SONY

CXD2951

Communication Command Specifications

Ver. 1.7

Revision Record			
No.	Date	Contents	Change page
1	2003/09/23	Ver. 1.0 Release	
2	2003/09/23	Ver. 1.1 Release	
		Added the revision record	P2
		Corrected "@PH" command name in the command list	P7
		Corrected the order in the command list	P7
		Corrected the explanations for "Speed over ground" in GPRMC, GPVTG sentence	P40,P41
3	2003/12/05	Ver. 1.2 Release	
		Added baud rate 19200/38400bps	P3
		Deleted @AL, @EP, @HL, @CRD, @CB, @TZ, @GS, @GSV command	P7
		Changed the variable format of @PM command	P11
		Changed the specification of @TT, @SK, @OI, @PV, @NC, @ANT command	P8,P12,P20-P23,P25
		Added new command @WLK, @PLM, @ST	P7,P26-P28
		Added new NMEA sentence SONY original PSGSA	P29,P38,P42
		Added the descriptions of the specifications for "Longitude" in GPGGA, GPGLL, GPRMC sentence	P30-P32,P35
		Changed the specifications for "UTC of position" in GPGGA, GPGLL, GPRMC sentence	P30-P32,P35
		Changed the notation of the timing figure	P43
		Changed the specification of almanac/ephemeris data format	P45-P48,P50-P52
		Changed the data format of Assistance data	P56-P58
4	2003/12/05	Ver. 1.3 Release	
		Corrected the example of the response to commands	P5
		Deleted @ANT in the Set Parameter Default Value List	P8
		Added the specification of output NEMA sentences at 4800 bps	P29
5	2004/01/08	Ver. 1.4 Release	
		Added the limit of command length	P4
		Changed the setting upper limit of @TM command	P10
		Added the note of @TT command	P12
		Added the notice	P29
		Corrected the note for "SNR" on GPGSV sentence	P35
		Added the note for "Speed over ground" on GPRMC, GPVTG sentence	P36,P37
6	2004/01/08	Ver. 1.5 Release	
		Deleted @ANT command	P7
		Corrected the example of GPRMC sentence	P35
7	2004/04/16	Ver. 1.6 Release	
		Changed explanations notation	P5
		Changed the reported format of @PV command	P6, P25

		Added new @SII,@SIO,@SS,@IND,@ADC,@ADS commands	P7-9, P17, P19, P31-33
		Added @ANT command	P8, P26
		Deleted @DGP command and D-GPS data format description	P8, P9
		Changed the notation of "Set Parameter Default Value List"	P9
		Added the explanation @AMI, @AMO, @EMI, @EMO, @ASI, @ASO, @SK, @OI, @NC, @WLK commands	P14-16, P23, P24,P26, P28
		Corrected the explanation and added the note of @PLM, @ST commands	P29, P30
		Added new $ADOUT sentence	P47
		Added the explanation and changed the specification of assistance data	P61
		Added new the assistance data format (3GPP TS 25.331)	P65-P71
8	2004/04/16	Ver. 1.7 Release	
		Deleted @SII, @SIO command and the assistance data format (3GPP TS 25.331)	P9
		Changed default output NMEA sentences for 4800 bps	P34,P35
		Added notation	P39
		Corrected notation	P47

Correspondent list between SW version and this specification	
Specification	Software
V1.0	00908F_129
V1.1	
V1.2	009090_124
V1.3	009090_126
V1.4	009090_127
V1.5	009090_128/001090_128
V1.6	009091_129
V1.7	009091_140/001091_140

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Chapter 1 I/O Data Input/Output Specifications

This chapter explains I/O specifications for CXD2951.

1.1. Communication

Interface: Asynchronous serial interface (UART)
Baud rate: 4800/9600/19200/38400bps
Start bit: 1 bit
Data bit: 8 bits
Stop bit: 1 bit
Parity bit: None
Flow control: Xon/Xoff
Data output cycle:
Approximately 1 second (default)

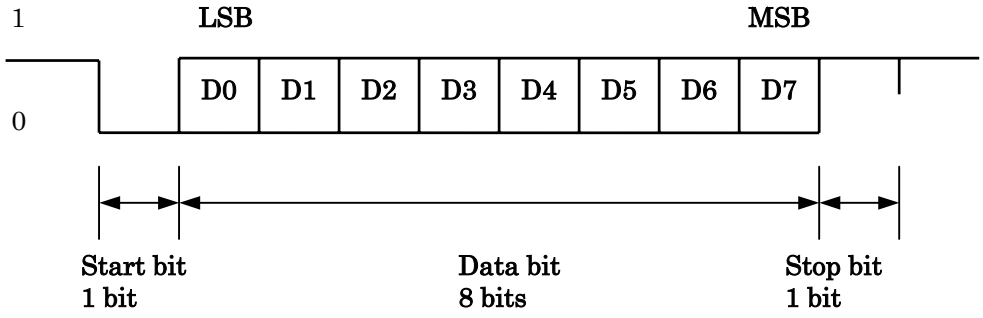

Fig.1. Asynchronous serial interface

1.2. Output Message Format

NMEA0183 (Ver3.01) messages are output.

Chapter 2 Input Commands

This chapter explains the input commands used in communication with the CXD2951.

2.1 Command Format

The communication command format consists of "@", a command and parameters in that order. Command input is recognized after a CR (carriage return) and a LF (line feed) are received. When an input is successfully recognized, an echo is sent back. Then if the command name and specified parameter values are entered correctly, the command is processed accordingly. However if a command or characters other than those noted in this specification is used, that operation cannot be guaranteed. Command length has a maximum limit of 127 characters (from @ symbol to line feed). If there are over 128 characters including line feed, the operation cannot be guaranteed.

When the command is processed properly, a processing message (shown below) is output as follows according to the command contents.

・Response to a basic command
(Example)
(1) @CD ← Command transmission
(2) @CD ← Echo back
(3) [CD] Done ← Processing message

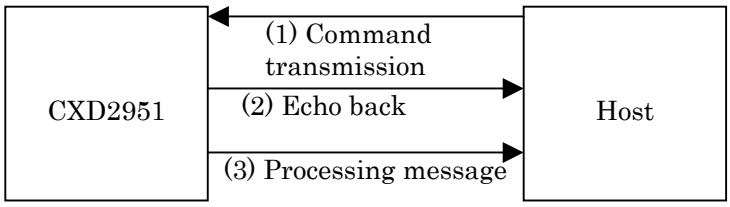

Fig. 2.1 Response to a Basic Command

・Response to a setting check request
(Example)
(1) @TT ← Command transmission
(2) @TT ← Echo back
(3) [TT] Done (1448.0 Hz) ← Processing message

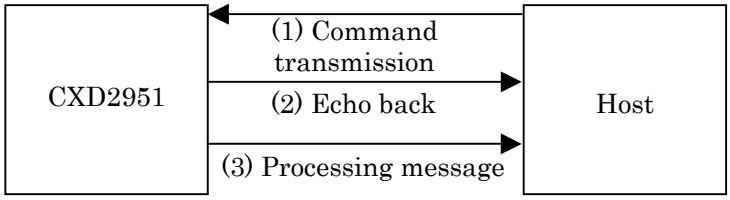

Fig. 2.2 Response to a Setting Check Request

・Response to an internal data output request or data input
(Example)
(1) @PV (Command transmission)
(2) @PV (Echo back)
(3) [PV] 009091_129 (Data output)
(4) [PV] Done (Processing message)

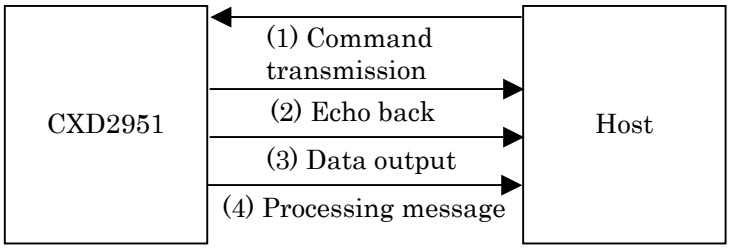

Fig. 2.3 Response to an Internal Data Output Request

If the entered command is incorrect or if a parameter setting is incorrect, an error message (shown below) is output. In such cases, the command is ignored.

Err: COMMAND	Command error. E.g., command name error.
[XX]Err: PARAMETER	Parameter error. E.g., parameter setting error.
[XX]Err: DATA	Data error. E.g., input data error, or no data input for 4 seconds or longer following command input.
[XX]Err: 1	Positioning has not yet been fixed, so output is not possible.
[XX]Err: 2	Positioning is being fixed, so the specified value cannot be set.
[XX]Err: 3	Other error.

