

16-Channel GPS Receiver Module

Description

The GXB2000 is a 16-channel GPS receiver module. The GXB2000 is a small and light device, and it includes all the functions required for GPS except for the antenna.

The GXB2000 can be support the various kinds of the portable applications as well as the car navigation system.

Features

- 16-channel GPS receiver capable of simultaneously receiving 16 satellites
- All-in-view measurement
- 2-satellite measurement
- D-GPS (Differential GPS)
 - RTCM SC104 version 2.1
 - DARC BTA R-003 standard
- Low current consumption (270mW, Typ)
- Small and light package type
- The countermeasure of EMI (electromagnetic wave impediment)

Recommended Operating Conditions

- Supply voltage (3V spec.) V_{DD} 3.0 to 3.6 V
- (5V spec.) V_{CC} 4.5 to 5.5 V
- Operating temperature T_{opr} -40 to +85 °C

GPS (Global Positioning System) is the position measurement system that the U.S. control and operate. It have some possibility of the position measurement deterioration that depends on the working GPS.
It dose not gurantee the standard,etc in this material including the case above.

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Specification

Specification of reception unit

| | | |
|---------------------------|---------------------------|---|
| Reception method | | Parallel 16 channels |
| RF input | Reception frequency | 1575.42MHz L1 band, C/A code |
| | Characteristics impedance | 50Ω |
| | Reception sensitivity | -130dBm or less (Sony's recommended antenna input level) |
| Positioning system | | WGS-84 |
| Positioning accuracy | Position | 100m 2DRMS (SA ON, PDOP = 2.5, HDOP = 1.5) |
| | Velocity | 0.9m/s (SA ON, PDOP = 2.5, HDOP = 1.5) |
| Positioning condition | | A) DOP limit 3D: PDOP ≤ 12 2D: HDOP ≤ 6 B) Elevation mask: 5° or more |
| Follow-up performance | Velocity | 500km/h or less |
| | Acceleration | 2G or less |
| Measured data update time | | Every 1s |
| D-GPS function | | DARC BTA R-003 standard RTCM SC104 version 2.1 (6 of 8 format) Using type 1 data for correct calculation |
| Measurement method | | All-in-view measurement 2-satellite measurement |

TTF (No signal break) *1

Hot Start (time, position, with ephemeris and almanac)

7 to 20s

Warm Start (time, position, without ephemeris, with almanac)

33 to 50s

Cold Start (time, position, without ephemeris and almanac)

35 to 60s

Reacquisition Time (interrupt recovery time)

The case of the interrupt less than 5 minutes 2 to 6s

The case of the interrupt more than 5 minutes 6 to 10s

*1 Condition: The case of meeting positioning condition and receiving 8 satellites continuously and normally.

Conditions of Cold Start

Abnormal RAM data and abnormal RTC data for the command input

RF input connector

JST: CN connector

I/O connector (Power supply, data mode)

JST: SM10B-SRSS

Communication Specification

| | |
|----------------------------|----------------------------------|
| Communication method | Start-stop synchronization |
| Transfer rate input/output | 9600bps |
| Electric level | TTL level |
| I/O code | ASCII code |
| Communication format | Sony/NMEA0183 switching possible |

Electrical Specification

| | |
|----------------------------|--|
| Supply voltage (3V spec.) | 3.1 to 3.6V Ripple 50mVp-p or less |
| (5V spec.) | 4.5 to 5.5V Ripple 50mVp-p or less |
| Current consumption | 82mA typ. (Vcc = 3.3V, 25°C) |
| Backup supply voltage | 1.8 to 3.0V |
| current | 30μA typ. (+B = 3.0V, 25°C) 70μA max. (+B = 3.0V, 85°C) |
| Pre-amplifier power supply | 2.7 to 3.6V, 10 to 30mA |
| Operating temperature | -40 to +85°C |

I/O Connector Pin

Pin Configuration

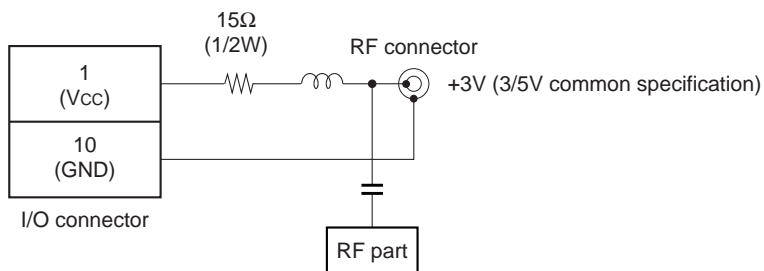
| Pin No. | Symbol | I/O | Description |
|---------|--------|-----|--|
| 1 | Vcc | — | Main power supply. |
| 2 | RESET | I | Reset input for initializing the reception unit. |
| 3 | TXD0 | O | Measured data output. |
| 4 | RXD0 | I | Command input. |
| 5 | RXD1 | I | D-GPS data input. |
| 6 | MODE | I | Communication format switching pin. (L = Sony, H = NMEA0183) |
| 7 | NC | — | No connection. |
| 8 | +BU | — | Power supply for backup. |
| 9 | NC | — | Fixed H level. |
| 10 | GND | — | GND |

Electrical Characteristics

(Topr = -40 to +85°C)

| Item | Symbol | Conditions | Min. | Typ. | Max. | Unit | Applicable pins |
|-------------------------------|----------|-----------------|------------------------|-----------------------|--------------------|------|-----------------|
| Supply voltage | 3V spec. | V _{DD} | 3.0 | 3.3 | 3.6 | V | 1 |
| | 5V spec. | V _{CC} | 4.5 | 5.0 | 5.5 | | |
| Input voltage | H level | V _{IH} | 0.7V _{DD} | | 5.5 | V | 2, 4, 5 |
| | L level | V _{IL} | | | 0.2V _{DD} | | |
| Output voltage | H level | V _{OH} | I _{OH} = -4mA | V _{DD} - 0.8 | | V | 3 |
| | L level | V _{OL} | I _{OL} = 4mA | | 0.4 | | |
| Backup supply voltage | | | 1.8 | | 3.0 | V | 8 |
| Current consumption at backup | | +BU = 3V | 5 | 30 | 70 | μA | 8 |

Antenna Pre-amplifier Power Supply Circuit



Sony Recommend Antenna Specification

Antenna part

| | |
|------------------|---|
| Center frequency | 1575.42MHz |
| Polarization | Right handed circular polarization |
| Gain | -5dBi or more (5° ≤ Angle of elevation) |
| Axis ratio | 3dB typ. (Angle of elevation = 90°) |

Pre-amplifier part

| | |
|-------------------|-----------------------------------|
| Gain | 22dB or more (without cable loss) |
| Noise figure (NF) | 2.5dB or less |

All-round specification (antenna + pre-amplifier + cable loss)

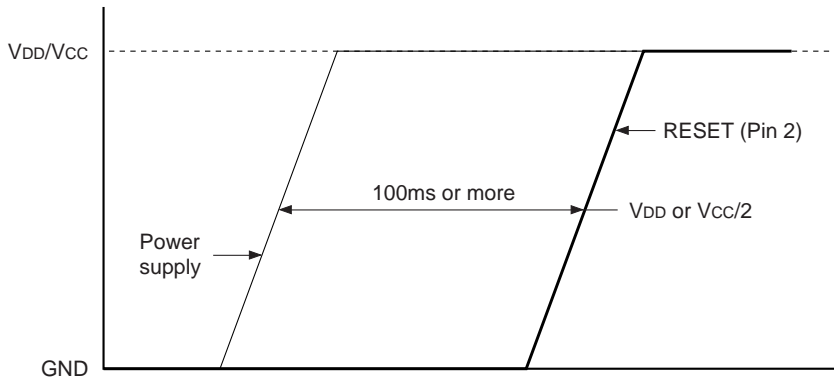
| | |
|---------------------|--|
| Gain | 17dBi or more (Angle of elevation = 90°) |
| Output impedance | 50Ω |
| Output VSWR | 2.0 or less |
| Supply voltage | 2.8 to 3.2V |
| Current consumption | 30mA or less |

Reception Unit Initialization and Operation

The GXB2000 operation is started by setting the reset input signal RESET (Pin 2) for the reception unit initialization to high level. The timing should satisfy the conditions noted below.

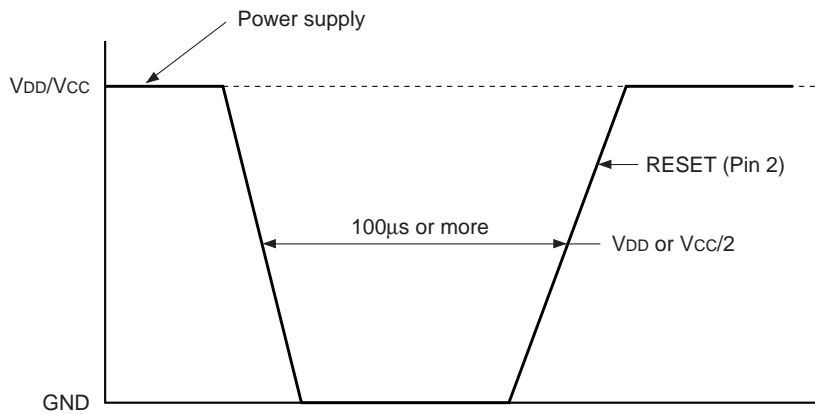
During Power-on (power-on reset)

$V_{DD} = 3.0$ to $3.6V$, $V_{CC} = 4.5$ to $5.5V$, temperature = -40 to $+85^{\circ}C$

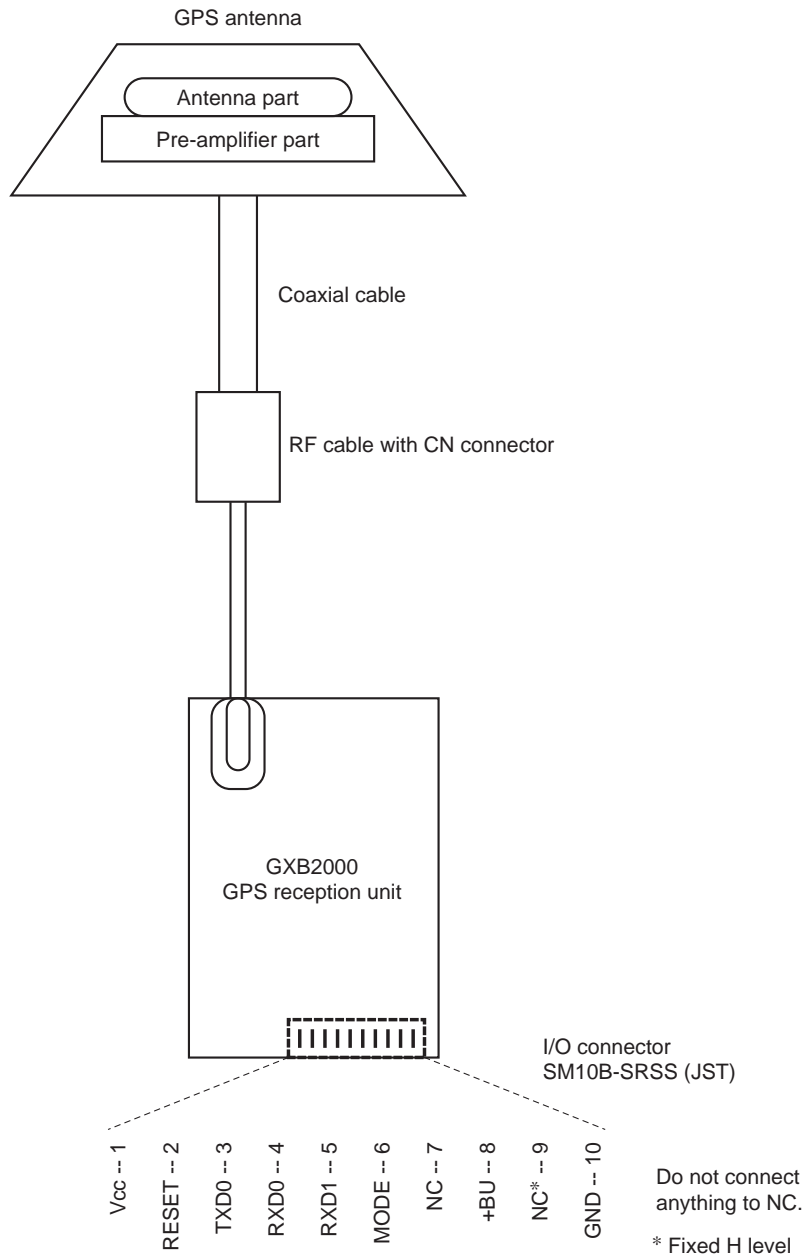


Initialization During Operation

$V_{DD} = 3.0$ to $3.6V$, $V_{CC} = 4.5$ to $5.5V$, temperature = -40 to $+85^{\circ}C$

