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SPECIFICATION

(For Reference)

MODEL NAME	GPS-54 TYPE GPS RECEIVER MODULE		
PART NAME	GPS-54D(B)-014-S45R0D0A34		
MANUFACTURER	POSITION COMPANY LIMITED		
COUNTRY OF ORIGIN	JAPAN	TOTAL PAGES	28 PAGES

This cover is included in total pages.

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APPROVED	PERSON RESPONSIBLE	APPROVED	PREPARED
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TABLE OF CONTENTS

REVISION RECORD

EDITION	DATE	PAGE NO.	DESCRIPTION	PREPARED	APPROVED

PRECAUTIONS

GPS (Global Positioning System) is a satellite-based navigation system. In an unobstructed, clear view of the sky, GPS-54 can position anywhere in the world, 24 hours a day.

This system was developed by the government of the United States and operated under management of the government. Under the policy of the government, the degradation of accuracy will occur without announcement in advance, and sometimes satellites do not transmit signal due to adjustment, test, and orbital revision.

Please aware that specifications in this document does not warrant against the above factors, Moreover, please use GPS-54 in enough consideration of the following notes.

(GENERAL)

We cannot take responsibility about the defect or trouble caused by modification or improper handling after shipment from out manufacturing factory.

(POSITION ACCURACY)

Satellite geometry, electromagnetic interference, and multipath will affect positioning data and degrade the position accuracy.

(POWER)

GPS-54 needs the stable power supply for the stable operation. The ripple voltage affects the performance of the positioning. Please inset series regulator, 100µF or more capacitor, and other devices to supply the stable power to the GPS-54.

(POWER AND DATA CABLE)

The impedance becomes high with long power and data cable and this will make easy for GPS-54 to be affected by the noise. Please make the power and data cable as short as possible not to be affected by the noise when installing to the other equipment.

The noise generated by GPS-54 is radiated from the power and data cable. Please avoid placing the power and data cable to the RF input.

(EQUIPMENT)

[Noise] Please keep GPS-54 as far away from the other circuit and the equipment that generates noise as possible. The high frequency noise within the receiver frequency band, 1575.42MHz ± 10MHz band will affect the receiver quality. Also because of the mixer and modulation, the low frequency noise will be increased the frequency by several times. If the increased frequency drops into the 1575.42 ± 10MHz band, the frequency will also affect the receiver quality and cast problem. In case of installing to the other equipment, it is suggested to install GPS-54 on the ground layer around 50mm x 50mm or more in order to strengthen sensitivity.

[Temperature] GPS-54 should not be placed close to heat and fans. Drastic change of temperature will still degrade the signal receiving even with the operational temperature.

(HANDLING)

Please wear anti static electricity bundle while handling the GPS-54. Static electricity will destroy IC and erase backup data. Please make sure to plug in or out the power and data cable in power-off condition.

Strong electromagnetic wave or noise generated by the other equipments will affect the performance of the positioning of GPS receiver module and when the worst, they will interrupt positioning or GPS-54 cannot come back from sleep mode on time. In such a case, please interrupt the main power supply and re-apply the main power supply after several seconds. When GPS-54 still cannot receive or position, please interrupt the backup power supply in addition to main power supply and re-apply the main power supply.

(PERFORMANCE)

Values in this document are acquired by our GPS receiver module with our standard GPS antenna. In case of installing to the other equipment, values in this document may not be acquired. In such a case, please take a measure according to note matters mentioned above.

1 SCOPE AND APPLICABILITY

This document is related with the specification and the performance of GPS-54 type GPS receiver module "GPS-54D(B)-014-S45R0D0A34".

2 COMPOSITION

Model name	Part name	Quantity	Notes
GPS receiver module	GSU-54D(B)-014	1	Installing to cover
Upper shield cover	G73ECD402A	1	
GPS antenna	DAX1575MS83T	1	Passive antenna Installing to cover