The command name appears in place of “XX”. The command name is “@XX” without the “@”.

When transmitting multiple commands in succession, the next command can be transmitted following confirmation of the echo back as shown in Fig. 2.4.

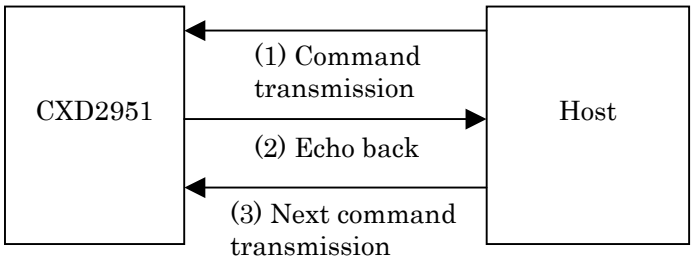

Fig. 2.4 Continuous Command Transmission Flow 1

However, when one of the following commands is transmitted, the next command can be transmitted following the confirmation of the echo back and the confirmation that the initial character of the NMEA message has been received as shown in Fig. 2.5.

- CLR command (2.11)
- SS command (2.12)
- CD command (2.13)
- SW command (2.14)
- SR command (2.15)
- IND command (2.24)
- ASI command (2.10)*

*(When ASI command is transmitted, the time needed to transmit all of the assistance data is also required.)

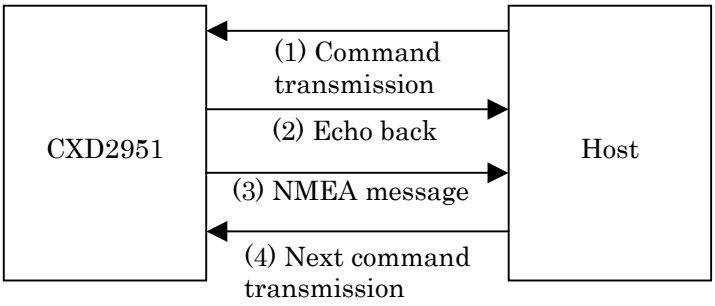

Fig. 2.5 Continuous Command Transmission Flow 2

2.2 Command List

No.	Command	Function description
1	@TM	Sets the receiver time.
2	@PM	Sets the receiver initial position.
3	@TT	Sets the TCXO offset value.
4	@AMI	Inputs Almanac data.
5	@AMO	Outputs Almanac data.
6	@EMI	Inputs Ephemeris data.
7	@EMO	Outputs Ephemeris data.
8	@ASI	Inputs assistance data.
9	@ASO	Outputs assistance data.
10	@CLR	Sets parameter to the default value and performs software reset. *
11	@SS	Clears position and performs software reset.
12	@CD	Clears memory and performs software reset (cold start).
13	@SW	Clears Ephemeris data and performs software reset (warm start).
14	@SR	Performs software reset (hot start).
15	@SK	Sets geodetic system.
16	@OI	Sets the message output interval.
17	@PV	Outputs software version.
18	@NC	Sets output interval for each NMEA sentence.
19	@ANT	Outputs result of antenna sense.
20	@NC	Sets output interval for each NMEA sentence.
21	@PLM	Sets low power mode.
22	@ST	Sets sleep-awake mode.
23	@IND	Calculates position in high sensitivity mode.
24	@ADC	Samples the A/D data.
25	@ADS	Sets the frequency of the A/D sampling data.

Table 2.1 Command List

* The default values are the factory settings. See “2.3. Set Parameter Default Value List” for details.

2.3 Set Parameter Default Value List

Parameters	Default Value *	Setting after reset		Setting command	
		@CLR/@CD	@SW/@SS/@SR	Name	During positioning
Time	2003/03/01 00:00:00	Reset	Held	@TM	Disabled
Position	null	Reset	Held/Reset/Held	@PM	Disabled
TCXO offset	null	Reset	Held	@TT	Disabled
Almanac	null	Reset	Held	@AM	Enabled
Ephemeris	null	Reset	Reset/Held/Held	@EM	Enabled
Geodetic system	A	Reset/Held	Held	@SK	Enabled
Output interval	1	Reset/Held	Held	@OI	Enabled
NMEA output interval	10110111	Reset/Held	Held	@NC	Enabled
Walking mode	OFF	Reset/Held	Held	@WLK	Enabled
Low power mode	0 ME PD	Reset	Reset	@PLM	Enabled
Sleep woking mode	0 ME PD	Reset	Reset	@ST	Enabled
A/D data sampling	OFF	Reset/Held	Held	@ADC	Enabled
Sampling frequency	10	Reset/Held	Held	@ADS	Enabled

Table 2.2 Set Parameter Default Value List

*Default values are the settings at the time of shipment from the factory, unless the RAM contents are cleared by "@CLR" command. See each command documents for the default value contents.

2.4 Command Notation Method

The following notation method is used in the command usage methods explained in the following sections.

[A | B | C]: One of A, B or C must be selected.
[A]: A can be selected as an option.

Do not input the brackets “[ ]”.

2.5 TM Command (receiver time setting)

Usage method

@TM YYYYMMDDhhmmss

YYYY:	Year
MM:	Month
DD:	Day
mm:	Minutes
ss :	Seconds

Explanation

This command sets the receiver clock time based on UTC time. Setting is not effective during positioning. If the command is transmitted without the time setting argument during positioning, the current time is reported.

The setting ranges are as follows:

Year:	2000 to 2099
Month:	01 to 12
Day:	01 to 31
Hours:	00 to 23
Minutes:	00 to 59
Seconds:	00 to 59

Example

For setting JST 15:29:24, August 29, 2002
(The time difference from UTC time to JST is 9 hours, so the setting should be 6:29:24.)

@TM 20020829062924

(Note: Be sure to take into account any time difference when making the setting.)

2.6 PM Command (receiver initial position setting)

Usage method

@PM [N|S]xxdxx.xxxx[E|W]yyydyy.yyyy

N|S: North Latitude (N), South Latitude (S)
xx: Degrees part of Latitude
d: Dividing word between degrees and minutes
xx.xxxx: Minutes part of Latitude
E|W: East Longitude (E), West Longitude (W)
yy: Degrees part of Longitude
d: Dividing word between degrees and minutes
bbb.bb: Minutes part of Longitude

Explanation

The receiver's approximate position is set using longitude and latitude values as its initial position. Altitude is 0 meters.
Setting is not effective during positioning. If the command is transmitted without the latitude and longitude arguments set during positioning, the current position is reported.

The setting ranges are as follows:
Latitude: 0.00 to 90.00
Longitude: 0.00 to 180.00

Example

For setting North Latitude 35.00°, East Longitude 139.00°

@PM N35E139
@PM N35d00E139d00

2.7 TT Command (TCXO offset value setting)

Usage method

@TT offset

offset: Offset value

Explanation

This command sets TCXO offset value in Hz units.
Setting is not effective during positioning. If the command is transmitted without the offset value argument set during positioning, the current offset value is reported.
Integers and decimal fractions (up to the first decimal place) may be set.

The setting ranges are as follows:
−99999.9 to 99999.9

Note

After TCXO offset value is set, execute software reset by using @SR command.

Example

For setting 1034Hz

@TT 1034

2.8 AM Command (Almanac data I/O)

Usage method

@AM[I | O]

I: Input
O: Output

Explanation

The @AMO command can be used to output Almanac data from the CXD2951, and the @AMI command can be used to transmit Almanac data to the CXD2951. See "4.1 Almanac Data" for the almanac I/O interface for this command.

During data input, the CXD2951 enters the data receive standby mode following @AMI command input and

[AMI] Ready

message output, and the host should start data transmission within 4 seconds of the standby mode. If data transmission does not start within this time, the CXD2951 returns to normal mode (message output).
When transmitting/receiving is completed, the following messages are output.