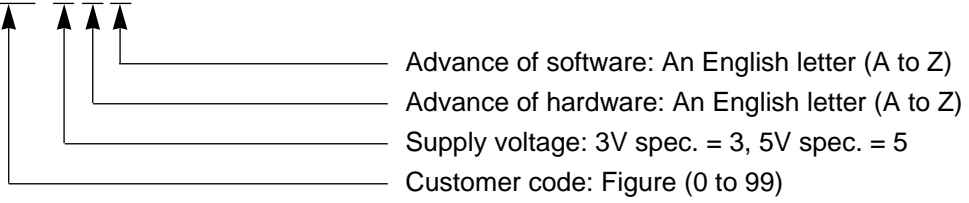


GXB2000 GPS Reception Unit Composition



Specification of form name

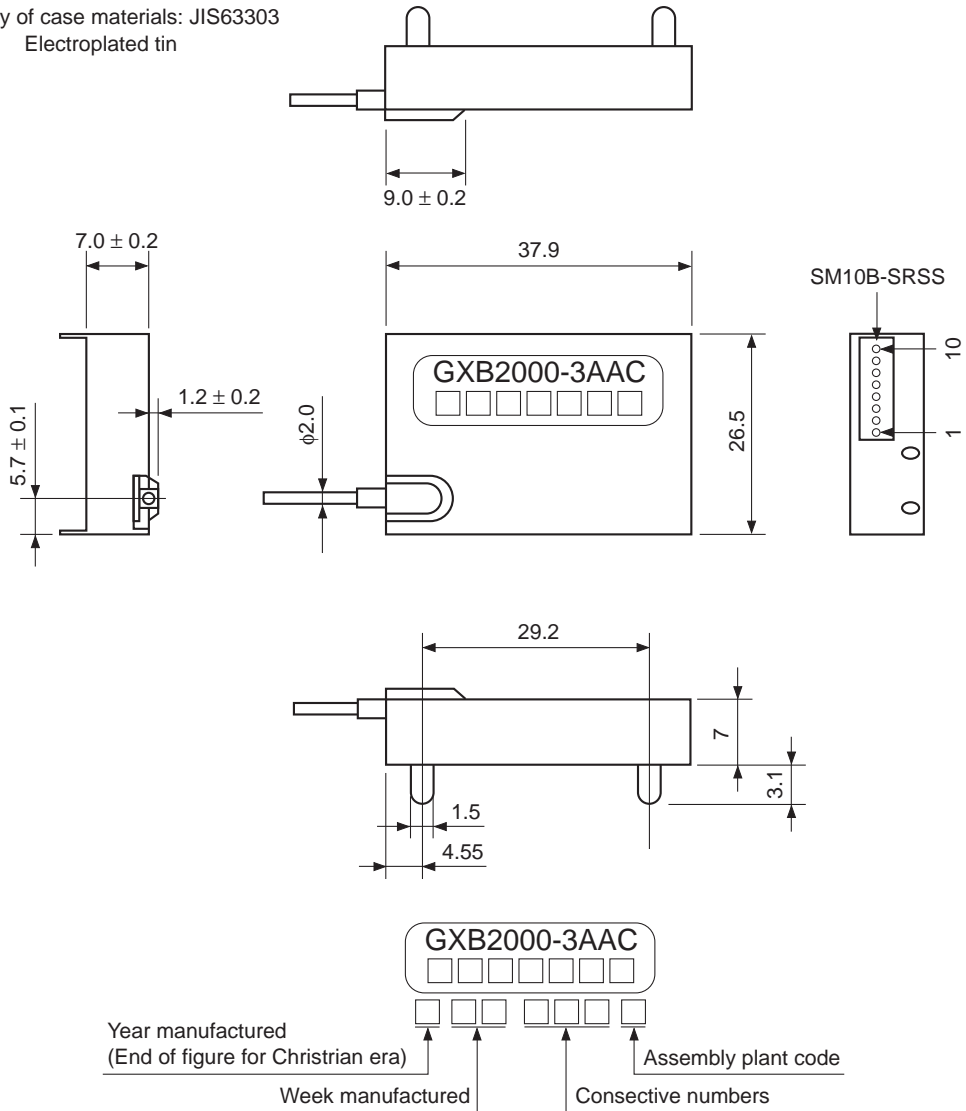
GXB20○○-□□□C



Package Outline

Unit: mm

Quality of case materials: JIS63303
 Electroplated tin



**GPS Receiver
Data Input/Output Specifications****Contents**

| | |
|---|------|
| 1. I/O Data Input/Output Specifications | S-2 |
| 2. D-GPS Data Input Specifications | S-16 |

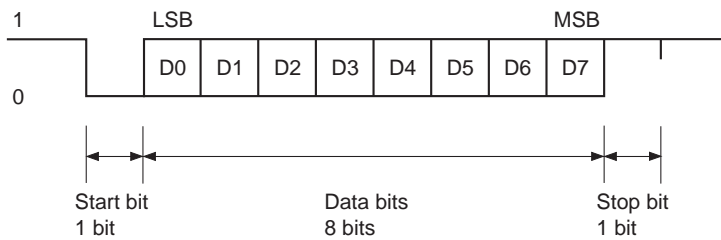
1. I/O Data Input/Output Specifications

1-1. Communication

1-1-1. Serial input/output communication method

| | |
|-------------------------------|--------------------------------------|
| Interface: | Asynchronous serial interface (UART) |
| Baud rate: | 9600 bps |
| Start bit: | 1 bit |
| Data bits: | 8 bits |
| Stop bit: | 1 bit |
| Parity bit: | None |
| Communication control signal: | None |
| Output period: | Approximately 1s |

1-1-2. Asynchronous serial interface



1-2. Output Data

1-2-1. Standard output

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|--|----------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 11010000 | Header | — | D0 |
| 2 | 0xxxxxxx | Software version information | 01 | 01 |
| 3 | 0xxxxxxx | Latitude | North latitude 87° 29' 10.24" (= 314950.24") | 0F |
| 4 | 0xxxxxxx | Resolution: 0.01" | | 02 |
| 5 | 0xxxxxxx | South latitude is two's complement notation. | | 26 |
| 6 | 0xxxxxxx | Value range: 32400000 to -32400000 | | 70 |
| 7 | 0xxxxxxx | Longitude | West longitude 175° 42' 30.11" (= -632550.11") | 61 |
| 8 | 0xxxxxxx | Resolution: 0.01" | | 6B |
| 9 | 0xxxxxxx | West longitude is two's complement notation. | | 1C |
| 10 | 0xxxxxxx | Value range: 64800000 to -64800000 | | 1D |
| 11 | 0xxxxxxx | Altitude | 3775m | 00 |
| 12 | 0xxxxxxx | Resolution: 1m Negative altitude is two's complement notation. Value range: 8191 to -8191 | | 1D 3F |
| 13 | 0xxxxxxx | Speed | 60.5km/h | 04 |
| 14 | 0xxxxxxx | Resolution: 0.1km/h Value range: 0 to 5150 | | 5D |
| 15 | 0xxxxxxx | Direction | 310.7° | 18 |
| 16 | 0xxxxxxx | Resolution: 0.1° Value range: 0 to 3599 | | 23 |
| 17 | 0xxxxxxx | PDOP value | 51.2 | 04 |
| 18 | 0xxxxxxx | Resolution: 0.1 Value range: 0 to 999 | | 00 |
| 19 | 0xxxxxxx | Current time mode 0: UTC time 1: JST time | 1 | 01 |
| 20 | 0xxxxxxx | Current time | 1999 | 0F |
| 21 | 0xxxxxxx | Year | | 4F |
| 22 | 0xxxxxxx | Month | | 02 |
| 23 | 0xxxxxxx | Date | | 22 |
| 24 | 0xxxxxxx | Hour | | 12 |
| 25 | 0xxxxxxx | Minute | | 54 |
| 26 | 0xxxxxxx | Second | | 46 |
| 27 | 0xxxxxxx | Day | | 01 |
| 28 | 0xxxxxxx | Measurement calculation time | 1999 | 0F |
| 29 | 0xxxxxxx | Year | | 4F |
| 30 | 0xxxxxxx | Month | | 02 |
| 31 | 0xxxxxxx | Date | | 22 |
| 32 | 0xxxxxxx | Hour | | 12 |
| 33 | 0xxxxxxx | Minute | | 55 |
| 34 | 0xxxxxxx | Second | | 30 |

| No. | BIT 76543210 | Contents | Example | |
|-------------------------------|-----------------|--|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 35 | 0xxxxxxx | Number of visible satellites Value range: 0 to 32 | 8 | 08 |
| 36 | 0xxxxxxx | Satellite Nos. used for measurement 8 satellite Nos. Value range: 0 to 32 Satellite No.: 0 is invalid. | 4 | 04 |
| 37 | 0xxxxxxx | | 10 | 0A |
| 38 | 0xxxxxxx | | 18 | 12 |
| 39 | 0xxxxxxx | | 9 | 09 |
| 40 | 0xxxxxxx | | 20 | 14 |
| 41 | 0xxxxxxx | | 25 | 19 |
| 42 | 0xxxxxxx | | 7 | 07 |
| 43 | 0xxxxxxx | 31 | 1F | |
| 44 | 0xxxxxxx | Measurement calculation mode 0: Invalid 1: 2-satellite measurement 2: 3-satellite measurement 3: 4-(or more) satellite measurement | 1 | 01 |
| 45 | 0xxxxxxx | Geodesic system Value range: 0 to 25 | 18 | 12 |
| 46 | 0xxxxxxx | Measurement delay time Resolution: 0.1s Value range: 0 to 9 | 0.4s | 04 |
| Information for 1st satellite | | | | |
| 47 | 0xxxxxxx | Satellite No. Value range: 0 to 32 | 16 | 10 |
| 48 | 0xxxxxxx | Azimuth Resolution: 1° Value range: 0 to 359° | 218° | 01 |
| 49 | 0xxxxxxx | | | 5A |
| 50 | 0xxxxxxx | Angle of elevation Resolution: 1° Value range: 0 to 90° | 56° | 38 |
| 51 | 0xxxxxxx | Reception status 0: Searching 1: Acquired 2: Usable for calculation 3: Radio waves cut off; interpolating 4: Satellite Unhealth 5: Currently being used for position calculation | 3 | 03 |
| 52 | 0xxxxxxx | Signal level Resolution: 1dBHz Value range: 0 to 100 | 100 | 64 |
| 53 to | | Information for 2nd satellite | | |
| 59 to | | Information for 3rd satellite | | |
| 65 to | | Information for 4th satellite | | |
| 71 to | | Information for 5th satellite | | |

| No. | BIT 76543210 | Contents | Example | |
|--------|-----------------|--|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 77 to | | Information for 6th satellite | | |
| 83 to | | Information for 7th satellite | | |
| 89 to | | Information for 8th satellite | | |
| 95 to | | Information for 9th satellite | | |
| 101 to | | Information for 10th satellite | | |
| 107 to | | Information for 11th satellite | | |
| 113 to | | Information for 12th satellite | | |
| 119 to | | Information for 13th satellite | | |
| 125 to | | Information for 14th satellite | | |
| 131 to | | Information for 15th satellite | | |
| 137 to | | Information for 16th satellite | | |
| 143 to | 0xxxxxxx | Preamplifier check 0: Normal, 1: Disconnected, 2: Short circuit | 2 | 02 |
| 144 to | | Reserved | | |
| 150 | 1101101 | Terminator. "Z" + 80H | — | DA |

