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Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



FURUNO

FURUNO GNSS Receiver
Model: GN-8720

Protocol Specifications

(Document No. SE14-600-033-00)



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Revision History

Version	Changed contents	Date
0	Initial release	2016.01.12

Table of Contents

1	Purpose	1
2	Approval Software Version	1
3	Communication Specification	1
4	NMEA Sentence Format	2
4.1	Standard Sentence	2
4.2	Proprietary Sentence	3
5	Configurable Parameters List	4
6	Receiver State	7
7	Backup Data	12
7.1	Flash ROM Data Area	13
8	Transmission and Reception Sequence	14
8.1	Startup Sequence	14
8.2	Sequence from Fix Session OFF to Fix Session	15
8.3	Periodical Output Sentence (Example 1)	16
8.4	Periodical Sentence (Example 2)	17
8.5	Receiver Configuration Setting Sequence	18
8.6	Receiver Data Output Request	20
8.7	Backup Data Input/Output	21
8.7.1	Backup Data Output Request Sequence	22
8.7.2	Backup Data Input Sequence	23
8.8	Change Serial Communication Configuration	24
8.9	Time Setting	25
8.10	Position Setting	28
8.11	ESIPLIST	30
8.11.1	New ESIPLIST Create	30
8.11.2	ESIPLIST Append	31
8.11.3	ESIPLIST Query	32
8.11.4	ESIPLIST Delete	32
8.11.5	ESIPLIST Configurable Command	33
8.12	Fix Session OFF Sequence	34
8.13	Power OFF Sequence	34
8.14	Flash ROM Reprogramming	35
9	Receiving NMEA Sentence	36
9.1	Receiving Data	36
9.2	Cutout from String	36
9.3	Cutout from Strings in Fixed Interval	36
9.4	Cutout from Every Strings	36
9.5	TalkerID	37
9.6	Satellite No.	37
9.7	Time in NMEA Sentence	37
9.8	Delta between Current Time and Position Fix Time	38
9.9	Position Fix Status	38
9.10	The Case Position Fix State Becomes Valid While No Position Fix	38
9.11	Direction	38
10	Abnormal Status	39
10.1	Assume Abnormal Status Type	39
10.2	How to Fix Abnormal Status	40
11	Function Exclusion	41
12	Standard NMEA Output	42
12.1	GBS – GNSS Satellite Fault Detection	42
12.2	GFA – GNSS Fix Accuracy and Integrity	43
12.3	GGA – Global Positioning System Fix Data	44
12.4	GLL – Geographic Position - Latitude/Longitude	45
12.5	GNS – GNSS Fix Data	46
12.6	GSA – GPS DOP and Active Satellites	47
12.7	GST – GNSS Pseudo Range Error Statistics	48

12.8	GSV – Satellites in View	49
12.9	RMC – Recommended Minimum Navigation Information	50
12.10	VTG – Course Over Ground and Ground Speed	51
12.11	ZDA – Time & Date	52
13	Proprietary NMEA Input	53
13.1	API – eRide GNSS Core Library Interface	53
13.1.1	ANTIJAM – Anti Jamming	53
13.1.2	CROUT – Original Sentence Output	54
13.1.3	DATUM – Geodetic Datum	55
13.1.4	DEFLS – Default Leap Second	55
13.1.5	EXTENDGSA – GSA Re-definition	56
13.1.6	FIRSTFIXFILTER – First Fix Filter Parameters	56
13.1.7	FIXMASK – Mask Configuration	57
13.1.8	FIXPERSEC – Multiple Fixes Per Second	58
13.1.9	GNSS – GNSS Satellite System	59
13.1.10	LATPROP – Latency Position Propagation	60
13.1.11	OUTPROP – Position Outage Propagation	60
13.1.12	PIN – Static Pinning	61
13.1.13	POS – Position Aiding	62
13.1.14	PPS – PPS (Pulse per second)	63
13.1.15	RAIM	63
13.1.16	RESTART/RESTARTNOFPR – Stop and Start the GNSS Core Library	64
13.1.17	SBASBLS – SBAS Search Select	64
13.1.18	SELFEPH – Self-Ephemeris™	65
13.1.19	START – Start the GNSS Core Library	66
13.1.20	STATIC – Static Entry/Exit Parameters	67
13.1.21	STOP/STOPNOFPR – Stop the GNSS Core	68
13.1.22	TIME – Time Aiding	68
13.2	CFG – Application Software Configuration	69
13.2.1	ESIPLIST – Save ESIP Command to FLASH	69
13.2.2	FACTORYRESET – Clear Non-Volatile Memory	69
13.2.3	FORMAT – Protocol Format	70
13.2.4	NMEAOUT – Configure the Standard NMEA Outputs	71
13.2.5	SILENTSTART – SILENTSTART Mode Setting	72
13.2.6	UART1 – Configure Serial Communications	72
13.2.7	UART2 – Configure Serial Communications	73
13.3	SYS – Control/Query the PVT System	74
13.3.1	ANTSEL – Antenna Selection Control	74
13.3.2	BBRAM	75
13.3.2.1	BBRAM – Query Command	75
13.3.2.2	BBRAM – Push Strings	75
13.3.3	ERRACT – Receiver’s State Processing at Abnormal Status	76
13.3.4	FIXSESSION – GNSS Session Query	76
13.3.5	GPIO – General Purpose Input/Output	77
13.3.6	RECPLAY – Diagnostics Mode	77
13.3.7	SELFEPH – Self-Ephemeris™ Models Calculation	78
13.3.8	SELFTEST – Self Test Request	78
13.3.9	VERSION – Software Version Information	79
14	Proprietary NMEA Output	80
14.1	ACK – Command Acknowledgement	80
14.2	CFG – Response to PERDCRG Input Commands	81
14.2.1	ADDON	81
14.2.2	ESIPLIST	81
14.3	CRx – Core Library GNSS Strings	82
14.3.1	CRE – Ephemeris Data	82
14.3.2	CRF – GNSS Accuracy and GPS Health	83
14.3.2.1	CRF,GxACC – GNSS Accuracy	83
14.3.2.2	CRF,GxANC – GNSS Health	84
14.3.3	CRL – LTCSM / Self-Ephemeris™ Data	85

14.3.4	CRP – PPS Status	86
14.3.5	CRQ – Galileo SAR/RLM Data	87
14.4	MSG – Event Driven Messages	89
14.5	RPx – Diagnostic Output Data	89
14.6	SYS – PERDSYS Output Commands	90
14.6.1	ANTSEL – Antenna Selection Control Output	90
14.6.2	BBRAM – Backup Data Output.....	91
14.6.3	FIXSESSION – GNSS Fix Session State Information.....	92
14.6.4	GPIO – General Purpose Input/Output	92
14.6.5	SELFEPH – Self-Ephemeris™ Calculation State.....	93
14.6.6	SELFTEST – Self Test Output	94
14.6.7	VBKERR – VBK Error Report.....	95
14.6.8	VERSION – Software Version Information	96
15	RTCM Correction Data	97
15.1	Configuration Diagram	97
15.2	RTCM Message Usage	97

1 Purpose

This document describes the eRide Serial communications Interface Protocol (eSIP) for controlling GN-8720.