[AMI] Done: Reception complete
[AMO] Done: Sending complete

Data sending/receiving procedure

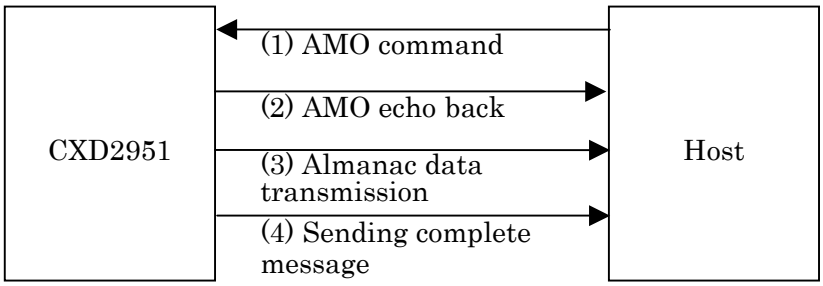

Fig. 2.6 Outputting Almanac data

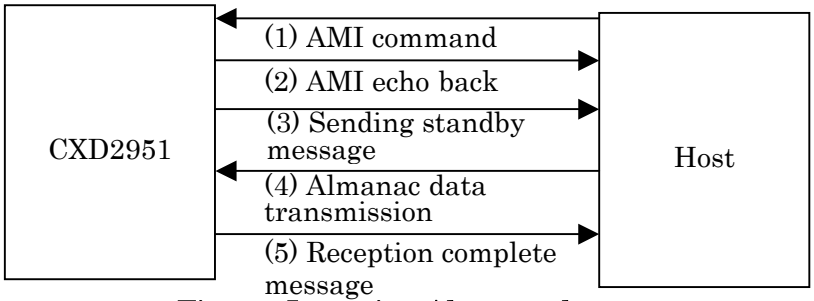

Fig. 2.7 Inputting Almanac data

2.9 EM command (Ephemeris data I/O)

Usage method

@EM[I | O]

I: Input
O: Output

Explanation

The @EMO command can be used to output Ephemeris data from the CXD2951, and the @EMI command can be used to transmit Ephemeris data to the CXD2951. See "4.2 Ephemeris Data" for the Ephemeris I/O interface for this command.

During data input, the CXD2951 enters the data receive standby mode following @EMI command input and

[EMI] Ready

message output, and the host should start data transmission within 4 seconds of the standby mode. If data transmission does not start within this time, the CXD2951 returns to normal mode (message output).
When transmitting/receiving is completed, the following messages are output.

[EMI] Done: Reception complete
[EMO] Done: Sending complete

Data sending/receiving procedure

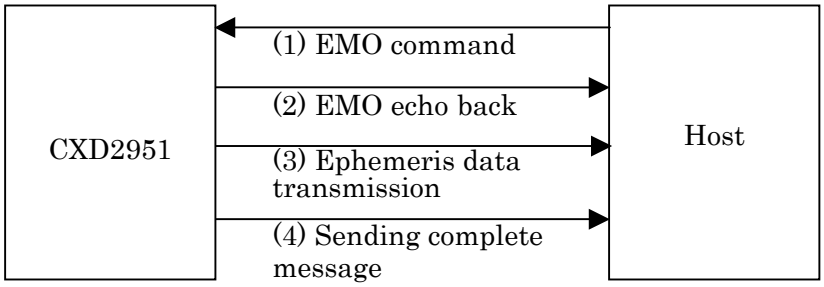

Fig. 2.8 Outputting Ephemeris data

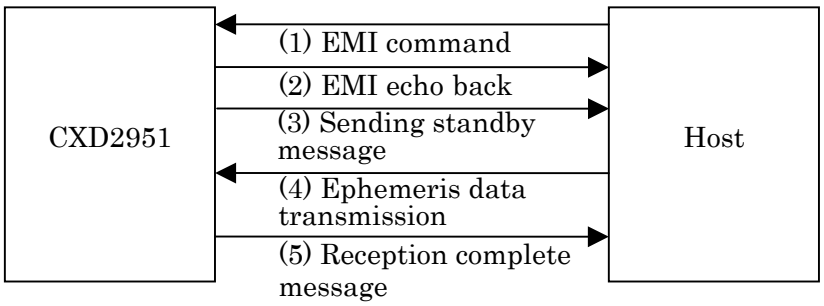

Fig. 2.9 Inputting Ephemeris data

2.10 AS command (assistance data I/O)

Usage method

@AS[I | O]

I: Input
O: Output

Explanation

The @ASO command can be used to output assistance data from the CXD2951, and the @ASI command can be used to transmit assistance data to the CXD2951. See "4.3 Assistance Data" for the Assistance I/O interface for this command.

During data input, the CXD2951 enters the data receive standby mode following @ASI command input and

[ASI] Ready

message output, and the host should start data transmission within 4 seconds of the standby mode. If data transmission does not start within this time, the CXD2951 returns to normal mode (message output).
When transmitting/receiving is completed, the following messages are output.

[ASI] Done: Reception complete
[ASO] Done: Sending complete

Data sending/receiving procedure

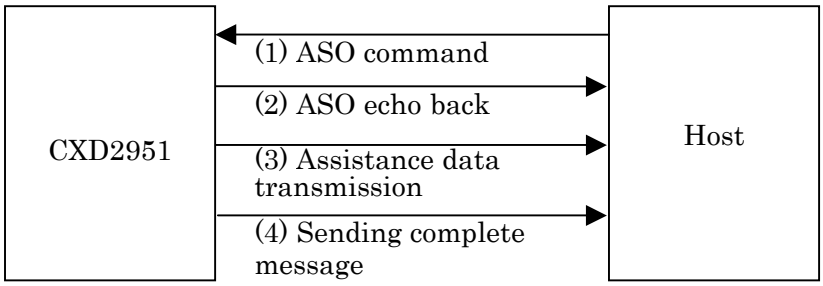

Fig. 2.10 Outputting assistance data

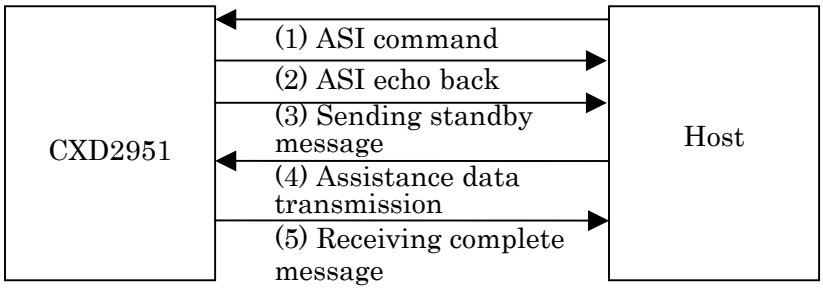

Fig. 2.11 Inputting assistance data

2.11 CLR command (clear set parameters)

Usage method

@CLR

Explanation

This command resets the user-set parameters to the default values; clears the time, position, Almanac data, Ephemeris data, and TCXO offset value; and restarts the equipment.
See Table 2.2 for the user-set parameter default values.

2.12 SS command (clear position)

Usage method

@SS

Explanation

This command clears the position and resets the software. While some user-set parameters are held, others return to the default values. See Table 2.2.

This command may shorten the position fix time when long-distance travel occurs from the last fixed position.

Note

NMEA message continues outputting the last position after command execution.

2.13 CD command (cold start)

Usage method

@CD

Explanation

This command performs a cold start reset. Cold start resetting clears the time, position, Almanac data, Ephemeris data, and TCXO offset value; and resets the software.
While some user-set parameters are held, others return to the default values. See Table 2.

2.14 SW command (warm start)

Usage method

@SW

Explanation

This command performs a warm start reset. Warm start resetting clears the Ephemeris data and resets the software.
While some user-set parameters are held, others return to the default values. See Table 2.2.

Note

If the CXD2951 does not have Almanac data from four or more visible satellites, a cold start is performed instead
.

2.15 SR command (hot start)

Usage method

@SR

Explanation

This command performs a hot start reset. Hot start resets the software while retaining the time, initial position, Almanac data, Ephemeris data, and TCXO offset value.)
While some user-set parameters are held, others return to the default values. See Table 2.2.

Note

If the CXD2951 does not have Ephemeris data from four or more visible satellites, then a warm start is performed instead.
If the CXD2951 does not have Almanac data from four or more visible satellites, then a cold start is performed.

2.16 SK command (geodetic system setting)

Usage method

@SK [A | B]

A: WGS-84
B: Tokyo geodetic system

Explanation

This command sets the geodetic system used for outputting position information.
Two different geodetic systems can be set: WGS-84 and the Tokyo geodetic system.

The default setting is WGS84. If the geodetic system argument is not set, the current setting value is reported. The setting is held internally even if the @CD, @SW, @SS or @SR reset commands are transmitted.
The default value is A (WGS-84).

Example

Changing to the Tokyo geodetic system

@SK B

2.17 OI command (message output interval setting)

Usage method

@OI interval

interval: [0 | 1 | 2 | 5 | 10]

Explanation

This command changes the output interval of positioning result messages. The settings are 0, 1, 2, 5, and 10 seconds. If 0 is set, message reporting isn't outputted.
To resume output, set a value other than 0.

If the interval value argument is not set, the current setting is reported. The setting is held internally even if the @CD, @SW, @SS or @SR reset commands are transmitted.
The default value is 1.

