A6	37	DF	F0	B0	5E	0D	0A
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87			

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	B1		UINT8	
2-3	SV id	0x1	Satellite id	UINT16	
4	SubFrameData[0][0]	00	Eph data subframe 1	UINT8	
5	SubFrameData[0][1]	00	Eph data subframe 1	UINT8	
6	SubFrameData[0][2]	00	Eph data subframe 1	UINT8	
7	SubFrameData[0][3]	00	Eph data subframe 1	UINT8	
8	SubFrameData[0][4]	00	Eph data subframe 1	UINT8	
9	SubFrameData[0][5]	00	Eph data subframe 1	UINT8	
10	SubFrameData[0][6]	00	Eph data subframe 1	UINT8	
11	SubFrameData[0][7]	00	Eph data subframe 1	UINT8	
12	SubFrameData[0][8]	00	Eph data subframe 1	UINT8	
13	SubFrameData[0][9]	00	Eph data subframe 1	UINT8	
14	SubFrameData[0][10]	00	Eph data subframe 1	UINT8	
15	SubFrameData[0][11]	00	Eph data subframe 1	UINT8	
16	SubFrameData[0][12]	00	Eph data subframe 1	UINT8	
17	SubFrameData[0][13]	00	Eph data subframe 1	UINT8	
18	SubFrameData[0][14]	00	Eph data subframe 1	UINT8	
19	SubFrameData[0][15]	00	Eph data subframe 1	UINT8	
20	SubFrameData[0][16]	00	Eph data subframe 1	UINT8	
21	SubFrameData[0][17]	00	Eph data subframe 1	UINT8	

22	SubFrameData[0][18]	00	Eph data subframe 1	UINT8	
23	SubFrameData[0][19]	00	Eph data subframe 1	UINT8	
24	SubFrameData[0][20]	00	Eph data subframe 1	UINT8	
25	SubFrameData[0][21]	00	Eph data subframe 1	UINT8	
26	SubFrameData[0][22]	00	Eph data subframe 1	UINT8	
27	SubFrameData[0][23]	00	Eph data subframe 1	UINT8	
28	SubFrameData[0][24]	00	Eph data subframe 1	UINT8	
29	SubFrameData[0][25]	00	Eph data subframe 1	UINT8	
30	SubFrameData[0][26]	00	Eph data subframe 1	UINT8	
31	SubFrameData[0][27]	00	Eph data subframe 1	UINT8	
32~59	SubFrameData[1][0~27]	00	Eph data subframe 2, same as field 4-31	UINT8	
60-87	SubFrameData[2][0~27]	00	Eph data subframe 3, same as field 4-31	UINT8	
Payload Length : 87 bytes					

MEAS_TIME– Measurement time information (0xDC) (Periodic)

This is the receiver time when the raw measurements are taken. This message is sent from the receiver to host. The payload length is 10 bytes

Structure:

<0xA0,0xA1>< PL><DC>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 0A DC 3D 06 ED 0B 0C BC 40 03 E8 1A 0D 0A

1 2 3 4 5 6 7 8 9 10

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	DC		UINT8	
2	IOD	3D	Issue of Data from (0-255)	UINT8	
3-4	Receiver WN	06ED	Receiver Week number (0-65535)	UINT16	weeks
4-8	Receiver TOW	0B0CBC40	Receiver TOW (0-604799999)	UINT32	ms
9-10	Measurement period	03E8	Measurement period (1-1000)	UINT16	ms
Payload Length : 10 bytes					

RAW_MEAS– Raw measurements from each channel (0xDD) (Periodic)

The raw measurements of satellites are taken at the same epoch from the receiver. This message is sent from the receiver to host. The measurement data of a channel is provided only when the corresponding satellite signal is under lock status. The payload length is (3+Number_of_measurement*23) bytes.

Structure:

<0xA0,0xA1>< PL><DD>< message body><CS><0x0D,0x0A>

Example:

A0 A1 01 5C DD 3D 0F 02 2B 41 74 42 DB 76 55 FA 29 C0 E2 E4 02 21 5A 00 00 44 20 80 00 07 09 29 41 77 8C F0

1 2 3

A9 E7 0C 43 C0 F9 72 54 2E EB 80 00 44 E3 A0 00 07 0A 28 41 75 CA 96 91 A9 E9 23 41 04 7D B1 E9 A9 80 00 C5 31 20 00 07 05 2B 41 74 9E BE EE 17 8C 6A 40 D3 71 D4 80 CF 00 00 C3 AE 00 00 07 1A 2E 41 75 02 83 E5 EC D7 65 C1 04 6D 73 BD E6 20 00 45 33 30 00 07 0C 28 41 77 C1 E0 1D A7 2E C1 40 FF 79 4C C9 14 80 00 C5 0D 80 00 07 11 28 41 77 E7 B0 E8 15 9A A8 41 0C 87 99 0C FA A0 00 C5 80 D8 00 07 0F 27 41 77 93 96 77 03 2B 0A C1 06 BF 2C 49 05 60 00 45 4F B0 00 07 04 2C 41 75 BA 4E B0 68 2B 43 40 FB 25 C7 A3 B6 C0 00 C4 FE 60 00 07 07 26 41 78 48 7F 72 DF C5 81 C0 D0 89 C8 BF 96 00 00 43 A7 80 00 07 0D 1D 00 00 00 00 00 00 00 00 41 05 F9 A2 D6 0D 40 00 C5 66 00 00 16 08 27 41 78 6A D7 A4 71 2A 50 C0 EF 02 44 2E 09 80 00 44 A2 80 00 07 19 23 41 78 7E E4 8B 0C 9E 26 40 E6 AD 04 2B 85 80 00 C4 98 20 00 07 42 1F 41 75 27 EA E2 16 7D 10 41 06 D6 0A 57 6B 00 00 C5 53 10 00 07 52 1E 00 00 00 00 00 00 00 00 C0 FE 83 49 5D A7 00 00 45 16 C0 00 06 AA 0D 0A

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Field	Name		Example(hex)	Description	Type	Unit
1	Message ID		DD		UINT8	
2	IOD		3D	Issue of Data from 0-255	UINT8	
3	NMEAS		0F	Number of measurement	UINT8	
4	Channel 1 Measurement	SVID	02	PRN for GPS satellites; (Slot_number+64) for Glonass satellites; (SVID+200) for Beidou2 satellites	UINT8	
5		CN0	2B	Satellite CNR	UINT8	dBHz
6-13		Pseudo-range	417442DB7655FA29	Satellite pseudo-range	DPFP	meter
14-21		Accumulated carrier cycle	C0E2E402215A0000	Accumulated carrier phase measurement, The carrier phase measurement is	DPFP	Cycles (L1)

				accumulated after carrier lock is achieved. Discontinuity in the carrier phase will be indicated by the cycle slip flag. We also adjust the polarity of the carrier phase measurement before output. The polarity of accumulated carrier cycle is defined such that an approaching satellite has decreasing accumulated carrier cycle measurement, the same as RINEX convention.		
22-25		Doppler frequency	44208000	The sign of doppler frequency is defined such that the approaching satellite has positive doppler frequency.	SPFP	Hz
26		Measurement Indicator	07	Bit 0 ON: pseudo-range is available in the channel. Bit 1 ON: Doppler frequency is available in the channel. Bit 2 ON: carrier phase is available in the channel. Bit 3 ON: cycle slip is possible in the channel. Bit 4 ON: coherent integration time of the channel is equal to or more than 10ms. (* Bit 0 is LSB)	UINT8	

27-49	Channel 2 measurement				
50-72	Channel 3 measurement				
:	:	:	:	:	:
Payload Length : 3+NMEAS*23 bytes					

SV_CH_STATUS– SV and channel status (0xDE) (Periodic)

This is the information about channel and satellite status. This message is sent from the receiver to host. The payload length is (3+Num_of_satellite*10) bytes.

Structure:

<0xA0,0xA1>< PL><DE>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 A3 DE 3D 10 00 02 07 01 2B 00 3E 00 10 1F 01 09 07 01 29 00 10 00 72 1F 02 0A 07 01 28 00 22 00 27

1 2 3

1F 03 05 07 00 2B 00 38 01 38 1F 04 1A 07 00 2E 00 2E 00 BA 1F 05 0C 07 00 28 00 0E 00 F8 1F 06 11 07 01 28 00 0A 00 9A 1F 07 0F 07 00 27 00 0E 00 D1 1F 08 21 07 00 29 00 42 00 2E 1F 09 04 07 00 2C 00 26 00 5B 1F 0C 07 07 00 26 00 09 00 4D 1F 0D 0D 07 00 1D 00 06 00 24 1F 0E 08 07 00 27 00 0A 00 6B 1F 0F 19 07 00 23 00 06 01 1B 1F 10 42 06 05 1F 00 20 00 15 1F 11 52 07 05 1E 00 31 01 4E 1F C7 0D 0A