2 Approval Software Version

This document applies to GN-8720. The associated Platform software version is ENP6.51A and newer.

3 Communication Specification

Table 3.1 shows the communication interface of the eSIP protocol.

Table 3.1 Communication Interface

	NMEA Protocol (eSIP)	RTCM SC-104 (Input Only)	
Communication Port	UART1 (TXD1, RXD1)	UART2 (RXD2)	
Communication Type	Asynchronous full duplex communication method (no control sequence)		
Transfer Rate ^(*1)	Baud rate [bps]	Deviation Error [%]	Baud rate [bps]
			Deviation Error [%]
	4,800	+0.00	4,800 (Default)
	9,600	+0.11	9,600
	19,200	-0.11	19,200
	38,400 (Default)	+0.32	38,400
	57,600	-0.54	57,600
	115,200	-0.54	115,200
	230,400	+2.08	230,400
Data Length ^(*1)	8 bit		
Stop Bit ^(*1)	1 bit		
Parity ^(*1)	None		
Output Rate	1000 ms (1 Hz) (Default)^(*2) 500 ms (2 Hz) 200 ms (5 Hz) 100 ms (10 Hz)		-
Character Code	NMEA-0183 Ver. 4.10 data based ASCII code ^(*3)		RTCM SC-104 (Ver. 2.3) ^{(*4) (*5)}
Protocol Contents	Input Data NMEA Proprietary Sentence Output Data NMEA Standard Sentence NMEA Proprietary Sentence	Input Data Message Type 1 Message Type 3 Message Type 9	

(*1) These setting can be changed. Please refer to Section 13.2.6 for details.

(*2) These setting can be changed. Please refer to Section 13.1.8 for details.

(*3) "NMEA 0183 STANDARD FOR INTERFACING MARINE ELECTRONIC DEVICES Version 4.10" (NATIONAL MARINE ELECTRONICS ASSOCIATION, June, 2012)

(*4) "RTCM RECOMMENDED STANDARDS FOR DIFFERENTIAL NAVSTAR GPS SERVICE Version 2.3" (DEVELOPED BY RTCM SPECIAL COMMITTEE NO.104, August 20, 2001)

(*5) This code is the standard code for the differential GPS correction data.

4 NMEA Sentence Format

4.1 Standard Sentence

\$	<Address field>	,	<Data field>	. . .	*<Checksum field>	<CR>	<LF>
----	-----------------	---	--------------	-------	-------------------	------	------

5 bytes

"\$" Start-of-Sentence marker

<Address field>

5-byte fixed length. First 2 bytes represent a talker ID, and the remaining 3 bytes do a sentence formatter.

The talker IDs are GN of GNSS, GP for GPS, GL for GLONASS and GA for Galileo. ^(*)

<Data field>

Mainly, they are variable-length fields and are delimited by delimiter "," (comma).

The valid data character set is all characters from ASCII 0x20-0x7D, except "!" (0x21), "\$" (0x24), "" (0x2A), "¥" (0x5C), and "^" (0x5E).

When there are not applicable data, they were expressed in null field.

The fields inside [] are optional fields.

<Checksum field>

8 bits data between "\$" and "" (excluding "\$" and "") are XORed, and the resultant value is converted to 2 bytes of hexadecimal letters.

<CR><LF> End-of-Sentence marker

<CR>: 0x0D

<LF>: 0x0A

Notes:

(*) Talker IDs are changed by GNSS command setting and used satellite systems. The following table shows the talker ID of standard NMEA sentences.

Standard NMEA Sentence		Talker ID Configuration with PERDAPI,GNSS ^(*)		
		AUTO	GN	LEGACYGP
RMC	Recommended Minimum Navigation Information	GN/GP/GL/GA	GN	GP
GNS	GNSS Fix Data	GN/GP/GL/GA	GN	GP
GGA	Global Positioning System Fix Data	GN/GP/GL/GA	GN	GP
GLL	Geographic Position - Latitude/Longitude	GN/GP/GL/GA	GN	GP
VTG	Course Over Ground and Ground Speed	GN/GP/GL/GA	GN	GP
GST	GNSS Pseudo range Error Statistics	GN/GP/GL/GA	GN	GP
GBS	GNSS Satellite Fault Detection	GN/GP/GL/GA	GN	GP
GFA	Integrity Data	GN/GP/GL/GA	GN	GP
GSA	GPS DOP and Active Satellites	GN/GP/GL/GA	GN/GP/GL/GA	GP
ZDA	Time & Date	GN/GP/GL/GA	GN	GP
GSV ^(*)	Satellites in View (GPS, SBAS, QZSS)	GP	GP	GP
	Satellites in View (GLONASS)	GL	GL	x
	Satellites in View (Galileo)	GA	GA	x

GN/GP/GL/GA: shows that the talker ID changes to the following talker ID by using satellite system.

GN: Multi satellite system, GP: Only GPS (involve SBAS and QZSS), GL: Only GLONASS, GA: Only Galileo

x: The satellite system is used for positioning through the sentence is not output.

(*) See Section 13.1.9 for talker ID configuration.

(*) The sentences are output when they are used for position fix and GN-8720 corresponds to the satellite.

4.2 Proprietary Sentence

\$	P	<maker code>	<Sentence type>	,	<Data field>	. . .	*<Checksum>	<CR>	<LF>
		3 bytes	3 bytes						

"\$" Start-of-Sentence marker

"P" Proprietary Sentence ID

<Maker code>
 It indicates the maker and it is "ERD".

<Sentence Type>
 It indicates the type of sentence.

<Data field>
 Mainly, they are variable-length fields and are delimited by delimiter ","(comma).
 The valid data character set is all characters from ASCII 0x20-0x7D, except "!" (0x21), "\$" (0x24),
 "" (0x2A), "¥" (0x5C), and "^" (0x5E).
 When there are not applicable data, they were expressed in null field.

<Checksum field>
 8 bits data between "\$" and ""(excluding "\$" and "") are XORed, and the resultant value is
 converted to 2 bytes of hexadecimal letters.

<CR><LF> End-of-Sentence marker
 <CR>: 0x0D
 <LF>: 0x0A

5 Configurable Parameters List

Table 5.1 shows the configurable parameters and default values.