Example

Setting the output interval to every 5 seconds

@OI 5

2.18 PV command (outputting the software version)

Usage method

@PV

Explanation

This command outputs the software version.

Example

@PV ← command Input

The following is output:

[PV] 009091_129

2.19 NC command (NMEA sentence output interval setting)

Usage method

@NC dddddddd

d: [0 | 1 | 2 | 5]

Explanation

This command sets the output intervals for individual NMEA sentences (GGA, GLL, GSA, GSV, RMC, VTG, ZDA) and SONY original sentence PSGSA.
The command requires 8 integer values (0, 1, 2, 5). The first number indicates the GGA output interval; the second indicates the GLL output interval; the third indicates the GSA output interval; the fourth indicates the GSV output interval; the fifth indicates the RMC output interval; the sixth indicates the VTG output interval; the seventh indicates the ZDA output interval; and the eighth indicates the PSGSA output interval. There are four different interval settings: 0, 1, 2, and 5. If 0 is set, the message is not output.

If any output interval arguments are not set, the current setting is used. The setting is held internally even if the @CD, @SW, @SS or @SR reset commands are transmitted.
The default setting is 10110111. (GGA, GSA, GSV, VTG, ZDA and PSGSA are output every second; GLL and RMC are not.)

Example

To output GGA every time and output GSA once every two times:

@NC 10200000

2.20 ANT command (reporting the antenna state)

Usage method

@ANT

Explanation

This command reports the antenna state when the antenna sensing function is performed.

[ANT] Normal:	Normal
[ANT] Open:	The antenna is disconnected. Open state.
[ANT] Short:	The antenna connector is shorted
[ANT] Done(OFF):	Antenna sensing is off

Antenna sense is performed at intervals of 1 second. If a short is detected, Port: EPORT12 inverts (from low to high) for about 3 seconds until next sensing. After that, the port output returns to the original level (low) and antenna sensing is performed again.

Note

Antenna sense isn't performed during the sleep state in the low power consumption mode, i.e. the sleep-awake mode. Antenna sense is performed unless the software is in the sleep state.

Example

Reporting the antenna state

@ANT

2.21 WLK command (walking mode setting)

Usage method

@WLK [ON | OFF]

ON: Start walking mode
OFF: Cancel walking mode

Explanation

This command sets the walking mode for the position filter.

If the argument is not set, the current setting is used. The settings are held internally even if the @CD, @SW, @SS or @SR reset commands are transmitted.
The default is off.

Example

Setting the walking mode for the position filter

@WLK ON

2.22 PLM command (low power mode setting)

Usage method

@PLM [0|5..10] [MD|ME] [PD|PE]

T: [0|5..10] interval time of positioning
MD: stop message in interval time
ME: output message in interval time
PD: not control EPORT12 synchronized with sleeping
PE: control EPORT12 synchronized with sleeping

Explanation

This command sets the low power mode.
If the low power mode is requested, the position update will be intermittent as specified.

Interval time settings are 0, 5, 6, 7, 8, 9, 10 [sec]. If 0 is set, the low power mode is terminated and the CXD2951 operates at the normal mode. If ME is set, NMEA messages are generated periodically at 1Hz.. Set MD if NMEA messages are not needed between the positioning updates. If PE is set, Port: EPORT12 level is synchronized with low power operation mode. EPORT12 is HIGH when the CXD2951 is in “inactive” state. When the CXD2951 goes back to the “active” state, the port takes on the previous state before “inactive” state depended on antenna sense function.

If the all arguments are not set, the current setting is reported. If MD or ME, PD or PE is not set, the previous setting is held. Default setting will be selected after the @CD, @SW, @SS or @SR commands. The default values are

Interval time:	0(normal mode)
Message output:	ME
Port control:	PD

Note

This command cannot be used with the sleep-awake mode at the same time. If the sleep-awake mode is set when the low power mode is performed, the low power mode will be cancelled and the sleep-awake mode will be performed.

Do not use @OI, @IND command at the same time.

Example

Setting 10 seconds interval positioning, NEMA messages output in interval time too and port control

@PLM 10 ME PE

2.23 ST command (sleep-awake mode setting)

Usage method

@ST T [MD|ME] [PD|PE]

T: [0|5..10] interval time of positioning
MD: stop message in interval time
ME: output message in interval time
PD: not control EPORT12 synchronized with sleeping
PE: control EPORT12 synchronized with sleeping

Explanation

This command sets sleep-awake mode.
If the sleep-awake mode is performed, the position update will be intermittent as specified.

Interval time settings are 0, 5, 6, 7, 8, 9, 10 [sec]. If 0 is set, the low power mode is terminated and the CXD2951 operates at the normal mode. If ME is set, NMEA messages are generated periodically at 1Hz. Set MD if NMEA messages are not needed between the positioning updates. If PE is set, Port: EPORT12 level is synchronized with low sleep-awake mode operation. EPORT12 is HIGH when the CXD2951 is in "inactive" state. . When the CXD2951 is back in "active" state, the port takes on the previous state before "inactive" state depended on antenna sense function.

If the all argument is not set, the current setting is reported. If MD or ME, PD or PE is not set, the previous setting is held. Default setting selected with the @CD, @SW, @SS or @SR commands. The default values are

Interval time:	0(normal mode)
Message output:	ME
Port control:	PD

Note

This command cannot be used with the low power mode at the same time. If the low power mode is set when the sleep-awake mode is performed, the sleep-awake mode will be cancelled and the low power mode will be performed.

Set this command after the positioning is succeeded. If this mode is set while the positioning is not succeeded, the position will not be succeeded after setting too. And while this mode is performed, the ephemeris data are not updated. Cancel this mode if the non-positioning is continued.

Do not use @OI, @IND command at the same time.

Example

Setting 10 seconds interval positioning, NEMA messages output in interval time too time and port control

```
@ST 10 ME PE
```

2.24 IND command (high sensitivity mode)

Usage method

@IND

Explanation

This command calculates positioning in the high sensitivity mode.
This command performs a hot start reset. And CXD2951 starts positioning in high sensitivity mode on condition that it has initial position, TCXO offset value and five more valid Ephemeris dates.

The following is output in the high sensitivity mode.

[IND] Done (OK)

Otherwise the state has a shortage of information, and the following is output

[IND] done (NG)

2.25 ADC command (A/D data sampling)

Usage method

@ADC [ON | OFF]
ON: start the A/D data sampling
OFF: stop the A/D data sampling

Explanation

This command samples the data from the A/D converter.
If this command is performed, the 10bit A/D converter inside CXD2951 executes data sampling with the frequency setting by @ADS command. The result is reported with $ADOUT sentence wtih every NMEA message output. See 3.3 for the $ADOUT format.

If the argument is not set, the current setting is used. The setting is held internally even if the @CD, @SW, @SS or @SR reset commands are transmitted.
The default value is OFF.

Example

Sampling the A/D data.

@ADC ON

2.26 ADS command (frequency value of the A/D data sampling setting)

Usage method

@ADS freq

freq: frequency value of A/D data sampling

Explanation

This command sets the frequency value of 10bit A/D converter inside of CXD2951 in units of Hz. A setting value is only in integer format.

If the frequency value argument is not set, the current setting is used. The setting is held internally even if the @CD, @SW, @SS or @SR reset commands are transmitted.
The default value is 10.

The setting ranges are as follows:

1 to 100

Example

For setting 50Hz

@ADS 50

Chapter 3 Output Messages

This chapter describes output messages for CXD2951.

CXD2951 outputs messages in NMEA0183 (Ver. 3.01) format.

3.1. NMEA0183 Format

CXD2951 can output 8 different types of sentence: GPGGA, GPGLL, GPGSA, GPGSV, GPRMC, GPVTG, GPZDA and PSGSA. If 9600bps or 19200bps or 38400bps baud rate is set for port setting, it outputs 6 types of sentence: GPGGA, GPGSA, GPGSV, GPVTG, GPZDA, PSGSA as default (fig. 3.1). Moreover, if 4800bps baud rate is set, it outputs 4 types of sentences: GPGGA, GPGSA, GPGSV, GPRMC as default (fig. 3.2).

Please use @NC command (2.18) if output sentence should be needed to change.

Notice: When the baud rate is set for port setting, NMEA message may not be outputted correctly in some cases. In this case, please execute @CLR command (2.11).

For 4800bps baud rate, it cannot output all 8 sentences of NMEA within 1 sec. As a rough guide, select less than 6 sentences for this baud rate.