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Field	Name		Example(hex)	Description	Type	Unit
1	Message ID		DE		UINT8	
2	IOD		3D	Issue of Data from 0-255	UINT8	
3	NSVS		10	Number of SVs	UINT8	
4	SV-CH 1 Status	Channel ID	00	Channel ID 0-43	UINT8	
5		SVID	02	PRN for GPS satellites; (Slot_number+64) for GLONASS satellites; (SVID+200) for Beidou2 satellites	UINT8	
6		SV Status indicator	07	Bit 0 ON: Almanac is received for this satellite Bit 1 ON: Ephemeris is received for this satellite Bit 2 ON: This satellite is healthy (*Bit 0 is LSB)	UINT8	
7		URA/ F_T	01	The URA index for GPS satellites; F_T parameter for GLONASS satellites. 255 indicates that URA/ F_T is not available	UINT8	
8		CN0	2B	CNR	SINT8	dBHz
9-10		Elevation	003E	SV Elevation	SINT16	deg

11-12		Azimuth	0010	SV Azimuth	SINT16	deg
13		Channel Status indicator	1F	Bit 0 ON: Pull-in stage is done for this channel Bit 1 ON: Bit synchronization is done for this channel Bit 2 ON: Frame synchronization is done for this channel Bit 3 ON: Ephemeris is received for this channel Bit 4 ON: Used in normal fix mode Bit 5 ON: Used in differential fix mode (*Bit 0 is LSB)	UINT8	
14-23	SV-CH 2 status					
24-33	SV-CH 3 status					
:	:		:	:	:	:
Payload Length : 3+NSVS*10 bytes						

RCV_STATE– Receiver navigation status (0xDF) (Periodic)

This is the PVT results calculated by the receiver. This message is sent from the receiver to host. The payload length is 81 bytes.

Structure:

<0xA0,0xA1>< PL><DF>< message body><CS><0x0D,0x0A>

Example:

A0	A1	00	51	DF	92	03	06	ED	41	07	DB	E7	FD	76	3B	21	C1	46	C6	04	2F	62	BF	D8	41	52	F1	B6	4B	17	F7
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

CC	41	44	46	79	B8	7A	DB	12	3C	8A	AA	D4	BC	1A	6E	F0	BB	C5	67	D2	41	16	AD	5E	6D	3F	7C	78	42	8F	D9
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

1E	40	5D	7C	6B	40	4B	07	FB	3F	7C	51	AD	40	40	FB	C2	3F	B1	06	30	33	0D	0A
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81			

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	DF		UINT8	
2	IOD	92	Issue of Data from 0-255	UINT8	
3	Navigation State	03	00: NO_FIX, 01: FIX_PREDICTION 02: FIX_2D 03: FIX_3D 04: FIX_DIFFERENTIAL	UINT8	
4-5	WN	06ED	GPS week number	UINT16	weeks
6-13	TOW	4107DBE7FD763B21	GPS TOW	DPFP	sec
14-21	ECEF POS_X	C146C6042F62BFD8	ECEF POS_X	DPFP	meter
22-29	ECEF POS_Y	4152F1B64B17F7CC	ECEF POS_Y	DPFP	meter
30-37	ECEF POS _Z	41444679B87ADB12	ECEF POS _Z	DPFP	meter
38-41	ECEF VEL_X	3C8AAAD4	ECEF VEL_X	SPFP	m/s
42-45	ECEF VEL_Y	BC1A6EF0	ECEF VEL_Y	SPFP	m/s
46-49	ECEF VEL_Z	BBC567D2	ECEF VEL_Z	SPFP	m/s
50-57	Clock Bias	4116AD5E6D3F7C68	Clock Bias of receiver	DPFP	meter
58-61	Clock Drift	428FD91E	Clock Drift of receiver	SPFP	m/s
62-65	GDOP	405D7C6B	GDOP	SPFP	
66-69	PDOP	404B07FB	PDOP	SPFP	
70-73	HDOP	3F7C51AD	HDOP	SPFP	

74-77	VDOP	4040FBC2	VDOP	SPFP	
78-81	TDOP	3FB10630	TDOP	SPFP	
Payload Length : 81 bytes					

GPS SUBFRAME– GPS Subframe buffer data (0xE0) (Periodic)

This is the information about the GPS subframe data bits currently collected in the receiver. The data bits are composed from the 24 higher bits of each of the navigation words and the parity bits are not included in the output. Only when all 10 navigation words have been verified by parity checking, the data bits in the subframe are output. Before being sent out to the host, the data bits are also polarity-adjusted. The 8 preamble bits of a subframe, for example, can be obtained from the first byte of the 3-byte field of navigation word 1. This message is sent from the receiver to host. The payload length is 33 bytes.