3 PERFORMANCE

Parameter		Description *3-1*
Receiving method		12 channel parallel
Receiving frequency		1575.42MHz±1MHz, C/A code
Sensitivity *3-2*	Tracking	-145dBm
	Acquisition	-134dBm
Accuracy	Position	15m or less (2drms): GPS (SA=OFF, PDOP≤3)
	Velocity	1m/s or less (rms): GPS (SA=OFF, PDOP≤3)
Dynamics	Altitude	-500m ~ 18000m
	Velocity	1800km/h or less
	Acceleration	2g or less
TTFF *3-3*	Cold start	70sec (typical, @normal temp.) *3-4*
	Warm start	38sec (typical, @normal temp.) *3-5*
	Hot start	8sec (typical, @normal temp.) *3-6*
Minimum unit	2D Position	10^{-4}min.
	Altitude	10^{-1}m
	Velocity	10^{-2}km/h, 10^{-2}knot
	Direction	10^{-2}°
Update rate		1sec
Positioning mode		2D and 3D automatic
Low power mode		Time setting and ON/OFF control
Differential GPS		SBAS *3-7*
Output format		NMEA-0183 compatible
Power supply *3-8*	Normal mode	+3.1VDC~+3.6VDC (@normal temp.)
	Back up mode	+2.1VDC~+3.6VDC (@normal temp.)
Current Consumption *3-8*	Normal mode	56mA~75mA (@normal temp.)
	Back up mode	6μA (typical, @normal temp.)
Operational temperature		-30°C~+80°C *3-9*
Storage temperature		-40°C~+80°C
Dimensions		20.8mm (W) x 20.8mm (D) x 9.2mm (H) *3-10* (Including cover and antenna, excluding projections)
Weight		12g or less (Including cover and antenna)

*3-1 : The above listed performance is based on the data acquired by the actual standard test conducted at Position Company Limited, and the performance may be degraded by user position, user environment, or test time.

*3-2 : When installing directly to the host PWB, make the ground pattern around GPS-54 and do not make signal lines around GPS-54.
When make ground pattern of 50 x 50 mm or more, this will be measures to noise.

*3-3 : TTFF is counted from the beginning of the serial NMEA message output.

*3-4 : Cold start means that GPS receiver module starts positioning without valid almanac data, valid ephemeris data, estimated position data, time and date at the open sky. (There are no blocks between GPS receiver module and GPS satellites whose elevation angles are higher than default elevation angles.)

*3-5 : Warm start means that GPS receiver module starts positioning with valid almanac data, estimated position data, time and date, without valid ephemeris data at the open sky. (There are no blocks between GPS receiver module and GPS satellites whose elevation angles are higher than default elevation angles.)

*3-6 : Hot start means that GPS receiver module starts positioning with valid almanac data, valid ephemeris data (ephemeris data is valid within 4 hours), estimated position data, time and date, at the open sky. (There are no blocks between GPS receiver module and GPS satellites whose elevation angles are higher than default elevation angles.)

*3-7 : At present, EGNOS and MSAS is in the examination broadcasting and contents of broadcast may affect position accuracy. When the formal broadcasting begins, the factors of the broadcasting contents change may degrade the precision of SBAS (specs: 7m/2drms), and when the worst, it may become not possible to do use.
It takes about 2~3 minutes after starting GPS positioning to start DGPS positioning by SBAS satellites (e.g.: latitude>60°, longitude>70° from SBAS satellite, or elevation angle of SBAS satellite<10°), because the receiving electric power is weaker than the GPS satellite.

*3-8 : For details, refer to “4.2.2 MAXIMUM RATINGS”, or “4.2.3 RATINGS”. The value of the operation voltage is the value at the terminal of the connector and does not include voltage drop such as that in the cable.

*3-9 : TTFFs out of normal temperature are less than 3 minutes, and in this case S/N degradation is less than 3dB.

*3-10 : For details, refer to “OUTLINE AND DIMENSIONAL DRAWING”.

4 SPECIFICATION

4.1 EXTERNAL VIEW

Refer to "OUTLINE AND DIMENSIONAL DRAWING".

4.2 ELECTRICAL CHARACTERISTICS

4.2.1 TERMINALS

Circuit sign J2	Signal name	Function *4.2-1*	
1	$\overline{\text{RD0}}$	Serial data input (For command input)	
2	GND	Ground	
3	$\overline{\text{SD0}}$	Serial data output	
4	BATT	Back-up power supply input	
5	VCC	Main power supply input	
6	VANT	Not available	
7	1PPS	Low power mode Control *4.2-2*	Low power mode: NC, or L level
			Full power mode: H level
8	NC	Not available (Non connection)	

Receptacle
J2: A3-8PA-2SV (HRS)

4.2-1 : Place unused terminals open.

4.2-2 : This terminal is used for control of low power control. When GPS-54 operates in low power mode and this terminal is at low level, GPS-54 will be forced to shift to full power mode. Since then this terminal will be at high level and GPS-54 will re-shift to low power mode. Refer to 4.3.3.2 "COMMAND".