Single message example

$GPGGA,105512,3536.5981,N,13944.8914,E,1,05,01.7,00100.7,M,039.2,M,,*44
$GPGSA,A,3,08,11,20,28,31,,,,,,,,03.2,01.7,02.7*02
$GPGSV,2,1,08,28,52,298,49,31,34,097,42,04,00,242,27,20,55,152,47*7E
$GPGSV,2,2,08,14,,,00,11,63,033,49,07,,,00,08,15,239,37*7B
$GPVTG,152.1,T,,M,000.0,N,000.0,K,A*0A
$GPZDA,105512,12,11,2003,,*48
$PSGSA,4,11,20,28,31,08,,,,,,,,03.2,01.7,02.7,01685,10551110,H*22

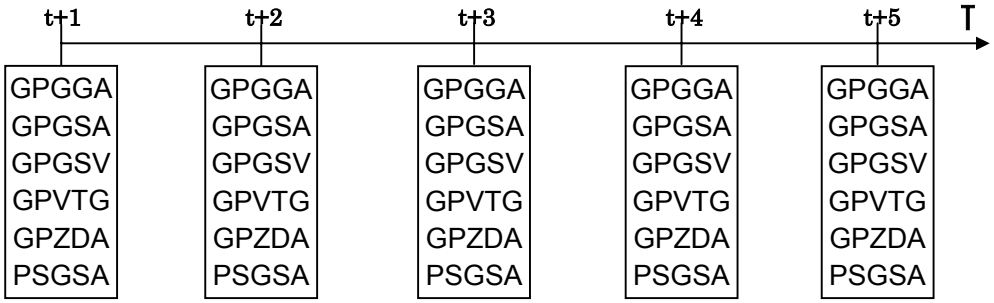

Fig. 3.1 Sentence Output Order

Single message example(at 4800 bps)

$GPGGA,112350,3536.6006,N,13944.8931,E,1,08,00.9,00098.1,M,039.2,M,,*44
$GPGSA,A,3,09,10,17,18,21,26,28,29,,,,,02.1,00.9,01.8*00
$GPGSV,3,1,11,05,02,178,00,08,03,039,00,09,52,208,46,10,34,120,43*77
$GPGSV,3,2,11,15,09,322,26,17,20,175,41,18,28,313,38,21,43,283,48*78
$GPGSV,3,3,11,26,59,023,50,28,18,063,39,29,50,044,45,,,,*46
$GPRMC,112350,A,3536.6006,N,13944.8931,E,000.0,016.2,240304,,,A*7B

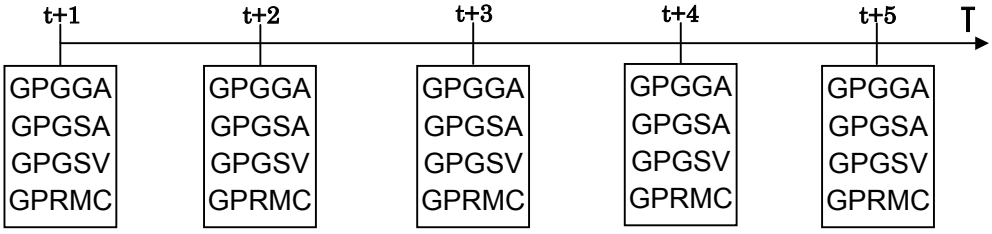

Fig. 3.2 Sentence Output Order (at 4800 bps)

♦GPGGA sentence

– Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPGGA		GGA header
UTC of position	012041		hh: Hours mm: Minutes ss: Seconds
Latitude	3537.1464		dd: ° mm.mmmm: ′ *1
North/South	N		N: North Latitude, S: South Latitude
Longitude	13943.8529		Ddd: ° mm.mmmm: ′ *1
East/West	E		E: East Longitude, W: West Longitude *1
GPS Quality Indicator	2		0: Disabled, 1: GPS positioning, 2: D-GPS positioning
Number of satellites	07		Number of satellites used in positioning calculation (00 to 12)
HDOP	01.2		*2
Altitude	00101.2	meters	*3
Unit	M		Meters
Geoidal separation	039.2	meters	*4
Unit	M		Meters
Age of DGPS data	04	second	Time elapsed since D-GPS reception*5
DGPS reference station ID	0000		
checksum	42		
<CR><LF>			End of sentence

Table 3.1 GPGGA Sentence Format

– Example

$GPGGA,012041,3537.1464,N,13943.8529,E,2,07,01.2,00101.2,M,039.2,M,04,0000*42

– Note

*1 The Longitude is always expressed as 0 degree when the Latitude is 90 degree, and is expressed as Longitude 0(180) degree East when the Longitude is 0(180) degree West.

*2 The DOP value is expressed as two integer digits and one decimal digit. Values 99.9 and higher are expressed as 99.9.

*3 The elevation is expressed as five integer digits and one decimal digit. Values of 99999.9 or more (–99999.9 or less) are expressed as 99999.9 (–99999.9).

*4 The difference from the geoidal surface is expressed as three integer digits and one decimal digit.

*5 The DGPS Age is expressed as two integer digits.

♦GPGLL sentence

– Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPGLL		GLL header
Latitude	3537.1483		dd: ° mm.mmmm: ′
North/South	N		N: North Latitude, S: South Latitude
Longitude	13943.8511		ddd: ° mm.mmmm: ′ *1
East/West	E		E: East Longitude, W: West Longitude *1
UTC of position	034639		hh: Hours mm: Minutes ss: Seconds
Status	A		A: Data valid, V: Data invalid
Mode Indicator	A		A: Autonomous, D: D-GPS, N: Data not valid *2
checksum	41		
<CR><LF>			End of sentence

Table 3.2 GPGLL Sentence format

– Example

$GPGLL,3537.1483,N,13943.8511,E,034639,A,A*41

– Note

*1 The Longitude is always expressed as 0 degree when the Latitude is 90 degree, and is expressed as Longitude 0(180) degree East when the Longitude is 0(180) degree West.

*2 Position system mode indicator

♦GPGSA sentence

– Explanation

Contents	Example	Explanation
Sentence ID	$GPGSA	GSA header
Mode	A	M: Manual, A: Automatic
Positioning mode	3	1: Fix not available, 2: 2D, 3: 3D
Satellite ID number	05	ID number of satellite used in solution
Satellite ID number	06	ID number of satellite used in solution
…		Display of quantity used (12 max)
PDOP	01.6	*
HDOP	01.0	*
VDOP	01.3	*
checksum	05	
<CR><LF>		End of sentence

Table 3.3 GPGSA Sentence Format

– Example

$GPGSA,A,3,05,06,09,14,18,23,25,30,,,,,01.6,01.0,01.3*05

– Note

* The DOP value is expressed as two integer digits and one decimal digit. Values 99.9 and higher are expressed as 99.9.

♦GPGSV sentence

– Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPGSV		GSV header
Total number of sentences	2		Total number of GSV sentences output (1 to 9) *1
Sentence number	1		Sequence number within total number (1 to 9)
Total number of satellites in view	08		Number of satellites visible from receiver
Satellite ID number	05		Satellite ID (01 to 32) *2
Elevation	61	degrees	Elevation angle of satellite as seen from receiver (00 to 90)
Azimuth	056	degrees	Satellite azimuth as seen from receiver (000 to 359)
SNR (C/N)	35	dBHz	Received signal level C/N (00 to 99) *3
…			
Satellite ID number	14		Write for four satellites
Elevation	52	degrees	
Azimuth	321	degrees	
SNR (C/N)	42	dBHz	
checksum	70		
<CR><LF>			End of sentence

Table 3.4 GPGSV Sentence Format

– Example

$GPGSV,2,1,08,05,61,056,35,06,12,158,41,09,23,066,41,14,52,321,42*70

– Note

*1 For 4800 bps, the maximum output lines are 3 lines.
*2 It is outputted in order of Satellite ID number.
*3 “00” when not tracking

♦GPRMC sentence

– Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPRMC		RMC header
UTC of position	093931		hh: Hours mm: Minutes ss: Seconds
Status	A		A: Data valid, V: Data invalid
Latitude	3536.5987		dd: ° mm.mmmm: ′
North/South	N		N: North Latitude, S: South Latitude
Longitude	13944.8905		ddd: ° mm.mmmm: ′ *1
East/West	E		E: East Longitude, W: West Longitude *1
Speed over ground	000.0	knots	Receiver's speed *2
Course over ground	090.7	degrees	Receiver's direction of travel Moving clockwise starting at due north
Date	241203		dd: Day, mm: Month, yy: Year
Magnetic variation		degrees	*3
East/West			E: East, W: West *3
Mode Indicator	A		A: Autonomous, D: D-GPS, N: Data not valid *4
checksum	76		
<CR><LF>			End of sentence