1-2-2. Expanded output

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 150 | 0xxxxxxx | Latitude 0.001 to 0.0001" value Value range: 0 to 99 | 0.0025" | 19 |
| 151 | 0xxxxxxx | Longitude 0.001 to 0.0001" value Value range: 0 to 99 | 0.0091" | 5B |
| 152 | 0xxxxxxx | Speed 0.01 km/h value Value range: 0 to 9 | 0.03km/h | 03 |
| 153 | 0xxxxxxx | Number of healthy satellites Value range: 0 to 32 | 15 | 0F |
| 154 | 0xxxxxxx | Not related to user | — | — |
| 155 | 0xxxxxxx | | | |
| 156 | 0xxxxxxx | | | |
| 157 | 0xxxxxxx | Not related to user | — | — |
| 158 | 0xxxxxxx | Not related to user | — | — |
| 159 | 0xxxxxxx | SVACC Value range: 0 to 15 | 13 | 0D |
| 160 | 0xxxxxxx | Error major axis radius (1 σ estimated error) Resolution: 1m Value range: 0 to 510 | 130 | 01 |
| 161 | 0xxxxxxx | | | 02 |
| 162 | 0xxxxxxx | Error minor axis radius (1 σ estimated error) Resolution: 1m Value range: 0 to 510 | 41 | 00 |
| 163 | 0xxxxxxx | | | 29 |
| 164 | 0xxxxxxx | Error major axis inclination Resolution: 1° Value range: 0 to 179 Angle clockwise from north | 165 | 01 |
| 165 | 0xxxxxxx | | | 25 |
| 166 | 0xxxxxxx | HDOP value Resolution: 0.1 Value range: 0 to 999 | 51.2 | 04 |
| 167 | 0xxxxxxx | | | 00 |
| 168 | 0xxxxxxx | VDOP value Resolution: 0.1 Value range: 0 to 999 | 51.2 | 04 |
| 169 | 0xxxxxxx | | | 00 |
| 170 | 0xxxxxxx | D-GPS measurement flag 0: Invalid 1: GPS measurement 2: D-GPS measurement | 1 | 01 |
| 171 | 0xxxxxxx | D-GPS station No. Value range: 0 to 1023 | 1023 | 07 |
| 172 | 0xxxxxxx | | | 7F |
| 173 | 0xxxxxxx | D-GPS data elapsed time Resolution: 1s | 1 | 01 |

| No. | BIT 76543210 | Contents | Example | |
|--------|-----------------|--------------------------------------|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 174 | 0xxxxxxx | DARC/RTCM mode 0: DARC 1: RTCM | 1 | 01 |
| 175 | 0xxxxxxx | PDOP limit value when D-GPS is on | 1 | 01 |
| 176 | 0xxxxxxx | HDOP limit value when D-GPS is on | 1 | 01 |
| 177 | 0xxxxxxx | PDOP limit value when D-GPS is off | 1 | 01 |
| 178 | 0xxxxxxx | HDOP limit value when D-GPS is off | 1 | 01 |
| 179 | 0xxxxxxx | Angle of elevation limit value | 1 | 01 |
| 180 | 0xxxxxxx | Speed limit value | 1 | 00 |
| 181 | 0xxxxxxx | | | 01 |
| 182 to | | Reserved | | |
| 190 | 1101101 | Terminator. "Z" + 80H | — | DA |

1-2-3. Almanac data output

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|-------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 10100100 | Header | | A4 |
| 2 | 0xxxxxxx | | | |
| . | . | | | |
| . | . | | | |
| . | . | | | |
| . | . | | | |
| . | . | | | |
| 44 | 0xxxxxxx | | | |
| 45 | 11011010 | Terminator. "Z" + 80H | — | DA |

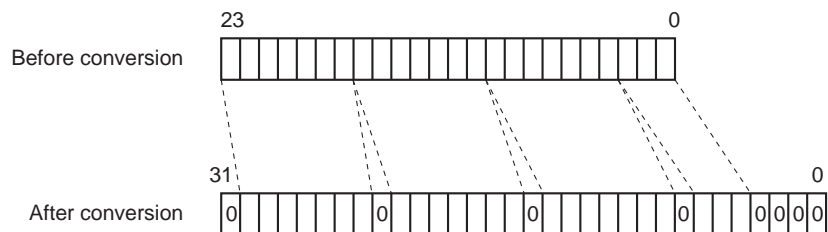
After the receiver receives an almanac output request, it transmits a response and then outputs the almanac data. The above format is for 1 subframe of the almanac data, and 64 frames of this data are sent in succession. Almanac communication data is sent by dividing the original data into 7-bit sections.

The almanac data stored in the GPS receiver memory has the configuration shown below. Normally each word of the almanac data has 6-bit parity, but this is eliminated when the data is stored in the memory. In addition, a 16-bit checksum is added in consideration of communication.

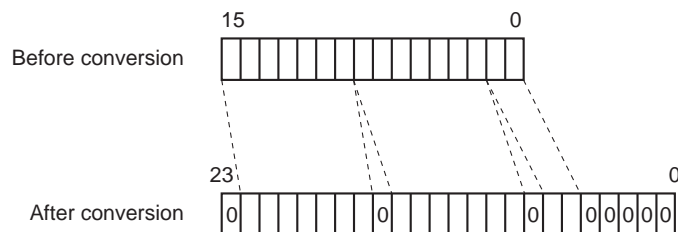
| | |
|----------|---------|
| WORD1 | 24 bits |
| WORD2 | 24 bits |
| WORD3 | 24 bits |
| WORD4 | 24 bits |
| WORD5 | 24 bits |
| WORD6 | 24 bits |
| WORD7 | 24 bits |
| WORD8 | 24 bits |
| WORD9 | 24 bits |
| WORD10 | 24 bits |
| Checksum | 16 bits |

The relationship between the above data and the communication data is shown to the right.

(1) Relationship between word data and communication data



(2) Relationship between checksum and communication data



1-3. Input Data

1-3-1. TM command (receiver clock setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100000 | Header | — | A0 |
| 2 | 0xxxxxxx | Year | 1999 | 0F |
| 3 | 0xxxxxxx | | | 4F |
| 4 | 0xxxxxxx | Month | 10 | 0A |
| 5 | 0xxxxxxx | Date | 29 | 1D |
| 6 | 0xxxxxxx | Hour | 8 | 08 |
| 7 | 0xxxxxxx | Minute | 46 | 2E |
| 8 | 0xxxxxxx | Second | 59 | 3B |
| 9 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-2. PT command (receiver latitude and longitude initial value settings)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|--|--|
| | | | Setting value | Input data (HEX) |
| 1 | 10100001 | Header | — | A1 |
| 2 | 0xxxxxxx | Latitude Resolution: 0.01" South latitude is two's complement notation. Value range: 32400000 to -32400000 | North latitude 87° 29' 10.24" (= 314950.24") | 0F |
| 3 | 0xxxxxxx | | | 02 |
| 4 | 0xxxxxxx | | | 26 |
| 5 | 0xxxxxxx | | | 70 |
| 6 | 0xxxxxxx | | | Longitude Resolution: 0.01" West longitude is two's complement notation. Value range: 64800000 to -64800000 |
| 7 | 0xxxxxxx | 6B | | |
| 8 | 0xxxxxxx | 1C | | |
| 9 | 0xxxxxxx | 1D | | |
| 10 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-3. SK command (receiver geodesic system parameter setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100010 | Header | — | A2 |
| 2 | 0xxxxxxx | Geodesic system Value range: 0 to 25 | 18 | 12 |
| 3 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-4. AMI command (receive almanac data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100011 | Header | — | A3 |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response. The NAVI (PC) side receives this command and then sends the almanac data to the GPS side.

1-3-5. AMO command (transmit almanac data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100100 | Header | — | A4 |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response, followed by the almanac data.

1-3-6. CD command (initialize almanac data area and cold start)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100101 | Header | — | A5 |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-7. SR command (wait 400ms and hot start)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100110 | Header | — | A6 |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-8. EL command (angle of elevation limit value setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100111 | Header | — | A7 |
| 2 | 0xxxxxxx | Angle of elevation Resolution: 1° Value range: 0 to 90° | 56° | 38 |
| 3 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-9. BC command (clear DARC receive data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101000 | Header | — | A8 |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-10. DG command (D-GPS on/off setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101001 | Header | — | A9 |
| 2 | 0xxxxxxx | D-GPS on/off setting 0: Off 1: On | 1 | 01 |
| 3 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-11. GS command (4 DOP threshold value settings)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101010 | Header | — | AA |
| 2 | 0xxxxxxx | PDOP threshold value when D-GPS is on | 64 | 40 |
| 3 | 0xxxxxxx | HDOP threshold value when D-GPS is on | 50 | 32 |
| 4 | 0xxxxxxx | PDOP threshold value when D-GPS is off | 64 | 40 |
| 5 | 0xxxxxxx | HDOP threshold value when D-GPS is off | 50 | 32 |
| 6 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-12. DMD command (DARC data input mode)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101011 | Header | — | AB |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-13. DMR command (RTCM data input mode)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101100 | Header | — | AC |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-14. EX command (expanded output mode on/off)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101101 | Header | — | AD |
| 2 | 0xxxxxxx | Expanded output on/off setting 0: Off 1: On | 1 | 01 |
| 3 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-15. SW command (eliminate ephemeris and warm start)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101110 | Header | — | AE |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-16. TC command (current time mode setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101111 | Header | — | AF |
| 2 | 0xxxxxxx | Current time mode setting 0: UTC 1: JST | 1 | 01 |
| 3 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-17. CH command (satellite No. setting during manual setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|-----------------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 11000000 | Header | — | C0 |
| 2 | 0xxxxxxx | Satellite Nos. for 16 channels Value range: 1 to 64 0 is invalid. | 9 | 09 |
| 3 | 0xxxxxxx | | 5 | 05 |
| 4 | 0xxxxxxx | | 18 | 12 |
| 5 | 0xxxxxxx | | 1 | 01 |
| 6 | 0xxxxxxx | | 20 | 14 |
| 7 | 0xxxxxxx | | 2 | 02 |
| 8 | 0xxxxxxx | | 6 | 06 |
| 9 | 0xxxxxxx | | 12 | 0C |
| 10 | 0xxxxxxx | | — | — |
| 11 | 0xxxxxxx | | — | — |
| 12 | 0xxxxxxx | | — | — |
| 13 | 0xxxxxxx | | — | — |
| 14 | 0xxxxxxx | | — | — |
| 15 | 0xxxxxxx | | — | — |
| 16 | 0xxxxxxx | | — | — |
| 17 | 0xxxxxxx | | — | — |
| 18 | 11011010 | | Terminator. "Z" + 80H | — |

After receiving the above command, the GPS side sends this command as a response.

1-3-18. LF command (D-GPS valid time setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 11000111 | Header | — | C7 |
| 2 | 0xxxxxxx | D-GPS valid time Resolution: s | | |
| 3 | 0xxxxxxx | | | |
| 4 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-19. EP1 command (receive ephemeris data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 11001101 | Header | — | CD |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response. The NAVI (PC) side receives this command and then sends the ephemeris data to the GPS side.