4.2.2 MAXIMUM RATINGS

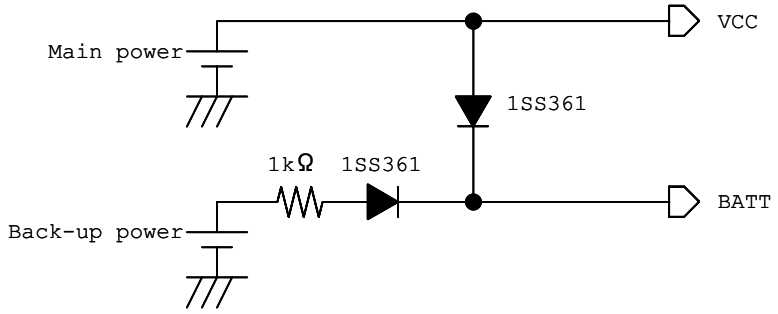
Parameter	Rating value	Unit	Notes
VCC Input voltage	-0.4~+4	V	
BATT Input voltage	-0.3~+12	V	
RD0, 1PPS Input voltage	-0.3~+5	V	
SD0 Output voltage	-0.3~3.1	V	
SD0 Output current	±25	mA	

4.2.3 RATINGS

Parameter			Rating value *4.2.3-1*			Unit	Remarks
			Minimum	Typical	Maximum		
VCC *4.2.3-2*	Voltage		3.1	3.3	3.6	V	
	Current *4.2.3-3*		56	64	75	mA	Full power mode
			-	15	-	mA	Low power mode 1
			-	300	-	µA	Low power mode 2
	Low Freq.		-	-	100	mVpp	
BATT *4.2.3-2*	Voltage		2.1	-	3.6	V	
	Current		-	6	12	µA	*4.2.3-4*
RD0, 1PPS *4.2.3-5*	H	Voltage	2.0	-	VCC	V	
	L	Voltage	-	-	0.8	V	
SD0 *4.2.3-5*	H	Voltage	2.3	-	2.8	V	
		Current	-	-	2	mA	
	L	Voltage	-	-	0.4	V	
		Current	-	-	2	mA	

4.2.3-1 : Each value is acquired under normal temperature.

4.2.3-2 : Please add the following circuit. In case that this circuit is not added, GPS-54 will not work.



4.2.3-3 : In low power mode, GPS-54 repeats full power operation, low power 1 operation, and low power 2 operation. Time of each operation is changed by setting.

4.2.3-4 : This value is acquired in case that VCC is not applied.

4.2.3-5 : Place unused terminals open.

4.3 INTERFACE

4.3.1 COMMUNICATION SPECIFICATION

Parameter	Specification *4.3.1-1*
Communication method	Full duplex asynchronous
Baud rate	9600bps
Start bit	1bit
Data bit	8bit
Stop bit	1bit
Parity bit	None
Input signal level	0V~VCC, Normal high
Output signal level	0V~2.8V, Normal high

4.3.1-1 : Communication is forbidden until 3 seconds after application of main power supply.
Each value is default and changeable by command input. For details, refer to 4.3.3.2 “COMMAND”.

4.3.2 BIT COMPOSITION

*: D7 is fixed logical 0 in case of ASCII code.

4.3.3 INPUT

4.3.3.1 INPUT FORMAT

$PSRF XXX, <Parameter 1>, ·····, <Parameter X>,*hh <CR><LF>
1 2 3 4 5

1. Header
   ASCII code
2. Command ID
   ASCII code
3. Parameter *4.3.3.1-1*
   ASCII code
4. Checksum
   8bit EX-OR of all character between “$” and “*” in the sentence (not including “$” and “*”)
5. Terminator
   Carriage return and line feed

4.3.3.1-1: Number of parameters depends on command ID. Separate each parameter with a “,” delimiter.

4.3.3.2 COMMAND

(1) Communication setting

$PSRF100, 1, X, 8, 1, 0*hh<CR><LF>
1 2

1. Message ID
2. Baud rate
   Value: 4800, 9600, 19200, 38400
   Unit: bps

e.g.)Set baud rate to 19200bps
$PSRF100,1,19200,8,1,0*38<CR><LF>

(2) Message control

$PSRF103, X, X, X, X*hh<CR><LF>
1 2 3 4 5

1. Message ID
2. Message
   0: GPGGA
   1: GPGLL
   2: GPGSA
   3: GPGSV
   4: GPRMC
   5: GPVTG
   8: GPZDA
3. Output mode
   0: Set rate
   1: Query
4. Rate
   Valid when setting "0"(Set rate) of "3. Output mode".
   Set "0" when setting "1"(Query) of "3. Output mode".
   Range: 0(=off), 1~255
   Unit: Seconds
5. Checksum
   0: Disable
   1: Enable

e.g.)Set GPGGA with checksum to output at 2 seconds interval
$PSRF103,0,0,2,1*26<CR><LF>
e.g.)Set GPGLL without checksum to output once after inputting command
$PSRF103,1,1,0,0*25<CR><LF>