Table 3.5 GPRMC Sentence Format

– Example

$GPRMC,093931,A,3536.5987,N,13944.8905,E,000.0,090.7,241203,,,A*76

– Note

*1 The Longitude is always expressed as 0 degree when the Latitude is 90 degree, and is expressed as Longitude 0(180) degree East when the Longitude is 0(180) degree West.
*2 The Speed over ground is expressed as three integer digits and one decimal digit. Values 999.9 and higher are expressed as 999.9.
*3 Travel direction (Degree Magnetic) is not output.
*4 Positioning system mode indicator

♦GPVTG sentence

– Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPVTG		VTG header
Course over ground	275.6	degrees	Receiver's direction of travel Moving clockwise starting at due north
	T		
Course over ground		degrees	Receiver's direction of travel*1
	M		
Speed over ground	000.0	knots	Receiver's speed (knots) *2
Unit	N		knots
Speed over ground	000.0	km/h	Receiver's speed (km/h) *2
Unit	K		km/h
Mode Indicator	A		A: Autonomous, D: D-GPS, N: Data not valid *3
checksum	0B		
<CR><LF>			End of sentence

Table 3.6 GPVTG Sentence Format

– Example

$GPVTG,275.6,T,,M,000.0,N,000.0,K,A*0B

– Note

*1 Travel direction (Magnetic Degrees) is not output.
*2 The Speed over ground is expressed as three integer digits and one decimal digit. Values 999.9 and higher are expressed as 999.9.
*3 Positioning system mode indicator

♦GPZDA sentence

– Explanation

Contents	Example	Unit	Explanation
Sentence ID	$GPZDA		ZDA header
UTC	105512		UTC time
Day	12		Day according to UTC time
Month	11		Month according to UTC time
Year	2003		Year according to UTC time
Local zone hours		hour	*
Local zone minutes		minute	*
checksum	48		
<CR><LF>			End of sentence

Table 3.7 GPZDA Sentence Format

– Example

$GPZDA,105512,12,11,2003,,*48

– Note

* Local zone hours and Local zone minutes are not output.

♦PSGSA sentence (CXD2951 original)

– Explanation

Contents	Example	Unit	Explanation
Sentence ID	$PSGSA		PSGSA header
Positioning mode	4		See Table 3.9
Calculation satellite ID	11		Satellite ID number used in speed calculation
Calculation satellite ID	23		Satellite ID number used in speed calculation
…			Display quantity of satellite used (12 max)
PDOP	01.5		Speed calculation PDOP *1
HDOP	00.9		Speed calculation HDOP *1
VDOP	01.2		Speed calculation VDOP *1
TCXO offset value	01682	Hz	*2
Positioning calculation time	10270708		hhmmssxx hh:Hours mm: Minutes ss:seconds xx:0.01seconds Time determined in positioning calculation
SONY Reserve	D		Reserved
checksum	29		
<CR><LF>			End of message

Table 3.8 PSGSA Sentence Format

Value	Explanation
0	Speed non-positioning
1	2D speed positioning
2	Pseudo 3D speed positioning
3	3D speed positioning

Table 3.9 Positioning Modes

– Example

$PSGSA,4,11,23,27,03,08,28,20,31,,,,,01.5,00.9,01.2,01682,10270708,D*29

– Note

*1 The DOP value is expressed as two integer digits and one decimal digit. Values 99.9 and higher are expressed as 99.9.

*2 The TCXO offset value is expressed as five integer digits. Values 99999(-99999) and higher(lower) expressed as 99999(-99999).

3.2. NMEA Message Data Output Specifications

The following table describes the output data configurations in the following positioning states: immediately after cold start, during positioning, during non-positioning and after positioning. See "3.1. NMEA0183 Format" for the output contents of individual sentences.

♦GPGGA sentence

Contents	After cold start	During positioning	During non-positioning
UTC of position	default (00:00:00)	UTC	UTC
Latitude	null	Positioning results	Previous value
North/South	N	Positioning results	Previous value
Longitude	null	Positioning results	Previous value
East/West	E	Positioning results	Previous value
GPS Quality Indicator	0	1 or 2	0
Number of satellites	00	Positioning results	00
HDOP	null	Positioning results	null*
Altitude	null	Positioning results	Previous value
Geoidal separation	null	Positioning results	Previous value
Age of DGPS data	null	null/DGPS information	null/DGPS information
DGPS reference station ID	null	null/DGPS information	null/DGPS information

Table 3.10 GPGGA Sentence Data Output List

* Non-positioning results are based on DOP limit restrictions. So, the DOP value is displayed.

♦GPGLL sentence

Contents	After cold start	During positioning	During non-positioning
Latitude	null	Positioning results	Previous value
North/South	N	Positioning results	Previous value
Longitude	null	Positioning results	Previous value
East/West	E	Positioning results	Previous value
UTC of position	default (00:00:00)	UTC	UTC
Status	V	A	V
Mode Indicator	N	A or D	N

Table 3.11 GPGLL Sentence Data Output List

♦GPGSA sentence

Contents	After cold start	During positioning	During non-positioning
Mode	A	A	A
Positioning mode	1	2 or 3	1
Satellite ID number	null	Positioning results	null
PDOP	null	Positioning results	null*
HDOP	null	Positioning results	null*
VDOP	null	Positioning results	null*

Table 3.12 GPGSA Sentence Data Output List

* Non-positioning results are based on DOP limit restrictions. So, the DOP value is displayed.

♦GPGSV sentence

Contents	After cold start	During positioning	During non-positioning
Total number of sentences	1	Calculation results	Calculation results
Sentence number	1	Calculation results	Calculation results
Number of satellites in view	00	Calculation results	Calculation results
Satellite ID number	null	Calculation results	Calculation results
Elevation	null	Calculation results	Calculation results
Azimuth	null	Calculation results	Calculation results
SNR(C/N)	null	Calculation results	Calculation results

Table 3.13 GPGSV Sentence Data Output List

♦GPRMC sentence

Contents	After cold start	During positioning	During non-positioning
UTC of position	default (00:00:00)	UTC	UTC
Status	V	A	V
Latitude	null	Positioning results	Previous value
North/South	N	Positioning results	Previous value
Longitude	null	Positioning results	Previous value
East/West	E	Positioning results	Previous value
Speed over ground	null	Positioning results	Previous value
Course over ground	null	Positioning results	Previous value
Date	default (010303)	UTC	UTC
Magnetic variation	null	null	null
East /West	null	null	null
Mode Indicator	N	A or D	N

Table 3.14 GPRMC Sentence Data Output List

♦GPVTG sentence

Contents	After cold start	During positioning	During non-positioning
Course (True)	null	Positioning results	Previous value
Course (Magnetic)	null	null	null
Speed (knot)	null	Positioning results	Previous value
Speed (km/h)	null	Positioning results	Previous value
Mode Indicator	N	A or D	N

Table 3.15 GPVTG Sentence Data Output List

♦GPZDA sentence

Contents	After cold start	During positioning	During non-positioning
UTC	default (00:00:00)	UTC	UTC
Day	default (01)	UTC	UTC
Month	default (03)	UTC	UTC
Year	default (2003)	UTC	UTC
Local zone hours	null	null	null
Local zone minutes	null	null	null

Table 3.16 GPZDA Sentence Data Output List

♦PSGSA message

Contents	After cold start	During positioning	During non-positioning
Positioning mode	0	1 or 2 or 3	0
Calculation satellite ID	null	Positioning results	null
PDOP	Calculation results	Positioning results	null*
HDOP	Calculation results	Positioning results	null*
VDOP	Calculation results	Positioning results	null*
TCXO offset value	00000	Positioning results	Previous value

Table 3.17 PSGSA Sentence Data Output List

* During non-positioning based on DOP limit restrictions, the DOP value is displayed.

3.3. Output format of A/D data sampling result

♦ADOUT Sentence (CXD2951 Original)

Contents	Example	Unit	Explanation
Sentence ID	$ADOUT		ADOUT Header
Sampling Frequency	010	Hz	*1
AD0	051211		Output average value of A/D converter CH0 *2
AD1	051211		Output average value of A/D converter CH1 *2
AD2	051211		Output average value of A/D converter CH2 *2
AD3	051211		Output average value of A/D converter CH3 *2
Checksum	4D		
<CR><LF>			Sentence end

Table 3.18 ADOUT Sentence Format

– Example

$ADOUT,010,051211,051211,051211,*4D

– Note

*1 Sampling frequency value is expressed as three integer digits.
*2 The Output average value is expressed as six integer digits. Data resolution is 0.01.
ex.123456 → 1234.56

3.4. NMEA Message Output Timing

NMEA messages are output within 1 s after the 1PPS pulse as shown in Fig. 3.3.