1-3-20. EP0 command (transmit ephemeris data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 11001110 | Header | — | CE |
| 2 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response, followed by the ephemeris data.

1-3-21. VF command (heading filter value setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10110001 | Header | — | B2 |
| 2 | 0xxxxxxx | Heading filter value | 999 | 07 |
| 3 | 0xxxxxxx | Resolution: 0.1km/h | (99.9km/h) | 67 |
| 4 | 11011010 | Terminator. "Z" + 80H | — | DA |

After receiving the above command, the GPS side sends this command as a response.

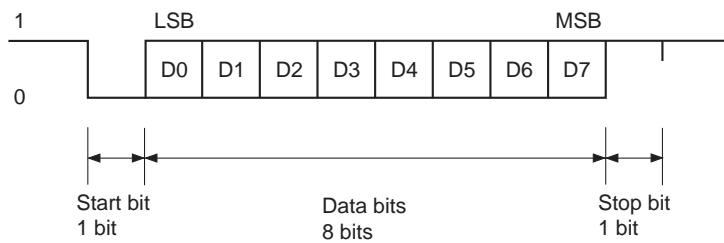
2. D-GPS Data Input Specifications

2-1. Communication

2-1-1. Serial input communication method

| | |
|-------------------------------|--------------------------------------|
| Interface: | Asynchronous serial interface (UART) |
| Baud rate: | 9600 bps |
| Start bit: | 1 bit |
| Data bits: | 8 bits |
| Stop bit: | 1 bit |
| Parity bit: | None |
| Communication control signal: | None |
| Input period: | 1s or more |

2-1-2. Asynchronous serial interface

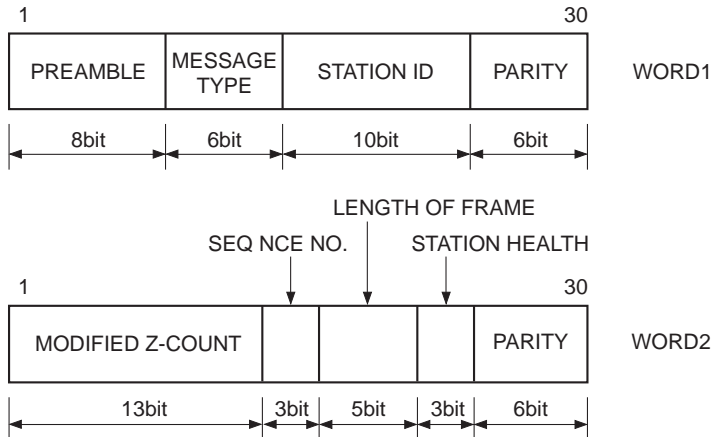


2-2. RTCM Data Input

RTCM data input conforms to the RTCM SC-104 format and supports message type 1.

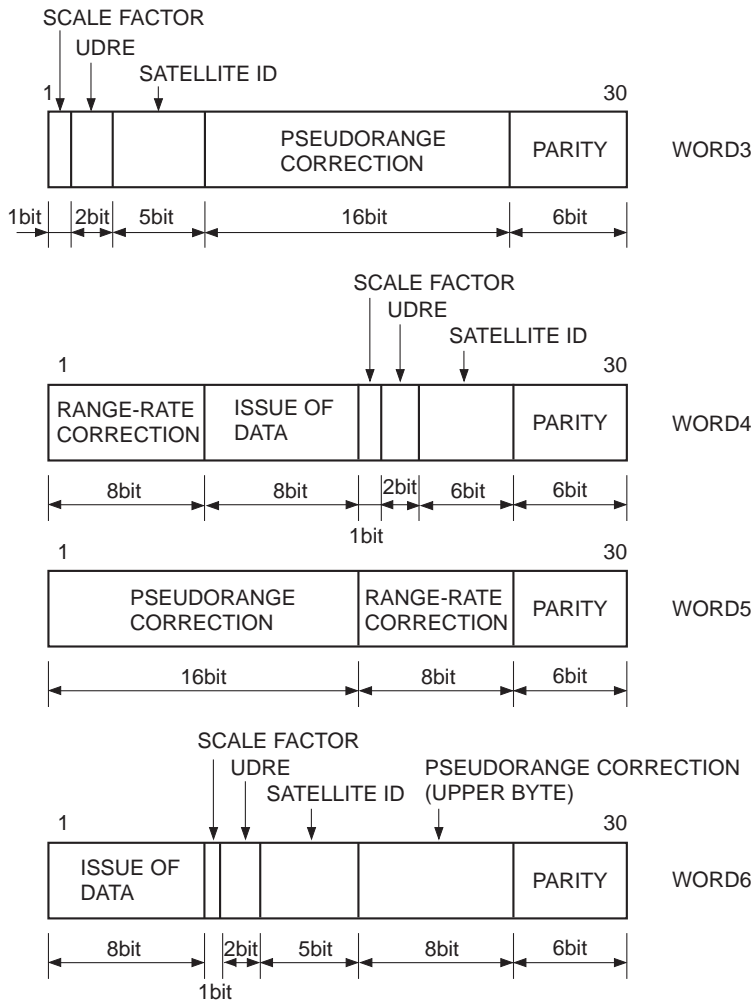
The message type shared header and message type 1 format are shown below. These data are sent in the "6 of 8" format. In this format, each word is divided into 6-bit units, the bits are reordered so that the LSB comes first and the MSB comes last, and then "01" is added to the head of the bits.

2-2-1. Message type shared header

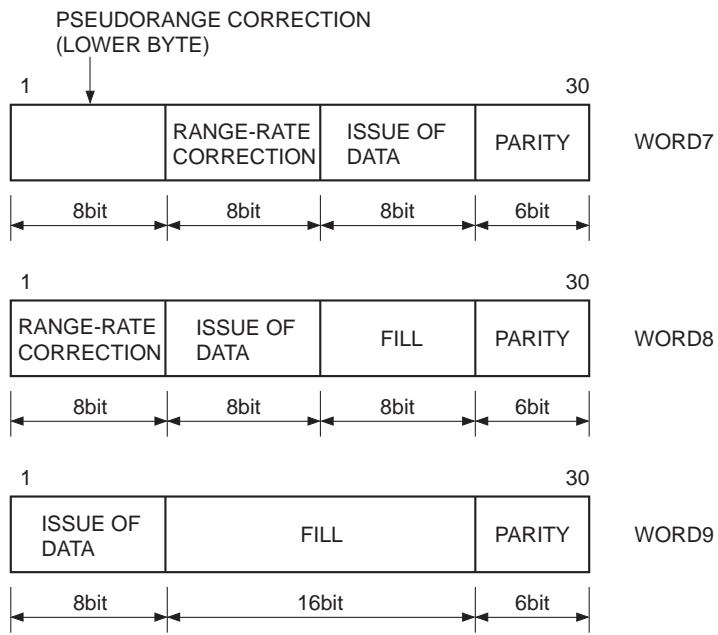


- PREAMBLE: Preamble
- MESSAGE TYPE: Message type
- STATION ID: Reference station ID No.
- PARITY: Error correction code
- MODIFIED Z-COUNT: Modified Z-count
- SEQ NCE NO.: Frame sequence No.
- LENGTH OF FRAME: Frame length
- STATION HEALTH: Reference station health

2-2-2. Message type 1 (differential GPS correction value)



- SCALE FACTOR: Pseudorange correction value scale factor
- UDRE: User differential range error index
- SATELLITE ID: Satellite ID No.
- PSEUDORANGE CORRECTION: Pseudorange correction value
- RANGE-RATE CORRECTION: Pseudorange rate-of-change correction value
- ISSUE OF DATA: Data issue No.



FILL: Dummy bit

2-3. DARC Data Input

DARC data is output in the communication format noted below. The D-GPS basic data is located in the D-GPS segments. The D-GPS basic data is comprised of 288 bits (36 bytes).

| Data packet 1 22 bytes | | Data packet 2 22 bytes | | | Checksum 1 byte | Terminator 1 byte |
|---------------------------|------------------------------|---------------------------|------------------------------|---------------|--------------------|----------------------|
| Prefix 4 bytes | D-GPS segment 18 bytes | Prefix 2 bytes | D-GPS segment 18 bytes | CRC 2 byte | xxh | 0Dh |

The D-GPS basic data configuration is as follows.

| Bit position | Description | Number of bits |
|--------------|-----------------------------------|----------------|
| 1 to 3 | D-GPS data ID | 3 bits |
| 4 | Correction time | 1 bit |
| 5 to 38 | 1st GPS satellite correction data | 34 bits |
| 39 to 72 | 2nd GPS satellite correction data | 34 bits |
| 73 to 106 | 3rd GPS satellite correction data | 34 bits |
| 107 to 140 | 4th GPS satellite correction data | 34 bits |
| 141 to 174 | 5th GPS satellite correction data | 34 bits |
| 175 to 208 | 6th GPS satellite correction data | 34 bits |
| 209 to 242 | 7th GPS satellite correction data | 34 bits |
| 243 to 276 | 8th GPS satellite correction data | 34 bits |
| 277 to 288 | Communication data | 12 bits |

The GPS satellite correction data configuration is as follows.

| Bit position | Description | Number of bits |
|--------------|---|----------------|
| 1 | Scale factor | 1 bit |
| 2 to 3 | UDRE (User differential range error index) | 2 bits |
| 4 to 8 | GPS satellite ID | 5 bits |
| 9 to 19 | PRC (Pseudorange correction value) | 11 bits |
| 20 to 26 | RRC (Pseudorange rate-of-change correction value) | 7 bits |
| 27 to 34 | IODE (Ephemeris data issue No.) | 8 bits |

Geodetic System and Corresponding Country

| Setting value | Geodetic system | Reference Ellipsoid | |
|---------------|---------------------------------------|----------------------|--|
| 0 | WGS-84 | WGS-84 | |
| 1 | TOKYO | Bessel 1841 | Japan, Korea |
| 2 | ADINDAN | Clarke 1880 | Ethiopia, Mali, Senegal, Sudan |
| 3 | ARC 1950 | Clarke 1880 | Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe |
| | CAPE | Clarke 1880 | South Africa |
| 4 | MERCHICH | Clarke 1880 | Morocco |
| 5 | HONG KONG 1963 | International | Hong Kong |
| 6 | SOUTH ASIA | Modified Fisher 1960 | Singapore |
| 7 | LUZEN | Clarke 1866 | Philippines |
| 8 | INDIAN | Everest | Thailand, Vietnam |
| 9 | INDIAN | Everest | Bangladesh, India, Nepal |
| 10 | KERTAU 1948 | Modified Everest | West Malaysia, Singapore |
| 11 | NORTH AMERICAN 1927 | Clarke 1866 | Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Mexico |
| 12 | EUROPEAN 1950 EUROPEAN 1950 | International | Austria, Belgium, Cyprus, Channel Islands, Denmark, England, Finland, France, Germany, Gibraltar, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Scotland, Shetland Island, Spain, Sweden, Switzerland |
| 13 | IRELAND 1965 | Modified Airy | Ireland |
| 14 | ORDNANCE SURVEY OF GREAT BRITAIN 1936 | Airy | England, Isle of Man, Scotland, Shetland Island, Wales |
| 15 | NAHRWAN | Clarke 1880 | Masirash Island, Oman, United Arab Emirates |
| 16 | NAHRWAN | Clarke 1880 | Saudi Arabia |
| 17 | OLD EGYPTIAN | Helmert 1906 | Egypt |
| 18 | NORTH AMERICAN 1927 | Clarke 1866 | Canada, Newfoundland Island |
| 19 | NORTH AMERICAN 1983 | GRS 80 | Alaska, Canada, Mexico, Central America, United States of America |
| 20 | AUSTRALIAN GEODETIC 1984 | Australian National | Australia, Tasmania Island |
| 21 | GEODETIC DATUM 1949 | International | New Zealand |
| 22 | PROVISIONAL SOUTH AMERICAN 1956 | International | Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela |
| 23 | SOUTH AMERICAN 1969 | South American 1969 | Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Trinidad and Tobago, Venezuela |
| 24 | CAMPO INCHAUSPE | International | Argentina |
| 25 | CORREGO ALEGE | International | Brazil |