Table 5.1 Configurable Parameters List

eSIP Command	Configurable Item		Range	Default	
API	ANTIJAM	Anti-Jamming function		GP: GPS (1.575 GHz band) Priority GL:GLONASS (1.602GHz band) Priority USER: User setting	GP
	CROUT	Original CR sentence output		E: CRE output F: CRF output L: CRL output P: CRP output Q: CRQ output ALLOFF: All CR sentence output off	ALLOFF
	DATUM	Geodetic Datum		001: WGS-84 172: Tokyo Datum	WGS-84
	DEFLS	Default leap second		00 to 32 [sec]	17
	EXTENDGSA	Number of fields for satellites used in the fix in the GSA sentence		12 to 16 [satellites]	12
	FIRSTFIXFILTER	First Fix Filter		STRONG: FF position accuracy Priority MEDIUM: TTFF and FF position accuracy balanced OFF: TTFF Priority	MEDIUM
	FIXMASK	Mask Satellite	Mask Elevation	0 to 90 [degree]	0
			Ephemeris age mask	0 to 28800 [sec]	14400
			SNR mask	0 to 49 [dB-Hz]	0
			Tracking status	0: tracking SVs which have available ephemeris are used in the position fix calculation. 1: only SVs with TSM measurements are used in the position fix calculation	0
	FIXPERSEC	Number of fixes per second		1, 2, 5, 10 [Hz]	1
	GNSS	Used satellite systems	Standard NMEA sentence talker ID	AUTO, GN, LEGACYGP (See the notes in Section 4.1 about talkerID.)	GN
			GPS	-1, 0, 1, 2, 3	2
			GLONASS	-1, 0, 1, 2, 3	2
			Galileo	-1, 0, 1, 2, 3	0
			QZSS	-1, 0, 1, 2, 3	2
			SBAS	-1, 0, 1, 2, 3	2
	LATPROP	Position propagation time		-1 to 2000 [msec] (step: 1msec)	0 (800msec)
	OUTPROP	Number of seconds to propagate the last valid position fix when the GNSS signal is lost.		0 to 10 [sec]	10
	PIN	Pinning strength		OFF: Pinning OFF STRONG: Pinning ON	STRONG
	POS	Position	Latitude	-90.0000 to 90.0000 [degree]	North 00000.0000
			Longitude	-180.0000 to 180.0000 [degree]	East 00000.0000
			Altitude	0 to 18300 [m]	-18.0
Uncertainty			1 to 8000000	-	
PPS	Pulse per second	Output type	FINE: PPS output ON OFF: PPS output OFF	FINE	
		Output mode	1: Always Output 2: Output after position fix	1	
		Pulse Interval	1000, 2000 [msec]	1000	
		Width PPS pulse	1 to 500 [msec]	200	
		Cable compensation	-100000 to 100000 [msec]	0	
RAIM	RAIM	ON/OFF	ON: RAIM function ON OFF: RAIM function OFF	OFF	
		Accuracy Level	1 to 999	-	

eSIP Command	Configurable Item		Range	Default	
SBASBLS	Priority of Searched SBAS Satellite and Query		0: WAAS 1: EGNOS 2: MSAS 3: GAGAN 255: Blind search in ascending order of PRN QUERY: Request the setting	2: MSAS	
SELFEPH	Self-Ephemeris mode ON/OFF		ON: The satellites which have available Self-Ephemeris™ are used in position fix calculation. OFF: Self-Ephemeris™ is not used in position fix calculation.	ON	
STATIC	Static mode transition condition setting	Velocity threshold for entering the mode	0 to 20480 [m/sec/2 ⁻¹²] (1.1 [m/sec] ≐ 4506 [m/sec/2 ⁻¹²])	4506	
		Time threshold for entering the mode	0 to 100 [sec]	2	
		Velocity threshold for exiting the mode	0 to 20480 [m/sec/2 ⁻¹²] (1.1 [m/sec] ≐ 4506 [m/sec/2 ⁻¹²])	4506	
		Time threshold for entering the mode	0 to 100 [sec]	2	
TIME	Time	Time of day ((UTC))	000000 to 235959 (HHMMSS HH: hour, MM: min, SS: sec)	000000	
		Day (UTC day)	1 to 31	22	
		Month (UTC month)	1 to 12	8	
		Year (UTC year)	2015 to 2099	1999	
		Uncertainty	0 to 9 [sec] (Error between the setting time and actual time)	-	
CFG	FORMAT	Protocol format		FECBIN,ESIP	ESIP
NMEAOUT	Standard NMEA output	Output sentence	GBS, GFA, GGA, GLL, GNS, GSA, GST, GSV, RMC, VTG, ZDA	RMC, GNS, GST, GSA, ZDA, GSV	
		Interval of output sentence	0 to 60	1	
SILENTSTART	SILENT START mode		-	-	
UART1	Communication port 1 setting	Baud rate	4800, 9600, 19200, 38400, 57600, 115200, 230400 [bps]	38400	
		Data length	8 [bit]	8	
		Parity	NONE, EVEN, ODD	NONE	
		Stop bit	1, 2 [bit]	1	
UART2	Communication port 2 setting	Baud rate	4800, 9600, 19200, 38400, 57600, 115200, 230400 [bps]	4800	
		Data length	8 [bit]	8	
		Parity	NONE, EVEN, ODD	NONE	
		Stop bit	1, 2 [bit]	1	
SYS	ANTSEL	Antenna mode selection		FORCE1H, FORCE1L, FLEXFS, QUERY	The mode is selected by the hardware setting
ERRACT	Receiver's state processing at abnormal status		HALT: Transfer to fix session off state IGNORE: Remain fix session state.	IGNORE	
FIXSESSION	GNSS session query		0: Not output autonomously 1: output autonomously	1	
REPLAY	Diagnostic mode ON/ OFF		ON : Diagnostic data output ON OFF: Diagnostic data output ON	OFF	
SELFEPH	Self-Ephemeris Calculation setting	Hours of model availability.	OFF, 8 to 72 [hour]	OFF	
		Accuracy	0: Low Accuracy mode 1: High Accuracy mode	-	
SELFTEST	Self test		-	-	

Notes:

The configuration parameters with eSIP command are returned to the default values by the following events.

(1) Command beginning with \$PERDAPI (exclude position and time)

- Power OFF
- Hardware Reset
- [PERDAPI,STOP](#) command, [PERDAPI,STOPNOFPR](#) command
- [PERDAPI,RESTART](#) command, [PERDAPI,RESTARTNOFPR](#) command
- [PERDCFG,FACTORYRESET](#) command

(2) Command beginning with \$PERDCFG and \$PERDSYS

- Power OFF
- Hardware Reset
- [PERDCFG,FACTORYRESET](#) command

The position by [PERDAPI,POS](#) command and the time by [PERDAPI,TIME](#) command are stored into the backup area of Backup RAM when these data are uncertain. When the receiver determines these data with GNSS satellite, these data are updated and stored into the area again. In case of no position fixed, the position by configured with PERDAPI,POS command and the time by PERDAPI,TIME command are stored into the backup area of backup RAM. When time and position are fixed by GNSS information, these data are updated and stored into the backup area again.