Structure:

<0xA0,0xA1>< PL><E0>< message body><CS><0x0D,0x0A>

Example:

A0	A1	00	21	E0	02	05	8B	0B	B4	3F	22	B5	4F	31	CF	4E	FD	81	FD	4D	00	A1	0C	98	79	E7	09	08	D5	C5	F8
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

ED	03	EB	FF	F4	04	0D	0A
29	30	31	32	33			

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	E0		UINT8	
2	SVID	02	GPS Satellite PRN	UINT8	
3	SFID	05	Sub-frame ID (1-5)	UINT8	
4	WORD 1 bit01~ bit24	8B0BB4	24 parity-checked and polarity-adjusted bits of subframe word 1	3-bytes	
5	WORD 2 bit01~ bit24	3F22B5	24 parity-checked and polarity-adjusted bits of subframe word 2	3-bytes	
6	WORD 3 bit01~ bit24	4F31CF	24 parity-checked and polarity-adjusted bits of subframe word 3	3-bytes	
7	WORD 4 bit01~ bit24	4EFD81	24 parity-checked and polarity-adjusted bits of subframe word 4	3-bytes	
8	WORD 5 bit01~ bit24	FD4D00	24 parity-checked and polarity-adjusted bits of subframe word 5	3-bytes	
9	WORD 6 bit01~ bit24	A10C98	24 parity-checked and polarity-adjusted bits of subframe word 6	3-bytes	
10	WORD 7 bit01~ bit24	79E709	24 parity-checked and polarity-adjusted bits of subframe word 7	3-bytes	
11	WORD 8 bit01~ bit24	08D5C5	24 parity-checked and polarity-adjusted bits of subframe word 8	3-bytes	
12	WORD 9 bit01~	F8ED03	24 parity-checked and polarity-adjusted	3-bytes	

	bit24		bits of subframe word 9		
13	WORD 10 bit01~ bit24	EBFFF4	24 parity-checked and polarity-adjusted bits of subframe word 10	3-bytes	
Payload Length : 33 bytes					

GLONASS STRING– Glonass String buffer data (0xE1) (Periodic)

This is the information about the string data bits currently collected by the receiver. This message is composed of GLONASS satellite slot number, string number and bit 80 to bit 09 in relative bi-binary code of the string. The output data bits (bit 80 to bit 09) of each string were already checked as correct by the Hamming code data verification algorithm before output by the receiver. The 8 Hamming code check bits (bit 08 to bit 01) are not included in the message. The data bits (bit 80 to bit 09) have been polarity-adjusted. This message is sent from the receiver to host. The payload length is 12 bytes.

Structure:

<0xA0,0xA1>< PL><E1>< message body><CS><0x0D,0x0A>

Example:

A0 A1 00 0C E1 52 0E B4 05 A9 C3 94 17 50 04 82 33 0D 0A

1 2 3 4 5 6 7 8 9 10 11 12

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	E1		UINT8	
2	SVID	52	GLONASS satellite slot number +64	UINT8	
3	String Number	0E	String number of navigation message (1-4)	UINT8	
4	Bit 80-73	B4	Data bit number 80-73 (relative bi-binary)	UINT8	
5	Bit 72-65	05	Data bit number 72-65 (relative bi-binary)	UINT8	
6	Bit 64-57	A9	Data bit number 64-57 (relative bi-binary)	UINT8	
7	Bit 56-49	C3	Data bit number 56-49 (relative bi-binary)	UINT8	
8	Bit 48-41	94	Data bit number 48-41 (relative bi-binary)	UINT8	
9	Bit 40-33	17	Data bit number 40-33 (relative bi-binary)	UINT8	
10	Bit 32-25	50	Data bit number 32-25 (relative bi-binary)	UINT8	
11	Bit 24-17	04	Data bit number 24-17 (relative bi-binary)	UINT8	
12	Bit 16-09	82	Data bit number 16-09 (relative bi-binary)	UINT8	
Payload Length : 12 bytes					

BEIDOU2 D1 SUBFRAME–BEIDOU2 D1 Subframe buffer data (0xE2) (Periodic)

This is the information about the BEIDOU2 D1 subframe data bits currently collected in the receiver. The data bits are composed from the 26 higher bits of the word1 and the 22 higher bits of the word2 to word9. And the parity bits are not included in the output. Only when all 10 navigation words have been verified by parity checking, the data bits in the subframe are output. Before being sent out to the host, the data bits are also polarity-adjusted. The 11 preamble bits of a subframe, for example, can be obtained from the first byte of navigation word 1. This message is sent from the receiver to host. The payload length is 31 bytes.