**GPS Receiver
NMEA-0183 Input/Output Specifications**

Contents

1. I/O Data Input/Output Specifications SS-2

2. NMEA Output Specifications SS-11

3. D-GPS Data Input Specifications SS-27

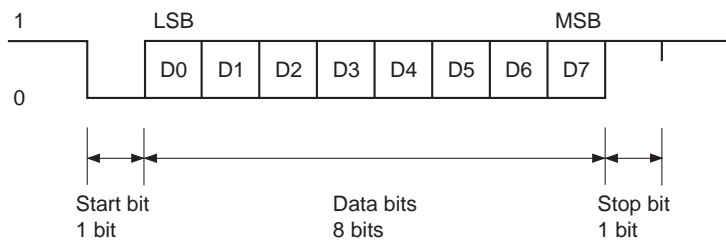
1. I/O Data Input/Output Specifications

1-1. Communication

1-1-1. Serial input/output communication method

Interface: Asynchronous serial interface (UART)
 I/O channel: CH0
 Baud rate: 4800bps
 Start bit: 1 bit
 Data bits: 8 bits
 Stop bit: 1 bit
 Parity bit: None
 Communication control signal: None
 Output period: Approximately 1s

1-1-2. Asynchronous serial interface



1-2. Almanac Data Output

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 10100100 | Header | | A4 |
| 2 | 0xxxxxxx | | | |
| · | · | | | |
| · | · | | | |
| · | · | | | |
| · | · | | | |
| · | · | | | |
| 44 | 0xxxxxxx | | | |
| 45 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

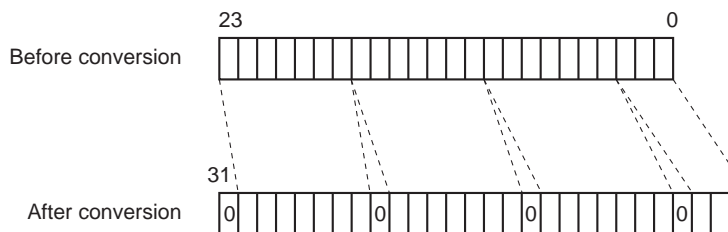
After the receiver receives an almanac output request, it transmits a response and then outputs the almanac data. The above format is for 1 subframe of the almanac data, and 64 frames of this data are sent in succession. Almanac communication data is sent by dividing the original data into 7-bit sections.

The almanac data stored in the GPS receiver memory has the configuration shown below. Normally each word of the almanac data has 6-bit parity, but this is eliminated when the data is stored in the memory. In addition, a 16-bit checksum is added in consideration of communication.

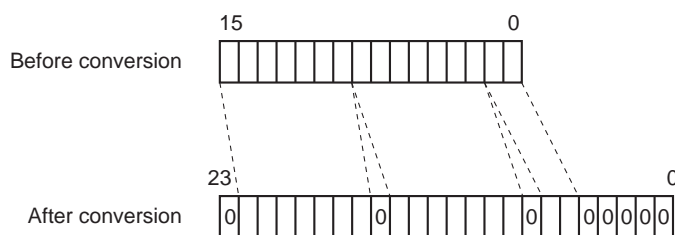
| | |
|----------|---------|
| WORD1 | 24 bits |
| WORD2 | 24 bits |
| WORD3 | 24 bits |
| WORD4 | 24 bits |
| WORD5 | 24 bits |
| WORD6 | 24 bits |
| WORD7 | 24 bits |
| WORD8 | 24 bits |
| WORD9 | 24 bits |
| WORD10 | 24 bits |
| Checksum | 16 bits |

The relationship between the above data and the communication data is shown to the right.

(1) Relationship between word data and communication data



(2) Relationship between checksum and communication data



1-3. Input Commands

1-3-1. TM command (receiver clock setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100000 | Header | — | A0 |
| 2 | 0xxxxxxx | Year | 1999 | 0F |
| 3 | 0xxxxxxx | | | 4F |
| 4 | 0xxxxxxx | Month | 10 | 0A |
| 5 | 0xxxxxxx | Date | 29 | 1D |
| 6 | 0xxxxxxx | Hour | 8 | 08 |
| 7 | 0xxxxxxx | Minute | 46 | 2E |
| 8 | 0xxxxxxx | Second | 59 | 3B |
| 9 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-2. PT command (receiver latitude and longitude initial value settings)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--|--|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100001 | Header | — | A1 |
| 2 | 0xxxxxxx | Latitude Resolution: 0.01" South latitude is two's complement notation. Value range: 32400000 to -32400000 | North latitude 87° 29' 10.24" (= -314950.24") | 0F |
| 3 | 0xxxxxxx | | | 02 |
| 4 | 0xxxxxxx | | | 26 |
| 5 | 0xxxxxxx | | | 70 |
| 6 | 0xxxxxxx | Longitude Resolution: 0.01" West longitude is two's complement notation. Value range: 64800000 to -64800000 | West longitude 175° 42' 30.11" (= -632550.11") | 61 |
| 7 | 0xxxxxxx | | | 6B |
| 8 | 0xxxxxxx | | | 1C |
| 9 | 0xxxxxxx | | | 1D |
| 10 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-3. SK command (receiver geodesic system parameter setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100010 | Header | — | A2 |
| 2 | 0xxxxxxx | Geodesic system Value range: 0 to 25 | 18 | 12 |
| 3 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-4. AMI command (receive almanac data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100011 | Header | — | A3 |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response. The NAVI (PC) side receives this command and then sends the almanac data to the GPS side.

1-3-5. AMO command (transmit almanac data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100100 | Header | — | A4 |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response, followed by the almanac data.

1-3-6. CD command (initialize almanac data area and cold start)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100101 | Header | — | A5 |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-7. SR command (wait 400ms and hot start)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100110 | Header | — | A6 |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-8. EL command (angle of elevation limit value setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10100111 | Header | — | A7 |
| 2 | 0xxxxxxx | Angle of elevation Resolution: 1° Value range: 0 to 90° | 56° | 38 |
| 3 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-9. BC command (clear DARC receive data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101000 | Header | — | A8 |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-10. DG command (D-GPS on/off setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101001 | Header | — | A9 |
| 2 | 0xxxxxxx | D-GPS on/off setting 0: Off 1: On | 1 | 01 |
| 3 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-11. GS command (4 DOP threshold value settings (up to 99 (63HEX) max.))

| No. | BIT 76543210 | Contents | Example | |
|--------|----------------------|--|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101010 | Header | — | AA |
| 2 3 | 0xxxxxxx 0xxxxxxx | PDOP threshold value when D-GPS is on | 64 | 00 40 |
| 4 5 | 0xxxxxxx 0xxxxxxx | HDOP threshold value when D-GPS is on | 50 | 00 32 |
| 6 7 | 0xxxxxxx 0xxxxxxx | PDOP threshold value when D-GPS is off | 135 | 01 07 |
| 8 9 | 0xxxxxxx 0xxxxxxx | HDOP threshold value when D-GPS is off | 114 | 00 72 |
| 10 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-12. DMD command (DARC data input mode)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101011 | Header | — | AB |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-13. DMR command (RTCM data input mode)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101100 | Header | — | AC |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-14. EX command (expanded output mode on/off)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101101 | Header | — | AD |
| 2 | 0xxxxxxx | Expanded output on/off setting 0: Off 1: On | 1 | 01 |
| 3 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-15. SW command (eliminate ephemeris and warm start)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101110 | Header | — | AE |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-16. TC command (current time mode setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10101111 | Header | — | AF |
| 2 | 0xxxxxxx | Current time mode setting 0: UTC 1: JST | 1 | 01 |
| 3 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-17. CH command (satellite No. setting during manual setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|-------------------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 11000000 | Header | — | C0 |
| 2 | 0xxxxxxx | Satellite Nos. for 16 channels Value range: 1 to 64 0 is invalid. | 9 | 09 |
| 3 | 0xxxxxxx | | 5 | 05 |
| 4 | 0xxxxxxx | | 18 | 12 |
| 5 | 0xxxxxxx | | 1 | 01 |
| 6 | 0xxxxxxx | | 20 | 14 |
| 7 | 0xxxxxxx | | 2 | 02 |
| 8 | 0xxxxxxx | | 6 | 06 |
| 9 | 0xxxxxxx | | 12 | 0C |
| 10 | 0xxxxxxx | | — | — |
| 11 | 0xxxxxxx | | — | — |
| 12 | 0xxxxxxx | | — | — |
| 13 | 0xxxxxxx | | — | — |
| 14 | 0xxxxxxx | | — | — |
| 15 | 0xxxxxxx | | — | — |
| 16 | 0xxxxxxx | | — | — |
| 17 | 0xxxxxxx | | — | — |
| 18 | 11011010 | | Terminator. "Z" + 80HEX | — |

After receiving the above command, the GPS side sends this command as a response.

1-3-18. LF command (D-GPS valid time setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 11000111 | Header | — | C7 |
| 2 | 0xxxxxxx | D-GPS valid time Resolution: s | | |
| 3 | 0xxxxxxx | | | |
| 4 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

1-3-19. EPI command (receive ephemeris data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 11001101 | Header | — | CD |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response. The NAVI (PC) side receives this command and then sends the ephemeris data to the GPS side.

1-3-20. EP0 command (transmit ephemeris data)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 11001110 | Header | — | CE |
| 2 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response, followed by the ephemeris data.

1-3-21. VF command (heading filter value setting)

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-------------------------|---------------|---------------------|
| | | | Setting value | Input data (HEX) |
| 1 | 10110001 | Header | — | B2 |
| 2 | 0xxxxxxx | Heading filter value | 999 | 07 |
| 3 | 0xxxxxxx | Resolution: 0.1km/h | (99.9km/h) | 67 |
| 4 | 11011010 | Terminator. "Z" + 80HEX | — | DA |

After receiving the above command, the GPS side sends this command as a response.