If it is necessary to automatically set up with these parameters, without having the host sending commands to the GNSS receiver, using the ESIPLIST function is ideal. See Section 8.11 and Section 13.2.1 about the ESIPLIST.

6 Receiver State

Table 6.1 shows the receiver's operating state and Figure 6.1 shows the state transition diagram.

Table 6.1 Receiver State List

State	Description
Power off	The receiver shuts off the power. It inputs and outputs nothing.
Fix session	Calculate PVT (Position, Velocity and Time) the continuously and outputs the result in a cycle. This receiver transfers to this state from power off at power on. The receiver transfers changes to this state when PERDAPI,START command is sent at fix session off state.
Fix session off	Stop calculating PVT and idles. The receiver transfer to this state when PERDAPI,STOP or PERDAPI,STOPNOFPR command is sent at fix session state. If the receiver detects self test error or error status, the receiver transfers this state from fix session state. ^(*1) The receiver transfers to this state from power off at power on when this mode is silent start mode. ^(*2) In terms of invalid command (*) at fix session state, It is necessary to input commands after transferring to this state. (*): See Table 6.3 for details.
BBDATA input	The receiver is inputting the backup data with PERDSYS,BBRAM command.
Flash ROM program rewriting	Update process of the position calculation programming is active with Flash ROM reprogramming tool.
ESIPLIST writing	Initial configuration process in Flash ROM area by eSIP commands list in ESIPLIST is activating with PERDCFG,ESIPLIST command.

Notes:

- (*1) It needs to set [PERDSYS,ERRACT](#) command to "HALT".
- (*2) It needs to register [PEREDCFG,SILENTSTART](#) command into ESIPLIST.

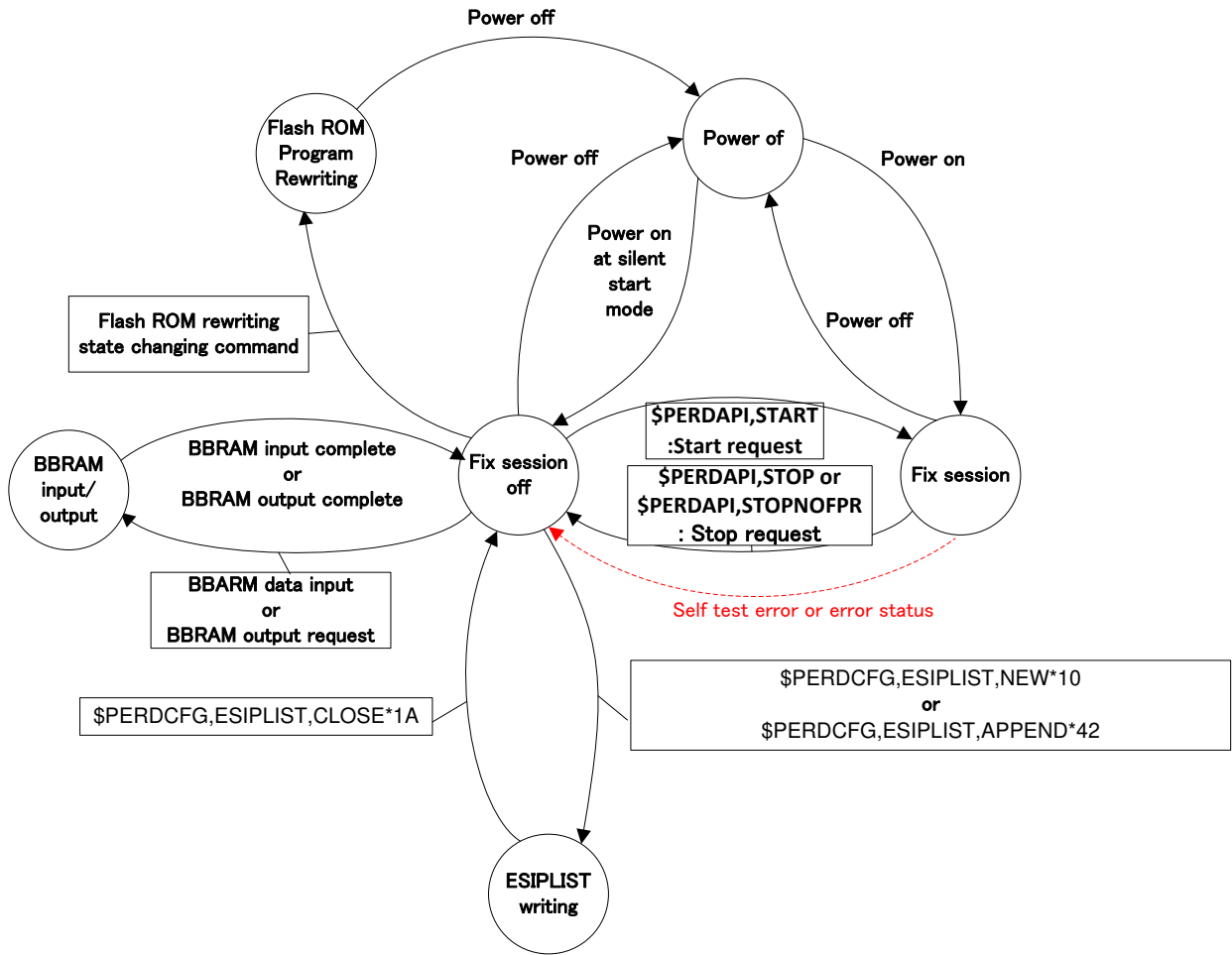


Figure 6.1 Receiver State Diagram

Table 6.2 shows input / output of communication port (UART1(Output) , UART1(Input) and I2C/ UART2) at each states.

Table 6.2 UART Input/Output at Each State

State	UART1 (Output)	UART1 (Input)	UART2 (Output)
Power off	The transmission function is invalid.	The reception function is invalid.	The reception function is invalid.
Fix session	The output data is either position fix data or input data.	The input data are all commands except the valid commands only when the state is fix session off.	The communication function for RTCM SC-104 is valid.
Fix session off	The output data is response of input command.	The input valid data are all commands except the valid commands only when the state is fix session.	The reception function is invalid.
BBDATA input/ output	Not applicable	PERDSYS,BBRAM command is valid at fix session off.	Not applicable
Flash ROM program reprogramming	The sentences based on Flash ROM reprogramming procedure are output. ^(*)	It only inputs the sentences for Flash ROM programming procedure. ^(*)	Not applicable
ESIPLIST writing	Responses to input are output.	Input commands are recorded into ESIPLIST during this state.	Not applicable

Notes:

(*) See "Flash ROM Programming Procedures with WinUppg" (Doc # SE13-900-009) about Flash ROM program rewriting.