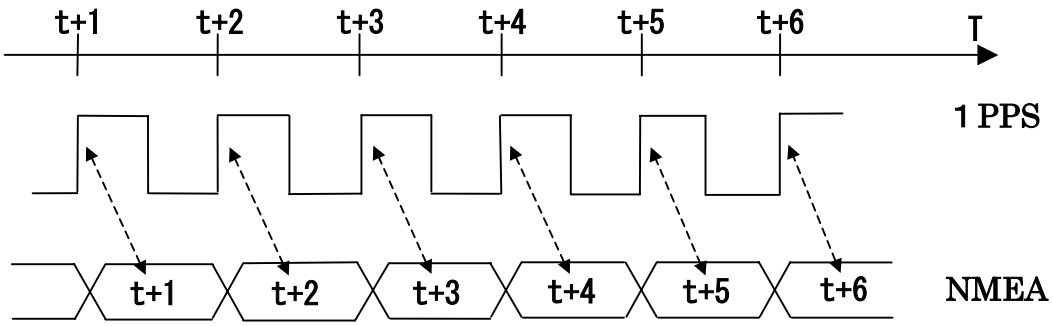

Fig. 3.3 NMEA Output Timing relative to 1PPS

Chapter 4 Output Data Formats

This chapter explains the CXD2951 output data formats.

4.1. Almanac Data

Almanac data is input/output using the AM command. This data is stored in sub-frames 4 and 5 of a navigation message. The parity part of this message is deleted, and two CRC bytes are added at end of each line. The data is also arranged by satellite ID. There are a total of 64 lines, with 32 bytes per line (*).

* Binary data should be converted to text for sending and receiving, so a single line ends up containing 64 bytes.

Table 4.1 presents the contents written to each line.

Line	Satellite ID	Description	Reference
1	0	Not used during data input	
2 to 33	1 to 32	Almanac data for each satellite	Fig. 4.1
34 to 51	33 to 50	Not used during data input	
52	51	Health	Fig. 4.2
53	52	Not used during data input	
54 to 56	53 to 55	Not used during data input	
57	56	IONO, UTC	Fig. 4.3
58 to 63	57 to 62	Not used during data input	
64	63	Health, etc.	Fig. 4.4

Table 4.1 Almanac Data

See ICD-GPS-200C for further details on the contents.

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	TLM (22bits) (10001011 fixed)							
2								
3							C (2bits)	
4	HOW (22bits)							
5								
6							t (2bits)	
7	DATA ID (2bits)		SV ID (6bits)					
8	e (16bits)							
9								
10	t_{oa} (8bits)							
11	δ_j (16bits)							
12								
13	$\dot{\Omega}$ (16bits)							
14								
15	SV HEALTH (8bits)							
16	$A^{1/2}$ (24bits)							
17								
18								
19	Ω_0 (24bits)							
20								
21								
22	ω (24bits)							
23								
24								
25	M_0 (24bits)							
26								
27								
28	a_{f0} (8MSbits) -total 11bits-							
29	a_{f1} (11bits)							
30				a_{f0} (3LSbits)			t (2bits)	
31	CRC (16bits)							
32								

t: Complementary data for parity check
C: Bits 23 and 24 of TLM (reserved)
□: Not used during data input ■: Required during data input

Fig. 4.1 Almanac data for each satellite

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	TLM (22bits) (10001011 fixed)							
2								
3							C (2bits)	
4	HOW (22bits)							
5								
6							t (2bits)	
7	DATA ID (2bits)		SV ID (6bits)					
8	t_{oa} (8bits)							
9	WN_a (8bits)							
10	SV1 HEALTH (6bits)						SV2 HEALTH	
11	(6bits)				SV3 HEALTH (6bits)			
12			SV4 HEALTH (6bits)					
13	SV5 HEALTH (6bits)						SV6 HEALTH	
14	(6bits)				SV7 HEALTH (6bits)			
15			SV8 HEALTH (6bits)					
16	SV9 HEALTH (6bits)						SV10 HEALTH	
17	(6bits)				SV11 HEALTH (6bits)			
18			SV12 HEALTH (6bits)					
19	SV13 HEALTH (6bits)						SV14 HEALTH	
20	(6bits)				SV15 HEALTH (6bits)			
21			SV16 HEALTH (6bits)					
22	SV17 HEALTH (6bits)						SV18 HEALTH	
23	(6bits)				SV19 HEALTH (6bits)			
24			SV20 HEALTH (6bits)					
25	SV21 HEALTH (6bits)						SV22 HEALTH	
26	(6bits)				SV23 HEALTH (6bits)			
27			SV24 HEALTH (6bits)					
28	reserved (3bits)			reserved (19bits)				
29								
30							t (2bits)	
31	CRC (16bits)							
32								

t: Complementary data for parity check
C: Bits 23 and 24 of TLM (reserved)
□: Not used during data input ■: Required during data input

Fig. 4.2 Health information

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	TLM (22bits) (10001011 fixed)							
2								
3							C (2bits)	
4	HOW (22bits)							
5								
6							t (2bits)	
7	DATA ID (2bits)		SV (PAGE) ID (6bits)					
8	α_0 (8bits)							
9	α_1 (8bits)							
10	α_2 (8bits)							
11	α_3 (8bits)							
12	β_0 (8bits)							
13	β_1 (8bits)							
14	β_2 (8bits)							
15	β_3 (8bits)							
16	A_1 (24bits)							
17								
18								
19	A_0 (32bits)							
20								
21								
22								
23	t_{ot} (8bits)							
24	WN_t (8bits)							
25	Δt_{LS} (8bits)							
26	WN_{LSF} (8bits)							
27	DN (8bits)							
28	Δt_{LSF} (8bits)							
29	reserved (14bits)							
30							t (2bits)	
31	CRC (16bits)							
32								

t: Complementary data for parity check
C: Bits 23 and 24 of TLM (reserved)
□: Not used during data input ■: Required during data input

Fig. 4.3 UTC and ion layer correction data

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	TLM (22bits) (10001011 fixed)							
2								
3							C (2bits)	
4	HOW (22bits)							
5								
6							t (2bits)	
7	DATA ID (2bits)		SV (PAGE) ID (6bits)					
8	SV1 A-SPOOF & SV CONFIG (4bits)				SV2 A-SPOOF & SV CONFIG (4bits)			
9	SV3 A-SPOOF & SV CONFIG (4bits)				SV4 A-SPOOF & SV CONFIG (4bits)			
10	SV5 A-SPOOF & SV CONFIG (4bits)				SV6 A-SPOOF & SV CONFIG (4bits)			
11	SV7 A-SPOOF & SV CONFIG (4bits)				SV8 A-SPOOF & SV CONFIG (4bits)			
12	SV9 A-SPOOF & SV CONFIG (4bits)				SV10 A-SPOOF & SV CONFIG (4bits)			
13	SV11 A-SPOOF & SV CONFIG (4bits)				SV12 A-SPOOF & SV CONFIG (4bits)			
14	SV13 A-SPOOF & SV CONFIG (4bits)				SV14 A-SPOOF & SV CONFIG (4bits)			
15	SV15 A-SPOOF & SV CONFIG (4bits)				SV16 A-SPOOF & SV CONFIG (4bits)			
16	SV17 A-SPOOF & SV CONFIG (4bits)				SV18 A-SPOOF & SV CONFIG (4bits)			
17	SV19 A-SPOOF & SV CONFIG (4bits)				SV20 A-SPOOF & SV CONFIG (4bits)			
18	SV21 A-SPOOF & SV CONFIG (4bits)				SV22 A-SPOOF & SV CONFIG (4bits)			
19	SV23 A-SPOOF & SV CONFIG (4bits)				SV24 A-SPOOF & SV CONFIG (4bits)			
20	SV25 A-SPOOF & SV CONFIG (4bits)				SV26 A-SPOOF & SV CONFIG (4bits)			
21	SV27 A-SPOOF & SV CONFIG (4bits)				SV28 A-SPOOF & SV CONFIG (4bits)			
22	SV29 A-SPOOF & SV CONFIG (4bits)				SV30 A-SPOOF & SV CONFIG (4bits)			
23	SV31 A-SPOOF & SV CONFIG (4bits)				SV32 A-SPOOF & SV CONFIG (4bits)			
24	reserved (2bits)		SV25 HEALTH (6bits) v					
25	SV26 HEALTH (6bits)						SV27 HEALTH	
26					SV28 HEALTH (6bits)			
27			SV29 HEALTH (6bits)					
28	SV30 HEALTH (6bits)						SV31 HEALTH	
29	(6bits)				SV32 HEALTH (6bits)			
30			reserved (4bits)				t (2bits)	
31	CRC (16bits)							
32								

t: Complementary data for parity check
C: Bits 23 and 24 of TLM (reserved)
□: Not used during data input ■: Required during data input

Fig. 4.4 Health information 2

4.2. Ephemeris Data

Ephemeris data is input/output using the EM command. This data is stored in sub-frames 1, 2, and 3 of the navigation message. The parity part of this message is deleted, and two CRC bytes are added at the end of each line. The data is also arranged by satellite ID. There are three lines per satellite with 32 bytes per line (*), so there are 96 lines for 32 satellites.