(3) Initialization **4.3.3.2-1*

$PSRF104, 0, 0, 0, 0, 0, 0, 12, X*hh<CR><LF>
1 2

1. Message ID
2. Stating mode
   1: Hot start
   All data valid
   2: Warm start
   Ephemeris cleared
   4: Cold start
   Clears all data in memory
   8: Clear memory
   Clears all data in memory and resets receiver back to factory defaults

e.g.)Set clear memory mode of initialization
$PSRF104,0,0,0,0,0,0,12,8*19<CR><LF>

(4) Datum

$PSRF106, X*hh<CR><LF>
1 2

1. Message ID
2. Datum setting
   21: WGS-84
   178: TOKYO Mean solution
   179: TOKYO Japan
   180: TOKYO Korea
   181: TOKYO Okinawa

e.g.)Set datum to WGS-84
$PSRF106,21*0F<CR><LF>

(5) DOP mask

$PFST210, X, 50, X, X*hh<CR><LF>
1 2 3 4

1. Message ID
2. Mode
   0: Auto (PDOP and HDOP)
   1: PDOP
   2: HDOP
   3: Reserved
   4: Never use
3. PDOP mask
   Range: 1~50
4. HDOP mask
   Range: 1~50

e.g.)Set DOP mask mode to PODP mask mode and PDOP mask to 15
$PSRF210,1,50,15,10*15<CR><LF>
(Available to set other value for HDOP mask)

(6) Elevation mask

$PSRF211, 50, X*hh<CR><LF>
1 2

1. Message ID
2. Elevation mask for navigation
   Unit: 10^{-1} degrees
   Range: -200~900

e.g.)Set elevation mask to use 15 degrees and over satellites for navigation
$PSRF211,50,150*14<CR><LF>

(7) C/N mask

$PSRF212, 28, X*hh<CR><LF>
1 2

1. Message ID
2. C/N mask for navigation
   Unit: dBHz
   Range: 20~50

e.g.)Set C/N mask to use 35 dBHz and over satellites for navigation
$PSRF212,28,35*2A<CR><LF>

(8) Power management **4.3.3.2-2*

$PSRF213, 0, X, X, X, X*hh<CR><LF>
1 2 3 4

1. Message ID
2. Full power time
   Unit: milliseconds
   Range: 200~900
   Set multiple of 100.
3. Update rate
   Unit: milliseconds
   Range: 1000~10000
   Set multiple of 1000.
4. Power management switch
   0: Full power mode
   1: Low power mode
5. Low power mode control switch **4.3.3.2-3*
   0: No control
   1: Control by use of 1PPS terminal

e.g.)Set full power time to 300 msec and update rate to 5 sec and set operating mode to low power mode with on/off control by 1PPS terminal
$PSRF213,0,300,5000,1,1*0D<CR><LF>

(9) Low power management **4.3.3.2-4*

$PSRF214, X, X*hh<CR><LF>
1 2 3

1. Message ID
2. Maximum acquisition time
   Unit: milliseconds
   Range: 120000~600000
   Set multiple of 1000.
3. Maximum off time
   Unit: milliseconds
   Range: 20000~60000
   Set multiple of 1000.

e.g.)Set maximum acquisition time to 100 sec and maximum off time to 10 sec when GPS fix is not available in low power mode
$PSRF214,100000,10000*10<CR><LF>

(10) SBAS setting *4.3.3.2-5*

$PSRF215, X, X, X, X*hh<CR><LF>
1 2 3 4 5

1. Message ID
2. SBAS PRN
   Range: 0(Auto search), 121~136
3. Mode
   0: Test mode
   1: Integrity
4. Time-out
   Unit: seconds
   Range: 1~255
5. Setting
   Bit0 Time-out 0: Default 1: User
   Bit1 Health 0: Reserved
   Bit2 Correction 0: Reserved
   Bit3 SBAS PRN 0: Auto search 1: User
   Set decimal code changed from hex code.

e.g.)Set SBAS satellite search mode to auto search, mode to integrity, time-out to 30 sec.
$PSRF215,0,1,30,1*12<CR><LF>