Table 6.3 shows input commands/ output sentences at fix session state / fix session off state.

Table 6.3 Input Command / Output Sentence at Each State

Standard NMEA Output

Output sentence	Output contents	Fix session	Fix session off
RMC	Recommended Minimum Navigation Information	O	-
GNS	GNSS Fix Data	O	-
GGA	Global Positioning System Fix Data	O	-
GLL	Geographic Position - Latitude/Longitude	O	-
VTG	Course Over Ground and Ground Speed	O	-
GST	GNSS Pseudo range Error Statistics	O	-
GBS	GNSS Satellite Fault Detection	O	-
GFA	Integrity Data	O	-
GSA	GPS DOP and Active Satellites	O	-
ZDA	Time & Date	O	-
GSV	Satellites in View	O	-

O: Output is available. It is possible to control output function (ON/ OFF) and output period by [PERDCFG,NMEAOUT](#) command.

-: Output is not available.

Proprietary NMEA Input

Input command	Input contents	Fix session	Fix session off
PERDAPI			
ANTIJAM	Anti Jamming		
CROUT	CR original sentence output		
DATUM	Geodetic datum		
DEFLS	Default leap second	^(*) / q	/ q
EXTENDGSA	GSA sentence re-definition		
FIRSTFIXFILTER	First fix filter parameters		
FIXMASK	Satellite Mask		
FIXPERSEC	Multiple fixes per second		
GNSS	GNSS satellite system configuration		
LATPROP	Enable latency position propagation		
OUTPROP	Enable position outage propagation		
PIN	Static pinning strength set		
POS	Position aiding		
PPS	PPS (Pulse per second)		
RAIM	RAIM		
RESTART/RESTARTNOFPR	Restart request		
SBASBLS	SBAS priority search select		
SELFEPH	Self-Ephemeris mode ON/OFF		
START	Start request	NACK	
STATIC	Static entry/exit parameters		
STOP/STOPNOFPR	Stop request		NACK
TIME	Time aiding		
PERDCFG			
ESIPLIST	Save/query ESIP commands to FLASH	q	/ q
FACTORYRESET	Clear non-volatile memory	NACK	
FORMAT	Protocol format	^(*)	
NMEAOUT	Configure the standard NMEA outputs		
SILENTSTART	SILENTSTART mode	E	E
UART1/UART2	Serial communication port configuration	^(*)	
PERDSYS			
ANTSEL	Antenna selection control	/ q	/ q
BGRAM	Backup data output query	q ^(*)	q
	Backup data input	NACK	
ERRACT	Receiver's state processing at abnormal status		
FIXSESSION	GNSS session query	/ q	/ q
GPIO	GPIO output query	q	q
REPLAY	Diagnostic mode ON/ OFF	^(*)	
SELFEPH	Self-Ephemeris models calculation		
SELFTEST	Self test	q	q
VERSION	Software version query	q	q

I: Input is available. q: Query is available. NACK: Not related to internal process.

E: Please register this command into ESIPLIST. (See Section 8.11 and Section 13.2.1 about ESIPLIST.)

Notes:

(*1) Input this command at fix session off state, though it is possible to input.

(*2) Request to output backup data at fix session off state to avoid mix transmission with back up and other data.

Proprietary NMEA Output

Output sentence	Output contents	Fix session	Fix session off
PERDACK			
ACK	Command acknowledgement	A	A
PERDCFG			
ADDON	Start status	S	-
ESIPLIST	ESIP command list query	Q	Q
PERDCRx			
CRE	GNSS ephemeris data	O	-
CRF,GxACC	GNSS accuracy	O	-
CRF,GxANC	GNSS health	O	-
CRL	LTCSM / Self-Ephemeris™ availability	O	-
CRP	PPS status	O	-
CRQ	Galileo SAR/RLM data	O	-
PERDMSG			
MSG	Event message	E	E
PERDRPx			
RPx	Diagnostic data	O	-
PERDSYS			
ANTSEL	Antenna selection control status	S/ Q	Q
BBRAM	Backup data output	Q ^(*1)	Q
FIXSESSION	GNSS session	Q/ R/ S/ E	Q
GPIO	GPIO status	Q	Q
SELFEPH	Self-Ephemeris™ Calculation state	E	E
SELFTEST	Self test	Q	Q
VBKERR	VBK error report	E	E
VERSION	Software version	S/ Q	Q

O: Output is available.

Q: This sentence is output when the query command is input.

R: This sentence is output at the following conditions:

- The state transfers from fix session off state to fix session state by [PERDAPI,START](#) command.
- The state transfers from fix session state to fix session off state by [PERDAPI,STOP](#) or [PERDAPI,STOPNOFPR](#) command.

S: This sentence is output at power on.

A: This sentence is output as ACK or NACK for input command.

E: This sentence is output when certain events occur.

-: Output is not available.

Notes:

- (*1) Please output backup data at fix session off state to avoid mix transmission with back up and other data.

7 Backup Data

The receiver backs up the last updated position, the last updated time, the ephemeris, the almanac, the CSM, the LTCSM and the Self-Ephemeris™. These backup data are used for shortening the position fix time at the next start-up.

(1) Last updated position

This data shows the last position data calculated by the receiver. It shows the position data in GGA, GLL, GNS and RMC sentence. This data is backed up every position fix.

(*) GGA, GLL, GNS and RMC sentences are output by [PERDCFG,NMEAOUT](#) command, or GLL, GNS and RMC sentences are output by default.

(2) Last updated time

This data shows the last UTC calculated by the receiver and the RTC counter value. It shows the UTC data in GGA, GLL, GNS and RMC sentence. This data is backed up after fixing the time at first.

(*) GGA, GLL, GNS and RMC sentences are output by [PERDCFG,NMEAOUT](#) command, or GLL, GNS and RMC sentences are output by default.

When the receiver's state is power off state and a backup power is supplied to the receiver, the time at power on can be calculated from the delta between the last updated time and RTC counter value.

This document defines the time calculated from the delta between the last updated time and the RTC counter value as RTC time. RTC time is valid when the receiver can calculate it and RTC time is invalid when the receiver cannot calculate it because backup power is not supplied.

(3) Ephemeris

These data show the ephemeris data broadcasted from GNSS satellites. These are backed up, when the receiver gets these and updates these.

(4) Almanac

These data show the almanac data broadcasted from GNSS satellites. These are backed up, when the receiver gets these and updates these.

(5) CSM

These data shows the all GPS satellites ephemeris model downloaded from an assist server. (These are FURUNO original format.) These are backed up into a backup RAM at downloading the data.