Structure:

<0xA0,0xA1>< PL><E2>< message body><CS><0x0D,0x0A>

Example:

A0	A1	00	1F	E2	CF	01	E2	40	47	37	58	00	0D	A0	E1	00	AC	03	87	8E	31	5B	53	B4	12	B2	C0	02	5B	04	60
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

07	AB	81	B1	0D	0A
29	30	31			

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	E2		UINT8	
2	SVID	CF	BEIDOU2 D1 Satellite SVID+200 (206~214)	UINT8	
3	SFID	01	Sub-frame ID (1-5)	UINT8	
4	WORD 1 bit01~ bit08	E2	26 parity-checked and polarity-adjusted bits of subframe word 1	UINT8	
5	WORD 1 bit09~ bit16	40		UINT8	
6	WORD 1 bit17~ bit24	47		UINT8	
7	WORD 1 bit25~ bit26 + WORD 2 bit01~ bit06	37		UINT8	
8	WORD 2 bit07~ bit14	58	22 parity-checked and polarity-adjusted bits of subframe word 2	UINT8	
9	WORD 2 bit15~ bit22	00		UINT8	
10	WORD 3 bit01~ bit08	0D	22 parity-checked and polarity-adjusted bits of subframe word 3	UINT8	
11	WORD 3 bit09~ bit16	A0		UINT8	
12	WORD 3 bit17~ bit22 + WORD 4 bit01~ bit02	E1		UINT8	
13	WORD 4 bit03~ bit10	00	22 parity-checked and polarity-adjusted bits of subframe word 4	UINT8	
14	WORD 4 bit11~ bit18	AC		UINT8	
15	WORD 4 bit19~ bit22 + WORD 5 bit01~ bit04	03		UINT8	
16	WORD 5 bit05~ bit12	87	22 parity-checked and polarity-adjusted bits of subframe word 5	UINT8	
17	WORD 5 bit13~ bit20	8E		UINT8	

18	WORD 5 bit21~ bit22 + WORD 6 bit01~ bit06	31	22 parity-checked and polarity-adjusted bits of subframe word 6	UINT8	
19	WORD 6 bit07~ bit14	5B		UINT8	
20	WORD 6 bit15~ bit22	53		UINT8	
21	WORD 7 bit01~ bit08	B4	22 parity-checked and polarity-adjusted bits of subframe word 7	UINT8	
22	WORD 7 bit09~ bit16	12		UINT8	
23	WORD 7 bit17~ bit22 + WORD 8 bit01~ bit02	B2		UINT8	
24	WORD 8 bit03~ bit10	C0	22 parity-checked and polarity-adjusted bits of subframe word 8	UINT8	
25	WORD 8 bit11~ bit18	02		UINT8	
26	WORD 8 bit19~ bit22 + WORD 9 bit01~ bit04	5B		UINT8	
27	WORD 9 bit05~ bit12	04	22 parity-checked and polarity-adjusted bits of subframe word 9	UINT8	
28	WORD 9 bit13~ bit20	60		UINT8	
29	WORD 9 bit21~ bit22 + WORD 10 bit01~ bit06	07		UINT8	
30	WORD 10 bit07~ bit14	AB	22 parity-checked and polarity-adjusted bits of subframe word 10	UINT8	
31	WORD 10 bit15~ bit22	81		UINT8	
Payload Length : 31 bytes					

BEIDOU2 D2 SUBFRAME–BEIDOU2 D2 Subframe buffer data (0xE3) (Periodic)

This is the information about the BEIDOU2 D2 subframe data bits currently collected in the receiver. The data bits are composed from the 26 higher bits of the word1 and the 22 higher bits of the word2 to word9. And the parity bits are not included in the output. Only when all 10 navigation words have been verified by parity checking, the data bits in the subframe are output. Before being sent out to the host, the data bits are also polarity-adjusted. The 11 preamble bits of a subframe, for example, can be obtained from the first byte of navigation word 1. This message is sent from the receiver to host. The payload length is 31 bytes.