2. NMEA Output Specifications

2-1. Output Messages

2-1-1. GPGGA message

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--|----------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 00100100 | Header "\$" | Fixed | 24 |
| 2 | 01000111 | Address field "G" "P" "G" "G" "A" | Fixed | 47 |
| 3 | 01010000 | | | 50 |
| 4 | 01000111 | | | 47 |
| 5 | 01000111 | | | 47 |
| 6 | 01000001 | | | 41 |
| 7 | 01001100 | | | " , " |
| 8 | xxxxxxxx | UTC time | 06:22:43 | 00 |
| 9 | xxxxxxxx | Hour (10's digit) | | 36 |
| 10 | xxxxxxxx | Hour (1's digit) | | 32 |
| 11 | xxxxxxxx | Minute (10's digit) | | 32 |
| 12 | xxxxxxxx | Minute (1's digit) | | 34 |
| 13 | xxxxxxxx | Second (10's digit) | | 33 |
| 14 | 01001100 | " , " | Fixed | 2C |
| 15 | xxxxxxxx | Latitude | 36° 03.979' | 33 |
| 16 | xxxxxxxx | Degree (10's digit) | | 36 |
| 17 | xxxxxxxx | Degree (1's digit) | | 30 |
| 18 | xxxxxxxx | Minute (10's digit) | | 33 |
| 19 | 00101110 | " . " | | 2E |
| 20 | xxxxxxxx | Minute (0.1's digit) | | 39 |
| 21 | xxxxxxxx | Minute (0.01's digit) | | 37 |
| 22 | xxxxxxxx | Minute (0.001's digit) | | 39 |
| 23 | 01001100 | " , " | | Fixed |
| 24 | xxxxxxxx | Latitude direction "N" or "S" | North latitude | 4E |
| 25 | 01001100 | " , " | Fixed | 2C |
| 26 | xxxxxxxx | Longitude | 140° 10.296' | 31 |
| 27 | xxxxxxxx | Degree (100's digit) | | 34 |
| 28 | xxxxxxxx | Degree (10's digit) | | 30 |
| 29 | xxxxxxxx | Degree (1's digit) | | 31 |
| 30 | xxxxxxxx | Minute (10's digit) | | 30 |
| 31 | 00101110 | " . " | | 2E |
| 32 | xxxxxxxx | Minute (0.1's digit) | | 32 |
| 33 | xxxxxxxx | Minute (0.01's digit) | | 39 |
| 34 | xxxxxxxx | Minute (0.001's digit) | | 36 |

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|---|----------------------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 35 | 01001100 | " , " | Fixed | 2C |
| 36 | xxxxxxx | Longitude direction "E" or "W" | West longitude | 57 |
| 37 | 01001100 | " , " | Fixed | 2C |
| 38 | xxxxxxx | GPS Quality Indicator "0": Invalid "1": GPS measurement "2": D-GPS measurement | D-GPS measurement | 32 |
| 39 | 01001100 | " , " | Fixed | 2C |
| 40 | xxxxxxx | Number of satellites used for measurement calculation "00" to "12" | 7-satellite measurement | 30 |
| 41 | xxxxxxx | | | 37 |
| 42 | 01001100 | " , " | Fixed | 2C |
| 43 | xxxxxxx | HDOP 10's digit 1's digit " . " 0.1's digit | 1.2 | 30 |
| 44 | xxxxxxx | | | 31 |
| 45 | 00101110 | | | 2E |
| 46 | xxxxxxx | | | 32 |
| 47 | 01001100 | " , " | Fixed | 2C |
| 48 | xxxxxxx | Altitude (m) 1,000's digit 100's digit 10's digit 1's digit | 23m | 30 |
| 49 | xxxxxxx | | | 30 |
| 50 | xxxxxxx | | | 32 |
| 51 | xxxxxxx | | | 33 |
| 52 | 01001100 | " , " | Fixed | 2C |
| 53 | 01001101 | Altitude units "M" | Fixed | 4D |
| 54 | 01001100 | " , " | Fixed | 2C |
| 55 | 01001100 | " , " | Fixed | 2C |
| 56 | 01001101 | "M" | Fixed | 4D |
| 57 | 01001100 | " , " | Fixed | 2C |
| 58 | xxxxxxx | D-GPS data elapsed time (s) 100's digit 10's digit 1's digit | 5s | 30 |
| 59 | xxxxxxx | | | 30 |
| 60 | xxxxxxx | | | 35 |
| 61 | 01001100 | " , " | Fixed | 2C |
| 62 | xxxxxxx | D-GPS reference station ID 1,000's digit 100's digit 10's digit 1's digit | 0 | 30 |
| 63 | xxxxxxx | | | 30 |
| 64 | xxxxxxx | | | 30 |
| 65 | xxxxxxx | | | 30 |
| 66 | 00101010 | " * " | Fixed | 2A |

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--------------------------|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 67 | xxxxxxx | Checksum | 4A | 34 |
| 68 | xxxxxxx | Hexadecimal upper digits | | |
| | | Hexadecimal lower digits | | 41 |
| 69 | 00001101 | Terminator | Fixed | 0D |
| 70 | 00001010 | <CR> | | |
| | | <LF> | | 0A |

The Geoidal Separation parameter is not output (between No. 54 and No. 55).

2-1-2. GPGLL message

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|-----------------------------------|----------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 00100100 | Header "\$" | Fixed | 24 |
| 2 | 01000111 | Address field "G" | Fixed | 47 |
| 3 | 01010000 | "P" | | 50 |
| 4 | 01000111 | "G" | | 47 |
| 5 | 01001100 | "L" | | 4C |
| 6 | 01001100 | "L" | | 4C |
| 7 | 01001100 | ", " | | Fixed |
| 8 | xxxxxxxx | Latitude Degree (10's digit) | 36° 03.979' | 33 |
| 9 | xxxxxxxx | Degree (1's digit) | | 36 |
| 10 | xxxxxxxx | Minute (10's digit) | | 30 |
| 11 | xxxxxxxx | Minute (1's digit) | | 33 |
| 12 | 00101110 | ". " | | 2E |
| 13 | xxxxxxxx | Minute (0.1's digit) | | 39 |
| 14 | xxxxxxxx | Minute (0.01's digit) | | 37 |
| 15 | xxxxxxxx | Minute (0.001's digit) | | 39 |
| 16 | 01001100 | ", " | | Fixed |
| 17 | xxxxxxxx | Latitude direction "N" or "S" | North latitude | 4E |
| 18 | 01001100 | ", " | Fixed | 2C |
| 19 | xxxxxxxx | Longitude Degree (100's digit) | 140° 10.296' | 31 |
| 20 | xxxxxxxx | Degree (10's digit) | | 34 |
| 21 | xxxxxxxx | Degree (1's digit) | | 30 |
| 22 | xxxxxxxx | Minute (10's digit) | | 31 |
| 23 | xxxxxxxx | Minute (1's digit) | | 30 |
| 24 | 00101110 | ". " | | 2E |
| 25 | xxxxxxxx | Minute (0.1's digit) | | 32 |
| 26 | xxxxxxxx | Minute (0.01's digit) | | 39 |
| 27 | xxxxxxxx | Minute (0.001's digit) | | 36 |
| 28 | 01001100 | ", " | Fixed | 2C |
| 29 | xxxxxxxx | Longitude direction "E" or "W" | West longitude | 57 |
| 30 | 01001100 | ", " | Fixed | 2C |
| 31 | xxxxxxxx | UTC time Hour (10's digit) | 06:22:43 | 00 |
| 32 | xxxxxxxx | Hour (1's digit) | | 36 |
| 33 | xxxxxxxx | Minute (10's digit) | | 32 |
| 34 | xxxxxxxx | Minute (1's digit) | | 32 |
| 35 | xxxxxxxx | Second (10's digit) | | 34 |
| 36 | xxxxxxxx | Second (1's digit) | | 33 |
| 37 | 01001100 | ", " | Fixed | 2C |

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 38 | xxxxxxx | Status "A": Data valid "V": Data invalid | Valid | 41 |
| 39 | 00101010 | " * " | Fixed | 2A |
| 40 | xxxxxxx | Checksum Hexadecimal upper digits | 4A | 34 |
| 41 | xxxxxxx | Hexadecimal lower digits | | 41 |
| 42 | 00001101 | Terminator <CR> | Fixed | 0D |
| 43 | 00001010 | <LF> | | 0A |

2-1-3. GPGSA message

| No. | BIT 76543210 | Contents | Example | |
|----------|-----------------|--|----------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 00100100 | Header "\$" | Fixed | 24 |
| 2 | 01000111 | Address field "G" "P" "G" "S" "A" | Fixed | 47 |
| 3 | 01010000 | | | 50 |
| 4 | 01000111 | | | 47 |
| 5 | 01010011 | | | 53 |
| 6 | 01000001 | | | 41 |
| 7 | 01001100 | | | ", " |
| 8 | xxxxxxxx | GPS measurement switching mode "M": Manual "A": Auto | Fixed to "A" | 41 |
| 9 | 01001100 | ", " | Fixed | 2C |
| 10 | xxxxxxxx | GPS measurement mode "1": Invalid "2": 2D measurement "3": 3D measurement | 3D measurement | 33 |
| 11 | 01001100 | ", " | Fixed | 2C |
| 12 | xxxxxxxx | Satellite Nos. used for measurement 1st satellite No. 10's digit 1's digit ", " ----- 2nd satellite No. ----- 3rd satellite No. ----- 4th satellite No. ----- 5th satellite No. ----- 6th satellite No. ----- 7th satellite No. ----- 8th satellite No. ----- 9th satellite No. ----- 10th satellite No. ----- 11th satellite No. ----- 12th satellite No. | | |
| 13 | xxxxxxxx | | | |
| 14 | 01001100 | | | |
| 15 to 17 | | | | |
| 18 to 20 | | | | |
| 21 to 23 | | | | |
| 24 to 26 | | | | |
| 27 to 29 | | | | |
| 30 to 32 | | | | |
| 33 to 35 | | | | |
| 36 to 38 | | | | |
| 39 to 41 | | | | |
| 42 to 44 | | | | |
| 45 to 47 | | | | |
| 48 | xxxxxxxx | PDOP 10's digit 1's digit ". " 0.1's digit | 2.4 | 30 |
| 49 | xxxxxxxx | | | 32 |
| 50 | 00101110 | | | 2E |
| 51 | xxxxxxxx | | | 34 |
| 52 | 01001100 | | | ", " |

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--------------------------------------|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 53 | xxxxxxx | HDOP 10's digit | 1.2 | 30 |
| 54 | xxxxxxx | 1's digit | | 31 |
| 55 | 00101110 | ". " | | 2E |
| 56 | xxxxxxx | 0.1's digit | | 32 |
| 57 | 01001100 | ". " | Fixed | 2C |
| 58 | xxxxxxx | VDOP 10's digit | 2.0 | 30 |
| 59 | xxxxxxx | 1's digit | | 32 |
| 60 | 00101110 | ". " | | 2E |
| 61 | xxxxxxx | 0.1's digit | | 30 |
| 62 | 00101010 | ". * " | Fixed | 2A |
| 63 | xxxxxxx | Checksum Hexadecimal upper digits | 4A | 34 |
| 64 | xxxxxxx | Hexadecimal lower digits | | 41 |
| 65 | 00001101 | Terminator <CR> | Fixed | 0D |
| 66 | 00001010 | <LF> | | 0A |

The data length for "Satellite Nos. used for measurement" is variable in order to output the numbers of all the satellites used for position measurement.

2-1-4. GPGSV message

| No. | BIT 76543210 | Contents | Example | | | | |
|----------|-----------------|---|---------------|----------------------|--------------------------------------|-------|----|
| | | | Setting value | Output data (HEX) | | | |
| 1 | 00100100 | Header "\$" | Fixed | 24 | | | |
| 2 | 01000111 | Address field "G" "P" "G" "S" "V" | Fixed | 47 | | | |
| 3 | 01010000 | | | 50 | | | |
| 4 | 01000111 | | | 47 | | | |
| 5 | 01010011 | | | 53 | | | |
| 6 | 01010110 | | | 56 | | | |
| 7 | 01001100 | | | ", " | Fixed | 2C | |
| 8 | xxxxxxxx | Total number of GPGSV messages "1" to "3" | 2 | 32 | | | |
| 9 | 01001100 | ", " | Fixed | 2C | | | |
| 10 | xxxxxxxx | GPGSV message number "1" to "3" | 1 | 31 | | | |
| 11 | 01001100 | ", " | Fixed | 2C | | | |
| 12 | xxxxxxxx | Number of satellites within field of vision 10's digit 1's digit | 08 | 30 | | | |
| 13 | xxxxxxxx | | | 38 | | | |
| 14 | 01001100 | ", " | Fixed | 2C | | | |
| 15 | xxxxxxxx | Information on satellites within field of vision for four satellites Satellite No. 10's digit 1's digit " , " Angle of elevation (°) 10's digit 1's digit " , " Azimuth (°) 100's digit 10's digit 1's digit " , " C/N (dB) 10's digit 1's digit " , " | | | | | |
| 16 | xxxxxxxx | | | | | | |
| 17 | 01001100 | | | | | | |
| 18 | xxxxxxxx | | | | | | |
| 19 | xxxxxxxx | | | | | | |
| 20 | 01001100 | | | | | | |
| 21 | xxxxxxxx | | | | | | |
| 22 | xxxxxxxx | | | | | | |
| 23 | xxxxxxxx | | | | | | |
| 24 | 01001100 | | | | | | |
| 25 | xxxxxxxx | | | | | | |
| 26 | xxxxxxxx | | | | | | |
| 27 | 01001100 | | | | | | |
| 28 to 40 | | | | | Information for 2nd satellite | | |
| 41 to 53 | | | | | Information for 3rd satellite | | |
| 54 to 56 | | | | | Information for 4th satellite | | |
| 67 | 00101010 | | | | " * " | Fixed | 2A |
| 68 | xxxxxxxx | | | | Checksum Hexadecimal upper digits | 4A | 34 |
| 69 | xxxxxxxx | | | | Hexadecimal lower digits | | 41 |

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--------------------|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 70 | 00001101 | Terminator <CR> | Fixed | 0D |
| 71 | 00001010 | <LF> | | 0A |

The satellite information for up to four satellites can be sent with a single GPGSV message, so multiple GPGSV messages (up to three messages) are sent when there are four or more satellites within the field of vision. When there are fewer than four satellites, the information for that number of satellites is sent.