(6) LTCSM

These data shows the extended satellites ephemeris model which the receiver can use for one week. (These are FURUNO original format.) These are backed up into Flash ROM area at downloading the data.

(7) Self-Ephemeris™

These data shows the extended ephemeris model made from received satellites ephemeris. The time is max 3 days. These are backed up into Flash ROM area at downloading the data.

Notes:

Because the data from (1) to (5) of above are saved into a backup RAM, these are continued to save while a backup power is supplied to the receiver. The receiver can also save these into Flash ROM, when [PERDAPI.STOP](#) command is sent.

Data (6) and (7) of above are saved into the Flash ROM area for LTCSM.

7.1 Flash ROM Data Area

Table 7.1 shows the data area contents in Flash ROM.

Table 7.1 Flash ROM Data Area Constitution Diagram

Data Area	Identification Name	Contents	Writing Timing
Data Area 1	FBINMFG	Area for manufacturing test	Manufacturing test
Data Area 2	GLOLTCSM1	Main area for GLONASS LTCSM ^(*)	GLONASS LTCSM from an assist server is received.
Data Area 3	GLOLTCSM2	Sub area for GLONASS LTCSM ^(*)	Data Area 2 is deleted.
Data Area 4	SELFEPH1	Main area for Self-Ephemeris ^{TM(*)}	Self-Ephemeris model has been calculated.
Data Area 5	SELFEPH2	Sub area for Self-Ephemeris ^{TM(*)}	Data Area 4 is deleted.
Data Area 6	LTCSM1	Main area for GPS LTCSM ^(*)	GPS LTCSM from an assist server is received.
Data Area 7	LTCSM2	Sub are for GPS LTCSM ^(*)	Data Area 6 is deleted.
Data Area 8	PREVRUN	Area for saving Backup RAM data	PERDAPI,STOP command is received.
Data Area 9	ESIPLIST	Area for saving ESIPLIST	PERDCFG,ESIPLIST command is received.
Data Area 10	ESIPROM	Area for saving ESIPROM (Any user cannot delete this area.)	At only writing the program into Flash ROM.

Notes:

(*1) The backup data is stored at main area first. When the main area is full of the data and the data in Flash ROM area should be deleted, the valid backup data is moved to the sub area.

8 Transmission and Reception Sequence

This chapter shows the transmission and reception sequences between the receiver and the host system. The receiver outputs the response sentence (\$PERDACK...) or the requested data when the commands written in the chapter 13 are input.

If the receiver does not return a response though the correct command is input, an error may be occurred on transmitting line. Please input the command again.

8.1 Startup Sequence

The receiver outputs the version message (\$PERDSYS,VERSION...), the configuration data^(*1) and the fix session start message (\$PERDSYS,FIXSESSION,ON) and do start process soon after power on. Until finishing the start process, the receiver cannot receive an input command. It takes max 600 msec to be able to input the command.

Figure 8.1 shows the sequence from power on to command input available.

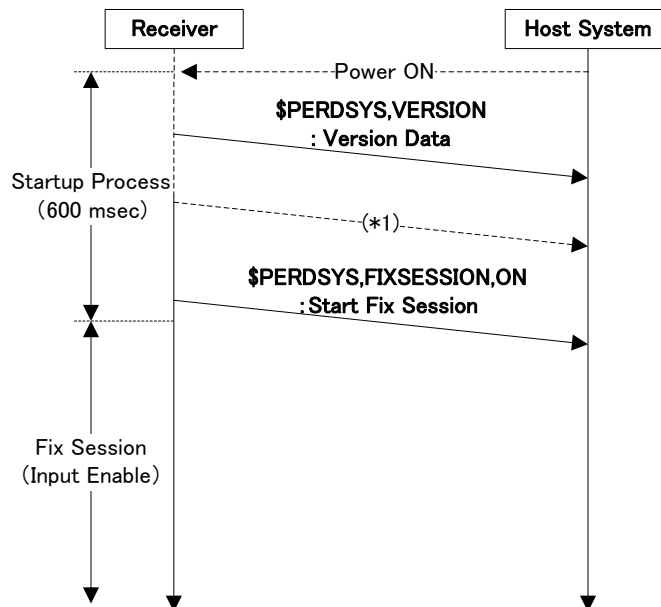


Figure 8.1 Communication Sequence from Power On to Command Input Available

Notes:

(*1) The configuration data are output.

8.2 Sequence from Fix Session OFF to Fix Session

Figure 8.2 shows the transition sequence from fix session off state to fix session state.

The receiver's state will change to fix session state after [PERDACK](#) sentence and [PERDSYS, FIXSESSION, ON](#) sentence are output, when [PERDAPI, START](#) command is input at fix session off state.

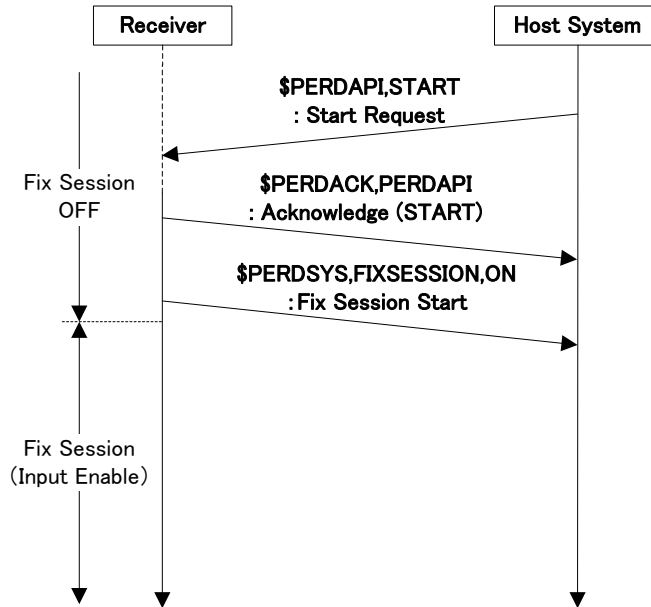


Figure 8.2 Communication Sequence from Fix Session OFF to Fix Session

8.3 Periodical Output Sentence (Example 1)

Figure 8.3 shows the periodical output sequence when the following NMEA sentences are output synchronized with positioning interval which is 1Hz.

(Output NMEA sentences)

RMC, GNS, GST, GSA, ZDA and GSV (Talker ID other than GSV are GN and Talker ID for GSV is GP.)