Structure:

<0xA0,0xA1>< PL><E3>< message body><CS><0x0D,0x0A>

Example:

A0	A1	00	1F	E3	CB	01	E2	40	47	37	95	A5	14	C8	CA	EA	CF	A5	00	15	55	55	55	55	55	55	55	55	55	55	55
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28

55	55	55	48	0D	0A
29	30	31			

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	E3		UINT8	
2	SVID	CB	BEIDOU2 D2 Satellite SVID+200 (201~205)	UINT8	
3	SFID	01	Sub-frame ID (1-5)	UINT8	
4	WORD 1 bit01~ bit08	E2	26 parity-checked and polarity-adjusted bits of subframe word 1	UINT8	
5	WORD 1 bit09~ bit16	40		UINT8	
6	WORD 1 bit17~ bit24	47		UINT8	
7	WORD 1 bit25~ bit26 + WORD 2 bit01~ bit06	37		UINT8	
8	WORD 2 bit07~ bit14	95	22 parity-checked and polarity-adjusted bits of subframe word 2	UINT8	
9	WORD 2 bit15~ bit22	A5		UINT8	
10	WORD 3 bit01~ bit08	14	22 parity-checked and polarity-adjusted bits of subframe word 3	UINT8	
11	WORD 3 bit09~ bit16	C8		UINT8	
12	WORD 3 bit17~ bit22 + WORD 4 bit01~ bit02	CA		UINT8	
13	WORD 4 bit03~ bit10	EA	22 parity-checked and polarity-adjusted bits of subframe word 4	UINT8	
14	WORD 4 bit11~ bit18	CF		UINT8	
15	WORD 4 bit19~ bit22 + WORD 5 bit01~ bit04	A5	22 parity-checked and polarity-adjusted	UINT8	

16	WORD 5 bit05~ bit12	00	bits of subframe word 5	UINT8	
17	WORD 5 bit13~ bit20	15		UINT8	
18	WORD 5 bit21~ bit22 + WORD 6 bit01~ bit06	55		UINT8	
19	WORD 6 bit07~ bit14	55	22 parity-checked and polarity-adjusted bits of subframe word 6	UINT8	
20	WORD 6 bit15~ bit22	55		UINT8	
21	WORD 7 bit01~ bit08	55		UINT8	
22	WORD 7 bit09~ bit16	55	22 parity-checked and polarity-adjusted bits of subframe word 7	UINT8	
23	WORD 7 bit17~ bit22 + WORD 8 bit01~ bit02	55		UINT8	
24	WORD 8 bit03~ bit10	55		UINT8	
25	WORD 8 bit11~ bit18	55	22 parity-checked and polarity-adjusted bits of subframe word 8	UINT8	
26	WORD 8 bit19~ bit22 + WORD 9 bit01~ bit04	55		UINT8	
27	WORD 9 bit05~ bit12	55		UINT8	
28	WORD 9 bit13~ bit20	55	22 parity-checked and polarity-adjusted bits of subframe word 9	UINT8	
29	WORD 9 bit21~ bit22 + WORD 10 bit01~ bit06	55		UINT8	
30	WORD 10 bit07~ bit14	55		UINT8	
31	WORD 10 bit15~ bit22	55	22 parity-checked and polarity-adjusted bits of subframe word 10	UINT8	
Payload Length : 31 bytes					

EXT_RAW_MEAS – Extended Raw Measurement Data v.1 (0xE5) (Periodic)

The extended raw measurements of satellites are taken at the same epoch from the receiver. This message is sent from the receiver to host. The extended measurement data of a channel is provided only when the corresponding satellite signal is under lock status. The payload length is (14+Number_of_measurement*31) bytes.