For each satellite, sub-frame 1 is written on the first line, sub-frame 2 on the second line, and sub-frame 3 on the third line. Their respective contents are presented in Figs. 4.5, 4.6, and 4.7.

* Binary data should be converted to text for sending and receiving, so a single line ends up containing 64 bytes.

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	TLM (22bits) (10001011 fixed)							
2								
3							C (2bits)	
4	HOW (22bits)							
5								
6							t (2bits)	
7	WN (10bits)							
8			C/AorPonL2 (2bits)		URA INDEX (4bits)			
9	SV HEALTH (6bits)						IODC (2MSbits)	
10	L (1bit)	reserved (87bits)						
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21	T_{GD} (8bits)							
22	IODC (8LSbits) -TOTAL 10bits-							
23	t_{oc} (16bits)							
24								
25	a_{f2} (8bits)							
26	a_{f1} (16bits)							
27								
28	a_{f0} (22bits)							
29								
30							t (2bits)	
31	CRC (16bits)							
32								

L: L2P DATA FLAG
t: Complementary data for parity check
C: Bits 23 and 24 of TLM (reserved)
□: Not used during data input ■: Required during data input

Fig. 4.5 First line (sub-frame 1)

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	TLM (22bits) (10001011 fixed)							
2								
3							C (2bits)	
4	HOW (22bits)							
5								
6							t (2bits)	
7	IODE (8bits)							
8	C_{rs} (16bits)							
9								
10	Δn (16bits)							
11								
12	M_0 (32bits)							
13								
14								
15								
16	C_{UC} (16bits)							
17								
18	e (32bits)							
19								
20								
21								
22	C_{US} (16bits)							
23								
24	$A^{1/2}$ (32bits)							
25								
26								
27								
28	t_{oe} (16bits)							
29								
30	F (1bit)	AODO (5bits)					t (2bits)	
31	CRC (16bits)							
32								

F: FIT INTERVAL FLAG
t: Complementary data for parity check
C: Bits 23 and 24 of TLM (reserved)
□: Not used during data input ■: Required during data input

Fig. 4.6 Second line (sub-frame 2)

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	TLM (22bits) (10001011 fixed)							
2								
3							C (2bits)	
4	HOW (22bits)							
5								
6							t (2bits)	
7	C_{ic} (16bits)							
8								
9	Ω_0 (32bits)							
10								
11								
12								
13	C_{is} (16bits)							
14								
15	i_0 (32bits)							
16								
17								
18								
19	C_{rc} (16bits)							
20								
21	ω (32bits)							
22								
23								
24								
25	$\dot{\Omega}$ (24bits)							
26								
27								
28	IODE (8bits)							
29	IDOT (14bits)							
30							t (2bits)	
31	CRC (16bits)							
32								

t: Complementary data for parity check
C: Bits 23 and 24 of TLM (reserved)
□: Not used during data input ■: Required during data input

Fig. 4.7 Third line (sub-frame 3)

4.3. Assistance Data

Assistance data is input/output using the AS command. This data is the minimum data required for realizing Network-Assisted GPS. The time, position, and Ephemeris data are required in order to perform positioning rapidly from a cold start state. Time and position are written on the first line of the data structure presented in Fig. 4.8, and Ephemeris data is written separately for each satellite on the second and subsequent lines (Figs. 4.9 and 4.10). *

For further details, see “3GPP TS 04.31”and “ETSI TS 101 109”.

* Binary data should be converted to text for sending and receiving.

♦GSM Time Present

– **Data range**

0–1 (1bit)

– **Explanation**

Flag indicating whether “GSM Time” is included in the subsequent data. Currently “GSM Time” is not supported, so this flag is always set to “0”.

♦GPS Week

– **Data range**

0–1023 (10bits)

– **Explanation**

Cumulative number of weeks from August 22, 1999.

♦GPS TOW

– **Data range**

0–604799.92 (23bits)

– **Data resolution**

0.08

– **Unit**

sec

– **Explanation**

Counter which is reset every week. It counts the cumulative time every 0.08 second from 00:00:00 on Sunday.

♦Type of Shape

– Data range

1000 (4bits)

– Explanation

The format of the subsequent reference location. Currently only "1000" is supported.

♦Sign of Latitude

– Data range

0–1 (1bit)

– Explanation

Indicates North Latitude or South Latitude.
0: North Latitude
1: South Latitude

♦Latitude

– Data range

0–8388607 (23bits)

– Explanation

Indicates a value of N when the following expression is satisfied relative to the latitude (in degrees):

$N \leqq Lat \times 2^{23}/90 < N+1$

♦Longitude

– Data range

0–16777314 (24bits)

– Explanation

Indicates a value for N when the following expression is satisfied relative to the longitude (in degrees):

$N \leqq Lon \times 2^{24}/360 < N+1$

♦D (sign of Altitude)

– **Data range**

0–1 (1bit)

– **Explanation**

Indicates whether the elevation value represents height (positive elevation) or depth (negative elevation).
0: Height
1: Depth

♦Altitude

– **Data range**

0–32767 (15bits)

– **Unit**

meter

– **Explanation**

Indicates a value for N when the following expression is satisfied relative to the altitude (in meters):
$N \leqq a < N+1$

♦Number of Satellite Total

– **Data range**

1-16 (4bits)

– **Explanation**

Total number of satellites in the subsequent Ephemeris data.

♦Satellite ID

– **Data range**

1–32 (6bits)

– **Explanation**

The satellite ID number in the subsequent Ephemeris data.

♦Satellite Status

– Data range

0–3 (2bits)

– Explanation

0: Newly input navigation model data for newly input satellite
1: Newly input navigation model data for previously input satellite
2: Previously inputted navigation model data for the last input satellite
3: Reserved

"0" is always set for output using the @ASO command. "0" and "1" are valid for data input using the @ASI command, but if "2" or "3" is set, the navigation model is not used.

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	GTP (1bit)	GPS Week (10bits)						
2				GPS TOW (23bits)				
3								
4								
5			Space (2bits)		Shape (4bits) (1000)			
6	Spare (4bits)				S (1bit)	Latitude (23bits)		
7								
8								
9					Longitude (24bits)			
10								
11								
12					D (1bit)	Altitude (15bits)		
13								
14					Num_Sats_Total (4bits)			
15	CRC (16bits)							
16								

□: Not used during data input ■: Required during data input

Fig. 4.8 Assistance data

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	SatID (6bits)						Status (2bits)	
2	C/A (2bits)		URA Index (4bits)				SV Health (6bits)	
3					IODC (10bits)			
4							L2P (1bit)	
5	Reserved (87bits)							
6								
7								
8								
9								
10								
11								
12								
13								
14								
15							Tgd (8bits)	
16							Toc (16bits)	
17								
18							Af2 (8bits)	
19							Af1 (16bits)	
20								
21							Af0 (22bits)	
22								
23								
24					Crs (16bits)			
25								
26					Delta n (16bits)			
27								
28					Mo (32bits)			
29								
30								
31								
32					Cuc (16bits)			
33								
34					e (32bits)			
35					Space (4bits)			
36	CRC (16bits)							
37								

Fig. 4.9 Ephemeris data

word	8bit	7bit	6bit	5bit	4bit	3bit	2bit	1bit
1	e (32bits)							
2								
3								
4	Cus (16bits)							
5								
6	A^1/2 (32bits)							
7								
8								
9								
10	Toe (16bits)							
11								
12	F (1bit)	AOD0 (5bits)					Cic (16bits)	
13								
14							OMEGA0 (32bits)	
15								
16								
17								
18							Cis (16bits)	
19								
20							Io (32bits)	
21								
22								
23								
24							Crc (16bits)	
25								
26							Omega (32bits)	
27								
28								
29								
30							OMEGAdot	
31	(24bits)							
32								
33							Idot (14bits)	
34								
35					Spare (4bits)			
36	CRC (16bits)							
37								

Fig. 4.10 Ephemeris data 2

CXD2951 Communication
Command Specifications

Sony Corporation