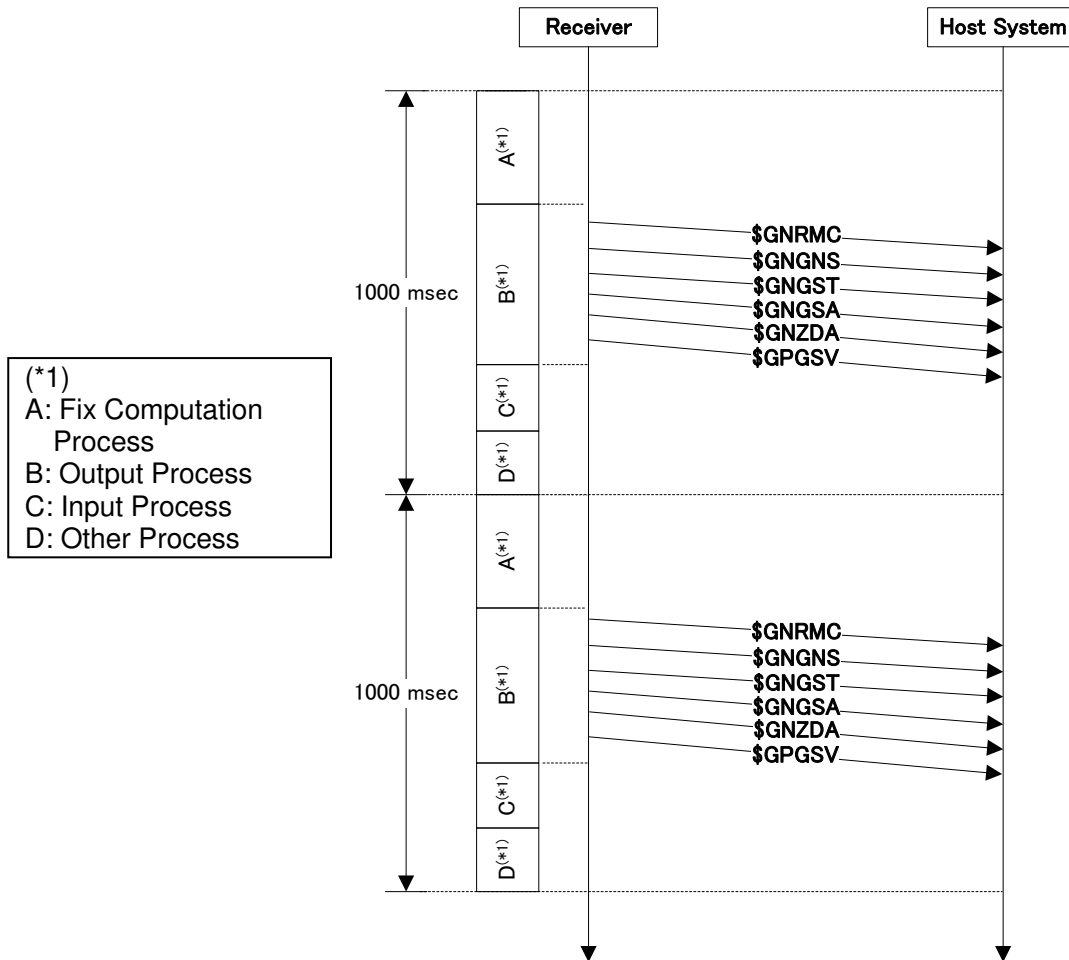


Figure 8.3 Communication Sequence (Periodical Output Example 1)

8.4 Periodical Sentence (Example 2)

Figure 8.4 shows the sequence under the following output conditions.

(Output conditions)

- Positioning interval: 2Hz
- Output NMEA sentence: GNS, RMC and GSV
- Output interval: GNS and RMC are output every positioning interval GSV is output once every 2 positioning interval.

The following commands are input to change from default output to above output conditions.

(Input commands)

- \$PERDAPI, FIXPERSEC, 2*2C : Positioning interval is 2Hz.
- \$PERDCFG, NMEAOUT, GST, 0*54 : GST sentence is not output.
- \$PERDCFG, NMEAOUT, ZDA, 0*4B : ZDA sentence is not output.
- \$PERDCFG, NMEAOUT, GSV, 2*54 : GSV sentence is output every 2 positioning.

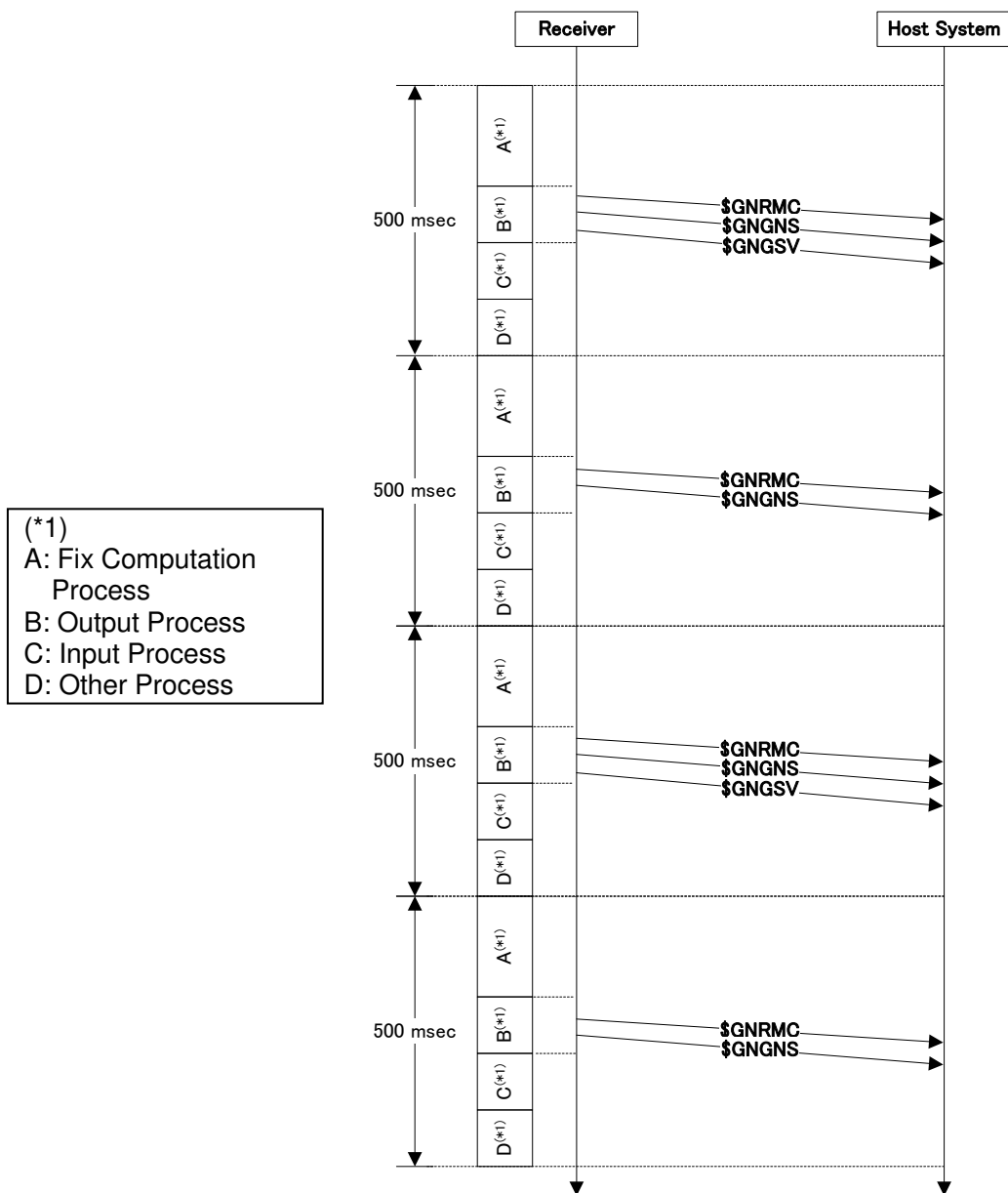


Figure 8.4 Communication Sequence (Periodical Output Example 2)