A0 A1 02 1D E5 01 0D 07 7C 06 AC 40 80 03 E8 00 00 11 00 0D E0 32 41 B3 33 99 89 62 C9 BA 41 B3 7F 98 FD
1 2 3
AD E0 00 45 79 40 00 00 00 00 40 07 00 00 00 02 E0 31 41 B3 22 3E ED EA FB D6 41 B3 B3 B8 3A EB A0 00 44 F1 40 00 00 00 00 40 07 00 00 00 06 E0 30 41 B3 31 EE 4F 2D 2C D9 41 B3 E3 77 47 15 20 00 C3 39 00 00 00 00 00 40 07 00 00 00 04 E0 33 41 B3 21 A6 72 9C 9E 8D 41 B3 97 3F 77 2B 60 00 45 2E F0 00 00 00 00 40 07 00 00 00 05 E0 31 41 B3 24 52 84 6C 89 0E 41 B3 C4 EF 07 A8 E0 00 44 7C C0 00 00 00 00 40 07 00 00 00 0C E0 29 41 B3 55 D6 AE 07 64 C5 41 B3 F5 9A F1 B5 E0 00 C4 7C 00 00 00 00 00 C0 07 00 00 00 14 E0 29 41 B3 53 25 16 98 94 03 41 B3 99 D7 19 9B 60 00 45 40 60 00 00 00 00 80 07 00 00 00 13 E0 2C 41 B3 48 02 4B 63 BF D0 41 B4 15 80 1A C7 60 00 C5 16 D0 00 00 00 00 40 07 00 00 04 C1 E0 30 41 B4 3D 68 15 86 5B 87 41 B3 D2 37 DB 1A 20 00 44 3D 00 00 00 00 00 40 07 00 00 01 80 C0 2D 41 B4 26 6A 74 EB C0 97 41 B3 CC 0C 45 53 A0 00 44 71 00 00 00 00 00 40 07 00 00 01 81 C0 2B 41 B4 19 E0 D3 AB 6B BA 41 B3 CC AC C2 C4 20 00 44 6F C0 00 00 00 00 40 07 00 00 02 06 E3 31 41 B3 15 16 02 23 16 1C 41 B4 0A 57 97 61 20 00 44 BA A0 00 00 00 00 40 07 00 00 02 05 E8 2D 41 B3 21 D8 78 41 5F 35 41 B4 5E 18 7C 73 A0 00 C4 E3 00 00 00 00 00 40 07 00 00 02 14 E9 2D 41 B3 0B 52 79 C4 94 08 41 B4 0F E8 10 A1 60 00 44 9E 40 00 00 00 00 40 07 00 00 02 13 EA 2C 41 B3 30 72 52 8C 68 0F 41 B4 68 6E 04 CF E0 00 C5 0F 90 00 00 00 00 40 07 00 00 02 15 EB 2F 41 B3 2A 46 FD 31 68 39 41 B3 D0 8E E5 12 E0 00 45 8D A8 00 00 00 00 40 07 00 00 02 07 EC 2C 41 B3 45 AB 04 39 61 D6 41 B3 E5 52 58 10 20 00 45 72 B0 00 00 00 00 80 07 00 00 CA 0D 0A
541

Field	Name	Example(hex)	Description	Type	Unit
1	Message ID	E5		UINT8	-
2	Version	01	Version of Extended Raw Measurement (0xE5)	UINT8	-
3	IOD	0D	Issue of Data (0-255)	UINT8	-
4-5	Receiver WN	077C	Receiver Week number (0-65535)	UINT16	weeks
6-9	Receiver TOW	06AC4080	Receiver TOW (0-604799999)	UINT32	ms
10-11	Measurement period	03E8	Measurement period (1-1000)	UINT16	ms
12	Measurement indicator	00	Bit 0 ON: Measurement is triggered by geotagging. Bit 1 ON: Receiver clock is	-	-

				adjusted in increment of 1 ms. A negative 1ms*speed_of_light discontinuity appears in range. Bit 2 ON: Receiver clock is adjusted in decrement of 1 ms. A positive 1ms*speed_of_light discontinuity appears in range. (* Both bit 1 and bit 2 ON: receiver clock is adjusted for several integer milliseconds) (* Bit 0 is LSB)		
13	Reserved 1		00	Reserved	-	-
14	NMEAS		11	Number of measurement	UINT8	-
15	Channel 1 Measurement	GNSS type	0	0 – GPS 1 – SBAS 2 – GLONASS 3 – Galileo 4 – QZSS 5 – BeiDou (* Use bit 0 to bit 3, bit 0 is LSB)	-	-
		Signal type	0	0-1 for L1 frequency (around 1575.42 MHz), 2-3 for L2 frequency (around 1227.60 MHz), 4-5 for L3 frequency (around 1176.45 MHz), 6-7 for other frequency. GPS: 0 – L1 C/A 1 – L1C 2 – L2C 4 – L5 SBAS: 0 – L1 GLONASS: 0 – L1		

				2 – L2 4 – L3 Galileo: 0 – E1 4 – E5a 5 – E5b 6 – E6 QZSS: 0 – L1 C/A 1 – L1C 2 – L2C 4 – L5 6 – LEX BeiDou: 0 – B1I 4 – B2I 6 – B3I (* Use bit 4 to bit 7, bit 0 is LSB)		
16		SVID	0D	GPS satellite PRN: 1 – 37; SBAS satellite PRN: 120 – 158; Glonass satellite slot number: 1 – 24; Galileo satellite PRN: 1 – 50; QZSS satellite PRN: 193 – 202; Beidou satellite PRN: 1 – 37	UINT8	-
17		Frequency ID	0	Frequency ID (0-13), only used for GLONASS. Frequency ID = frequency channel number + 7 (* Use bit 0 to bit 3, bit 0 is LSB)	-	-
		Lock time indicator	E	Lock time indicator (0-15), used to monitor the time of continuous lock on signal. Reset to 0 when a cycle slip occurs. Relationship between		