2-1-5. GPRMC message

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--|----------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 00100100 | Header "\$" | Fixed | 24 |
| 2 | 01000111 | Address field "G" | Fixed | 47 |
| 3 | 01010000 | "P" | | 50 |
| 4 | 01010010 | "R" | | 52 |
| 5 | 01001101 | "M" | | 4D |
| 6 | 01000011 | "C" | | 43 |
| 7 | 01001100 | ", " | | Fixed |
| 8 | xxxxxxxx | UTC time Hour (10's digit) | 06:22:43 | 00 |
| 9 | xxxxxxxx | Hour (1's digit) | | 36 |
| 10 | xxxxxxxx | Minute (10's digit) | | 32 |
| 11 | xxxxxxxx | Minute (1's digit) | | 32 |
| 12 | xxxxxxxx | Second (10's digit) | | 34 |
| 13 | xxxxxxxx | Second (1's digit) | | 33 |
| 14 | 01001100 | ", " | Fixed | 2C |
| 15 | xxxxxxxx | Status "A": Data valid "V": Data invalid | Valid | 41 |
| 16 | 01001100 | ", " | Fixed | 2C |
| 17 | xxxxxxxx | Latitude Degree (10's digit) | 36° 03.979' | 33 |
| 18 | xxxxxxxx | Degree (1's digit) | | 36 |
| 19 | xxxxxxxx | Minute (10's digit) | | 30 |
| 20 | xxxxxxxx | Minute (1's digit) | | 33 |
| 21 | 00101110 | ". " | | 2E |
| 22 | xxxxxxxx | Minute (0.1's digit) | | 39 |
| 23 | xxxxxxxx | Minute (0.01's digit) | | 37 |
| 24 | xxxxxxxx | Minute (0.001's digit) | | 39 |
| 25 | 01001100 | ", " | | Fixed |
| 26 | xxxxxxxx | Latitude direction "N" or "S" | North latitude | 4E |
| 27 | 01001100 | ", " | Fixed | 2C |
| 28 | xxxxxxxx | Longitude Degree (100's digit) | 140° 10.296' | 31 |
| 29 | xxxxxxxx | Degree (10's digit) | | 34 |
| 30 | xxxxxxxx | Degree (1's digit) | | 30 |
| 31 | xxxxxxxx | Minute (10's digit) | | 31 |
| 32 | xxxxxxxx | Minute (1's digit) | | 30 |
| 33 | 00101110 | ". " | | 2E |
| 34 | xxxxxxxx | Minute (0.1's digit) | | 32 |
| 35 | xxxxxxxx | Minute (0.01's digit) | | 39 |
| 36 | xxxxxxxx | Minute (0.001's digit) | | 36 |

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--------------------------------------|----------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 37 | 01001100 | ", " | Fixed | 2C |
| 38 | xxxxxxx | Longitude direction "E" or "W" | West longitude | 57 |
| 39 | 01001100 | ", " | Fixed | 2C |
| 40 | xxxxxxx | Speed (knots) 100's digit | 20knot/h | 30 |
| 41 | xxxxxxx | 10's digit | | 32 |
| 42 | xxxxxxx | 1's digit | | 30 |
| 43 | 00101110 | ". " | | 2E |
| 44 | xxxxxxx | 0.1's digit | | 30 |
| 45 | 01001100 | ", " | Fixed | 2C |
| 46 | xxxxxxx | Heading (°) 100's digit | 48.5° | 30 |
| 47 | xxxxxxx | 10's digit | | 34 |
| 48 | xxxxxxx | 1's digit | | 38 |
| 49 | 00101110 | ". " | | 2E |
| 50 | xxxxxxx | 0.1's digit | | 35 |
| 51 | 01001100 | ", " | Fixed | 2C |
| 52 | xxxxxxx | Date 10's digit | July 13, 1999 | 31 |
| 53 | xxxxxxx | 1's digit Month | | 33 |
| 54 | xxxxxxx | 10's digit | | 30 |
| 55 | xxxxxxx | 1's digit Year | | 37 |
| 56 | xxxxxxx | 10's digit | | 39 |
| 57 | xxxxxxx | 1's digit | | 39 |
| 58 | 01001100 | ", " | | Fixed |
| 59 | 01001100 | ", " | Fixed | 2C |
| 60 | 00101010 | " * " | Fixed | 2A |
| 61 | xxxxxxx | Checksum Hexadecimal upper digits | 4A | 34 |
| 62 | xxxxxxx | Hexadecimal lower digits | | 41 |
| 63 | 00001101 | Terminator <CR> | Fixed | 0D |
| 64 | 00001010 | <LF> | | 0A |

The Magnetic Variation parameter is not output.
(between No. 58 and No. 59, and between No. 59 and No. 60)

2-1-6. GPVTG message

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--------------------------------------|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 00100100 | Header "\$" | Fixed | 24 |
| 2 | 01000111 | Address field "G" | Fixed | 47 |
| 3 | 01010000 | "P" | | 50 |
| 4 | 01010110 | "V" | | 56 |
| 5 | 01010100 | "T" | | 54 |
| 6 | 01000111 | "G" | | 47 |
| 7 | 01001100 | ", " | | Fixed |
| 8 | xxxxxxxx | Heading (°) 100's digit | 48.5° | 30 |
| 9 | xxxxxxxx | 10's digit | | 34 |
| 10 | xxxxxxxx | 1's digit | | 38 |
| 11 | 00101110 | ". " | | 2E |
| 12 | xxxxxxxx | 0.1's digit | | 35 |
| 13 | 01001100 | ", " | Fixed | 2C |
| 14 | 01010100 | "T" | Fixed | 54 |
| 15 | 01001100 | ", " | Fixed | 2C |
| 16 | 01001100 | ", " | Fixed | 2C |
| 17 | 01001101 | "M" | Fixed | 4D |
| 18 | 01001100 | ", " | Fixed | 2C |
| 19 | xxxxxxxx | Speed (knots) 100's digit | 20knot/h | 30 |
| 20 | xxxxxxxx | 10's digit | | 32 |
| 21 | xxxxxxxx | 1's digit | | 30 |
| 22 | 00101110 | ". " | | 2E |
| 23 | xxxxxxxx | 0.1's digit | | 30 |
| 24 | 01001100 | ", " | Fixed | 2C |
| 25 | 01001110 | "N" | Fixed | 4E |
| 26 | 01001100 | ", " | Fixed | 2C |
| 27 | xxxxxxxx | Speed (km/h) 100's digit | 20km/h | 30 |
| 28 | xxxxxxxx | 10's digit | | 32 |
| 29 | xxxxxxxx | 1's digit | | 30 |
| 30 | 00101110 | ". " | | 2E |
| 31 | xxxxxxxx | 0.1's digit | | 30 |
| 32 | 01001100 | ", " | Fixed | 2C |
| 33 | 01001011 | "K" | Fixed | 4B |
| 34 | 00101010 | " * " | Fixed | 2A |
| 35 | xxxxxxxx | Checksum Hexadecimal upper digits | 4A | 34 |
| 36 | xxxxxxxx | Hexadecimal lower digits | | 41 |

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--------------------|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 37 | 00001101 | Terminator <CR> | Fixed | 0D |
| 38 | 00001010 | <LF> | | 0A |

The Course Over Ground and Degree Magnetic parameters are not output.
(between No. 15 and No. 16)

2-1-7. GPZDA message

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--------------------------------------|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 1 | 00100100 | Header "\$" | Fixed | 24 |
| 2 | 01000111 | Address field "G" | Fixed | 47 |
| 3 | 01010000 | "P" | | 50 |
| 4 | 01011010 | "Z" | | 5A |
| 5 | 01000100 | "D" | | 44 |
| 6 | 01000001 | "A" | | 41 |
| 7 | 01001100 | ", " | | Fixed |
| 8 | xxxxxxxx | UTC time Hour (10's digit) | 06:22:43 | 00 |
| 9 | xxxxxxxx | Hour (1's digit) | | 36 |
| 10 | xxxxxxxx | Minute (10's digit) | | 32 |
| 11 | xxxxxxxx | Minute (1's digit) | | 32 |
| 12 | xxxxxxxx | Second (10's digit) | | 34 |
| 13 | xxxxxxxx | Second (1's digit) | | 33 |
| 14 | 01001100 | ", " | Fixed | 2C |
| 15 | xxxxxxxx | Date 10's digit | 13th | 31 |
| 16 | xxxxxxxx | 1's digit | | 33 |
| 17 | 01001100 | ", " | Fixed | 2C |
| 18 | xxxxxxxx | Month 10's digit | July | 30 |
| 19 | xxxxxxxx | 1's digit | | 37 |
| 20 | 01001100 | ", " | Fixed | 2C |
| 21 | xxxxxxxx | Year 10's digit | 1999 | 39 |
| 22 | xxxxxxxx | 1's digit | | 39 |
| 23 | 01001100 | ", " | Fixed | 2C |
| 24 | 01001100 | ", " | Fixed | 2C |
| 25 | 00101010 | " * " | Fixed | 2A |
| 26 | xxxxxxxx | Checksum Hexadecimal upper digits | 4A | 34 |
| 27 | xxxxxxxx | Hexadecimal lower digits | | 41 |
| 28 | 00001101 | Terminator <CR> | Fixed | 0D |
| 29 | 00001010 | <LF> | | 0A |

The Local Zone Description parameter is not output.
(between No. 23 and No. 24, and between No. 24 and No. 25)

2-1-8. PSNY message (manufacturer expanded output)