8.5 Receiver Configuration Setting Sequence

Figure 8.5 shows the communication sequence for the receiver which is update rate 1Hz and output positioning data synchronized with positioning cycle of RMC, GNS and GSV sentences when the receiver setting is changed by sending the following commands.

- [PERDAPI, FIXMASK](#) command
- [PERDAPI, PIN](#) command

The following figure shows the difference in response time which is a response of each input of command by input timing and the time which is reflected to positioning results against input command setting by input timing.

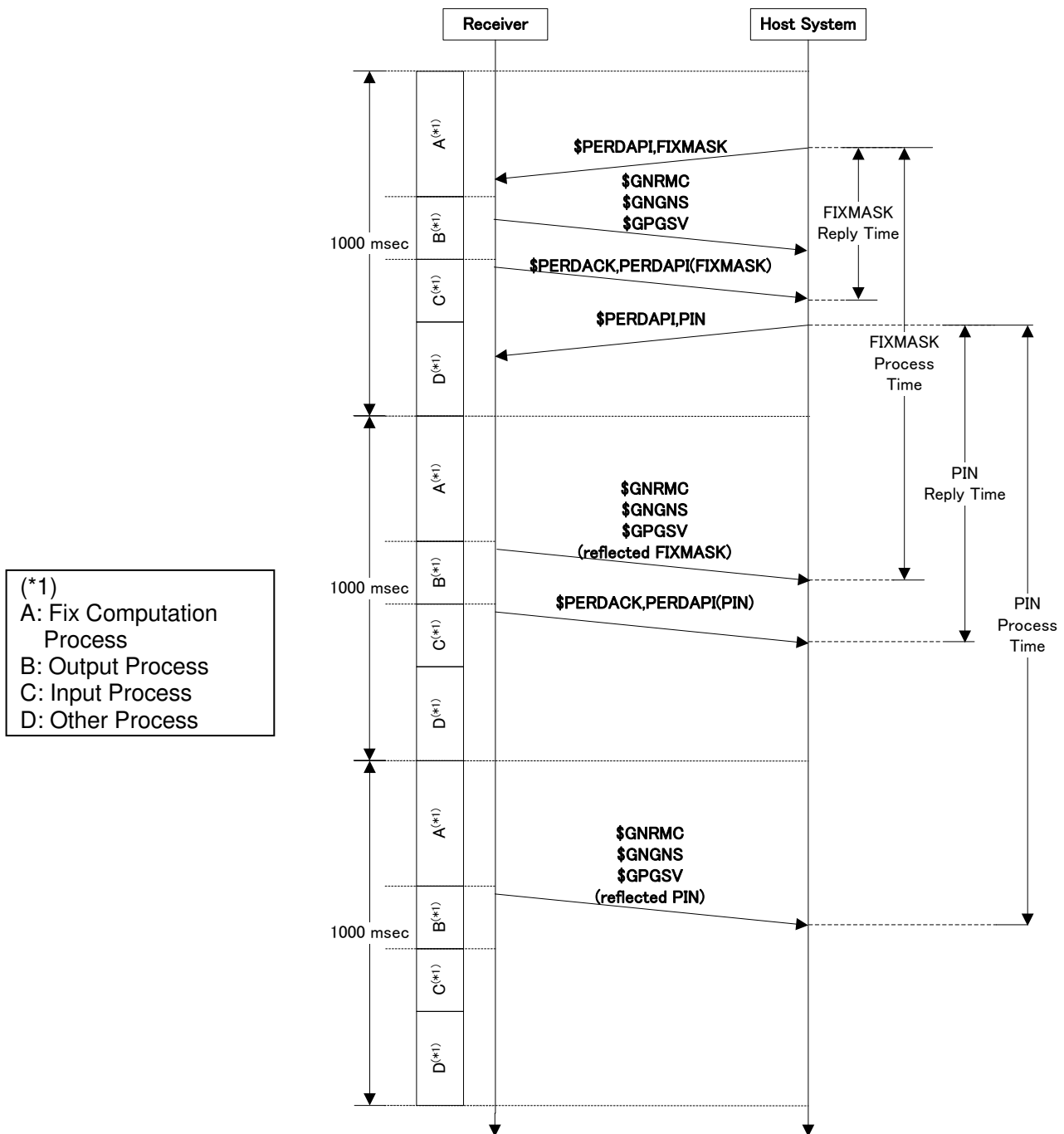


Figure 8.5 Communication Sequence Example in Case of Changing Receiver Setting (1 Hz)

Notes:

1. Maximum response time from data input to data output

The receiver needs **maximum 1000 msec** to output requested data since data output request command which is input just behind input processing will be accepted at next input processing of completion of positioning calculation processing and output processing when the receiver is in Fix session state and update rate 1Hz.

Table 8.1 shows the maximum response time from data input to data output for each state and each update rate.

Table 8.1 Maximum Response Time from Data Input to Data Output

State	Update rate [Hz]	Maximum response time [msec]
Fix session	1	1000
	2	500
	5	200
	10	100
Fix session off	-	100

2. Maximum response time from setting data input to positioning data output

The receiver needs **maximum 2000 msec** to output positioning data which is reflected setting data input by sending command when the receiver is in Fix session state and update rate 1Hz.

Table 8.2 shows the maximum response time to output positioning data after input of setting data for each state and each update rate.

Table 8.2 Maximum Response Time from Setting Data Input to Positioning Data Output

State	Update rate [Hz]	Maximum response time [msec]
Fix session	1	2000
	2	1000
	5	400
	10	200

3. Number of commands which is able to input at one time

The receiver can accept input command once per second in principal. The receiver can accept multiple input commands per 1 second when it has low load depending on setting of receiver and positioning status.

20 commands can be input to the receiver in a row when the receiver is in Fix session off state. It is able to input next command at the timing of finishing output of receiver response against command group which are input first.