				indicator and lock time (second): 0 – 0 ≤ t < (2^1) / 20 1 – (2^1) / 20 ≤ t < (2^2) / 20 2 – (2^2) / 20 ≤ t < (2^3) / 20 3 – (2^3) / 20 ≤ t < (2^4) / 20 | | | 13 – (2^13)/20 ≤ t < (2^14)/20 14 – (2^14)/20 ≤ t < (2^15)/20 15 – (2^15)/20 ≤ t (* Use bit 4 to bit 7, bit 0 is LSB)		
18		CN0	32	Satellite CNR	UINT8	dB-Hz
19-26		Pseudorange	41B333998962C9BA	Satellite pseudorange	DPFP	meter
27-34		Accumulated carrier cycle	41B37F98FDADE000	Accumulated carrier phase measurement, the carrier phase measurement is accumulated after carrier lock is achieved. The polarity of accumulated carrier cycle is defined such that an approaching satellite has decreasing accumulated carrier cycle measurement, the same as RINEX convention. (* Discontinuity in the carrier phase is indicated by the bit 3 of channel indicator.) (** Unknown half-cycle ambiguity is indicated by the bit 5 of channel indicator)	DPFP	Cycles

35-38		Doppler frequency	45794000	The sign of doppler frequency is defined such that the approaching satellite has positive doppler frequency.	SPFP	Hz
39		Pseudorange standard deviation	00	Estimated standard deviation of pseudorange (* Not supported in version 1)	-	meter
40		Accumulated carrier cycle standard deviation	00	Estimated standard deviation of accumulated carrier cycle (* Not supported in version 1)	-	Cycles
41		Doppler frequency standard deviation	00	Estimated standard deviation of Doppler frequency (* Not supported in version 1)	-	Hz
42-43		Channel Indicator	4007	Bit 0 ON: pseudorange is available in the channel. Bit 1 ON: Doppler frequency is available in the channel. Bit 2 ON: carrier phase is available in the channel. Bit 3 ON: cycle slip is possible in the channel. Bit 4 ON: coherent integration time of the channel is equal to or more than 10ms. Bit 5 ON: unknown half-cycle ambiguity in the channel (* Bit 0 is LSB)	-	-
44-45		Reserved 2		Reserved	-	-
46-76	Channel 2 measurement					
77-107	Channel 3 measurement					
:	:		:	:	:	:
Payload Length : 14 + NMEAS * 31 bytes						

Change Log

Ver 1.4.32 Sep 26 2016

1. Modify Message ID 0x1E and 0x89 to add “Extended_ Raw_Meas Enabling” field.
2. Add “EXT_RAW_MEAS, ID: 0xE5” Extended Raw Measurement Data v.1 message.

Ver 1.4.31 Aug 12 2014

1. Updated 0xDE channel ID to go up to 43

Ver 1.4.30 May 12 2014

1. Update 0xE2, 0xE3 message description: Describe each byte clearly.

Ver 1.4.29 Apr. 3 2014

1. Update 0xDD, 0xDE message description: Add BD2 SVID.
2. Add 0xE2, 0xE3 for BD2 D1&D2 subframe output data messages.

Ver 1.4.28 Dec. 30 2013

1. Created this document based on AN00028.to add binary measurement data related commands.
2. Add 0x1E, 0x1F, 0x89 binary commands for binary measurement data output
3. Add 0x5B, 0x5C, 0x90 for Glonass ephemeris binary commands
4. Add 0xDC, 0xDE, 0xDF, 0xE0, 0xE1 for binary periodic output data messages.

Ver 1.4.27 Dec. 4 2013

1. Update “CONFIGURE SBAS, ID: 0x62, SID: 0x1” message field 4, Ranging by adding auto mode.
2. Update “SBAS STATUS, ID: 0x62, SID: 0x80” message field 4, Ranging by adding auto mode.

Ver 1.4.26, Sep. 17, 2013

1. Update 0x63/0x1, 0x63/0x2, 0x63/0x80 to use name “SAEE” instead of “SAGPS”.
2. Add NMEA talker ID related commands, ID: 0x4B, 0x4F, 0x93.

Ver 1.4.25, July 10, 2013

1. Initial release based on AN0003 1.4.24.

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