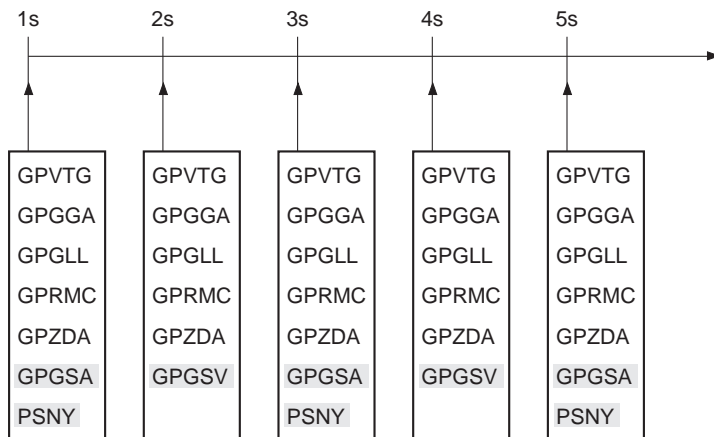
| No. | BIT 76543210 | Contents | Example | | |
|-----|-----------------|---|---------------|----------------------|----|
| | | | Setting value | Output data (HEX) | |
| 1 | 00100100 | Header "\$" | Fixed | 24 | |
| 2 | 01010000 | Address field "P" | Fixed | 50 | |
| 3 | 01010011 | "S" | | 53 | |
| 4 | 01011110 | "N" | | 5E | |
| 5 | 01011001 | "Y" | | 49 | |
| 6 | 01001100 | ", " | | Fixed | 2C |
| 7 | xxxxxxxx | Preamplifier status "0": Normal "1": Open "2": Shorted | Open | 31 | |
| 8 | 01001100 | ", " | Fixed | 2C | |
| 9 | xxxxxxxx | Geodesic system "0" to "25" | WGS-84 | 30 | |
| 10 | xxxxxxxx | | | 30 | |
| 11 | 01001100 | ", " | Fixed | 2C | |
| 12 | xxxxxxxx | Angle of elevation limit (°) 10's digit | 5° | 30 | |
| 13 | xxxxxxxx | | | 1's digit | 35 |
| 14 | 01001100 | ", " | Fixed | 2C | |
| 15 | xxxxxxxx | Speed limit (km/h) 100's digit | 500km/h | 35 | |
| 16 | xxxxxxxx | | | 10's digit | 30 |
| 17 | xxxxxxxx | | | 1's digit | 30 |
| 18 | 01001100 | ", " | Fixed | 2C | |
| 19 | xxxxxxxx | PDOP limit (D-GPS on) 10's digit | 4 | 30 | |
| 20 | xxxxxxxx | | | 1's digit | 34 |
| 21 | 01001100 | ", " | Fixed | 2C | |
| 22 | xxxxxxxx | HDOP limit (D-GPS on) 10's digit | 6 | 30 | |
| 23 | xxxxxxxx | | | 1's digit | 36 |
| 24 | 01001100 | ", " | Fixed | 2C | |
| 25 | xxxxxxxx | PDOP limit (D-GPS off) 10's digit | 4 | 30 | |
| 26 | xxxxxxxx | | | 1's digit | 34 |
| 27 | 01001100 | ", " | Fixed | 2C | |
| 28 | xxxxxxxx | HDOP limit (D-GPS off) 10's digit | 6 | 30 | |
| 29 | xxxxxxxx | | | 1's digit | 36 |

| No. | BIT 76543210 | Contents | Example | |
|-----|-----------------|--|---------------|----------------------|
| | | | Setting value | Output data (HEX) |
| 30 | 00101010 | " * " | Fixed | 2A |
| 31 | xxxxxxx | Checksum | 4A | 34 |
| 32 | xxxxxxx | Hexadecimal upper digits Hexadecimal lower digits | | |
| 33 | 00001101 | Terminator <CR> | Fixed | 0D |
| 34 | 00001010 | <LF> | | |

2-2. Output Timing

1s period: GPVTG, GPGGA, GPGLL, GPRMC, GPZDA

2s period: GPGSA, PSNY, GPGSV



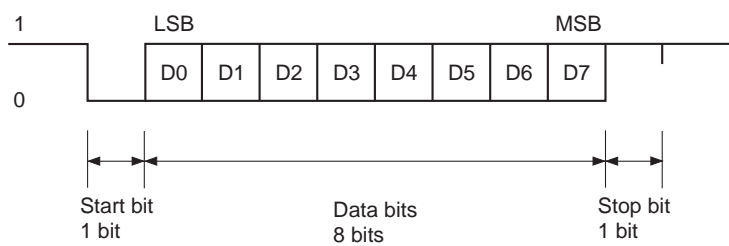
3. D-GPS Data Input Specifications

3-1. Communication

3-1-1. Serial input communication method

| | |
|-------------------------------|--------------------------------------|
| Interface: | Asynchronous serial interface (UART) |
| I/O channel: | CH1 |
| Baud rate: | 9600bps |
| Start bit: | 1 bit |
| Data bits: | 8 bits |
| Stop bit: | 1 bit |
| Parity bit: | None |
| Communication control signal: | None |
| Input period: | 1s or more |

3-1-2. Asynchronous serial interface

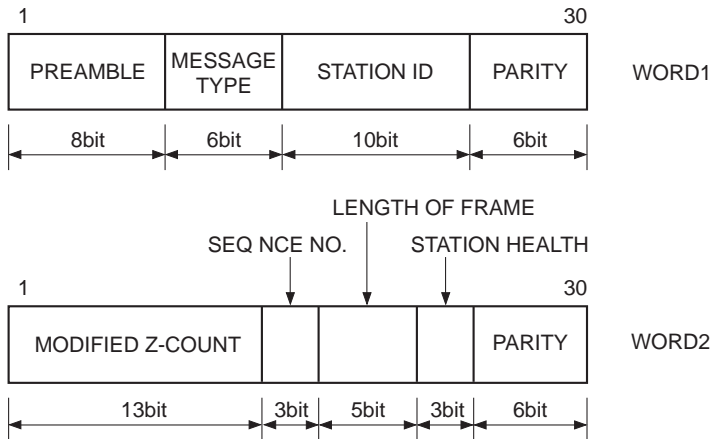


3-2. RTCM Data Input

RTCM data input conforms to the RTCM SC-104 format and supports message type 1.

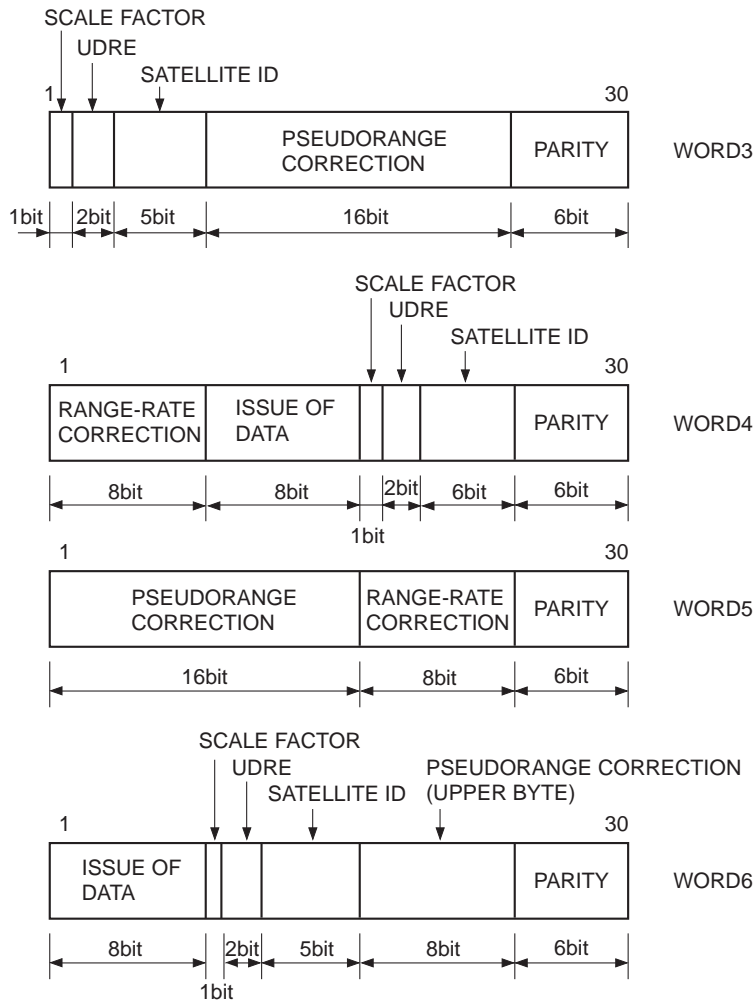
The message type shared header and message type 1 format are shown below. These data are sent in the "6 of 8" format. In this format, each word is divided into 6-bit units, the bits are reordered so that the LSB comes first and the MSB comes last, and then "01" is added to the head of the bits.

3-2-1. Message type shared header

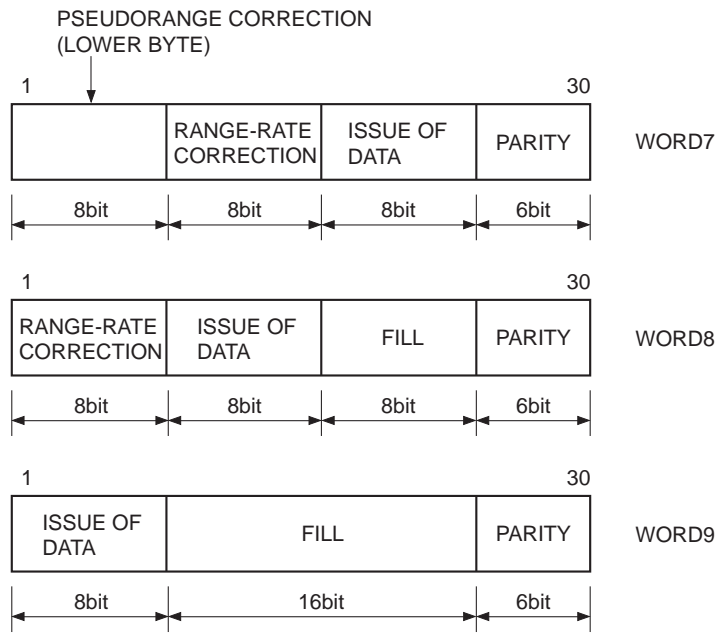


- PREAMBLE: Preamble
- MESSAGE TYPE: Message type
- STATION ID: Reference station ID No.
- PARITY: Error correction code
- MODIFIED Z-COUNT: Modified Z-count
- SEQ NCE NO.: Frame sequence No.
- LENGTH OF FRAME: Frame length
- STATION HEALTH: Reference station health

3-2-2. Message type 1 (differential GPS correction value)



- SCALE FACTOR: Pseudorange correction value scale factor
- UDRE: User differential range error index
- SATELLITE ID: Satellite ID No.
- PSEUDORANGE CORRECTION: Pseudorange correction value
- RANGE-RATE CORRECTION: Pseudorange rate-of-change correction value
- ISSUE OF DATA: Data issue No.



FILL: Dummy bit

3-3. DARC Data Input

DARC data is output in the communication format noted below. The D-GPS basic data is located in the D-GPS segments. The D-GPS basic data is comprised of 288 bits (36 bytes).

| Data packet 1 22 bytes | | Data packet 2 22 bytes | | | Checksum 1 byte | Terminator 1 byte |
|---------------------------|------------------------------|---------------------------|------------------------------|----------------|--------------------|----------------------|
| Prefix 4 bytes | D-GPS segment 18 bytes | Prefix 2 bytes | D-GPS segment 18 bytes | CRC 2 bytes | xxh | 0Dh |

The D-GPS basic data configuration is as follows.

| Bit position | Description | Number of bits |
|--------------|-----------------------------------|----------------|
| 1 to 3 | D-GPS data ID | 3 bits |
| 4 | Correction time | 1 bit |
| 5 to 38 | 1st GPS satellite correction data | 34 bits |
| 39 to 72 | 2nd GPS satellite correction data | 34 bits |
| 73 to 106 | 3rd GPS satellite correction data | 34 bits |
| 107 to 140 | 4th GPS satellite correction data | 34 bits |
| 141 to 174 | 5th GPS satellite correction data | 34 bits |
| 175 to 208 | 6th GPS satellite correction data | 34 bits |
| 209 to 242 | 7th GPS satellite correction data | 34 bits |
| 243 to 276 | 8th GPS satellite correction data | 34 bits |
| 277 to 288 | Communication data | 12 bits |

The GPS satellite correction data configuration is as follows.

| Bit position | Description | Number of bits |
|--------------|---|----------------|
| 1 | Scale factor | 1 bit |
| 2 to 3 | UDRE (User differential range error index) | 2 bits |
| 4 to 8 | GPS satellite ID | 5 bits |
| 9 to 19 | PRC (Pseudorange correction value) | 11 bits |
| 20 to 26 | RRC (Pseudorange rate-of-change correction value) | 7 bits |
| 27 to 34 | IODE (Ephemeris data issue No.) | 8 bits |