(11) Pinning switch

$PSRF217, X*hh<CR><LF>
1 2

1. Message ID
2. Pinning switch
   0: Off
   1: On

e.g.)Set pinning on
$PSRF217,0*3F<CR><LF>

(12) Differential switch *4.3.3.2-5*

$PSRF218, X, 0, 0*hh<CR><LF>
1 2

1. Message ID
2. Differential source
   0: None
   1: SBAS
   2: Reserved

e.g.)Set DGPS mode to SBAS
$PSRF218,1,0,0*31<CR><LF>

(13) Initial position setting **4.3.3.2-6*

$PFST219, X, X, X*hh<CR><LF>
1 2 3 4

1. Message ID
2. Latitude
   Unit: degrees
   Range: -90~90
3. Longitude
   Unit: degrees
   Range: -180~180
4. Altitude
   Unit: meters
   Range: -500~18000

e.g.) Set latitude, longitude, and altitude to 35°40’41.40’’ N, 139°46’9.59’’ E, 15 meters
$PSRF219,35.6780667,139.7693306,15*36<CR><LF>

(15) Local time setting **4.3.3.2-7*

$PFST221, X*hh<CR><LF>
1

1. Message ID
2. Local time setting
   Unit: 1 by 6 minutes
   Range: -115~115

e.g.) Set JST (UTC+9hours, 540minutes/6minutes=90)
$PSRF221,90*03<CR><LF>

*4.3.3.2-1: GPS-54 cannot accept command input for 3 seconds after inputting initialization command.

*4.3.3.2-2: In low power mode, GPS-54 shifts to full power mode every 30 minutes in order to update ephemeris and correct RTC.

*4.3.3.2-3: In low power mode, in case of setting low power mode control switch "0, No control", command can be input in only full power process. In case of setting "1, control by 1PPS terminal", when 1PPS terminal is at high level, GPS-54 will be forced to shift to full power mode and command can be input. Then 1PPS terminal is set to low level again, GPS-54 will re-shift back to low power mode. When setting "1", change high level to low level or low level to high level beforehand. In case that GPS-54 cannot shift to low power mode after changing high level to low level, interrupt main power supply and re-apply.

*4.3.3.2-4: In low power mode, when GPS fix cannot be gotten for several seconds to several tens of seconds continuously, GPS-54 will repeat full power mode and low power mode by setting of maximum acquisition time and maximum off time. After that, GPS fix can be gotten then GPS-54 will re-shift to low power mode.

*4.3.3.2-5: Set differential switch to SBAS mode before SBAS setting.

*4.3.3.2-6: When inputting during GPS or DGPS fix, acknowledge message will be output but actual command will be ignored.

*4.3.3.2-7: When setting parameter that is out of range, following message will be output.

<116 and above>

$Range out > 115: Input221.<CR><LF>

<-116 and below>

$Range our < -115: Input221.<CR><LF>

This command is applied to GPGGA and GPRMC and not to GPGLL and GPZDA.

4.3.3.3 COMMAND LIST

Command	Message ID	Range *4.3.3.3-1*	Default
Communication	100	Baud rate: 4800~38400	9600
Message control	103	Message: 0~8	-
		Mode: 0~1	-
		Rate: 0~255	-
		Checksum: 0~1	-
Initialization	104	Mode: 1~8	-
Datum	106	21: WGS-84 178: TOKYO mean solution 179: TOKYO Japan 180: TOKYO Korea 181: TOKYO Okinawa	178
DOP mask	210	Mode: 0~4	0
		PDOP: 1~50	20
		HDOP: 1~50	20
Elevation mask	211	-200~900	75
C/N mask	212	20~50	28
Power management	213	Full power time: 300~900	-
		Update rate: 1000~6000	-
		Power management switch: 0~1	0
		Low power mode control switch: 0~1	0
Low power management	214	Max acquisition time: 120000~600000	120000
		Max off time: 20000~60000	30000
SBAS setting	215	SBAS PRN: 0, 121~136	-
		Mode: 0~1	-
		Time-out: 1~255	18
		Setting: 0~15	-
Pinning switch	217	0~1	1
Differential switch	218	0~2	2
Initial position Setting	219	Latitude: -90~90	36
		Longitude: -180~180	136
		Altitude: -500~18000	0
Local time setting	221	-115~115	0

4.3.3.3-1: Value out of range can be input by command, but do not input such a value because GPS-54 may malfunction.

4.3.4 OUTPUT

4.3.4.1 POSITIONING DATA

ASCII code
NMEA-0183 format compatible

4.3.4.1.1 UPDATE RATE

1sec : GPGGA+GPGSA+GPGSV+GPRMC+GPVTG+GPZDA (Default output message)

4.3.4.1.2 OUTPUT ORDER

GPGGA+GPGLL+GPGSA+GPGSV+GPRMC+GPVTG+GPZDA **4.3.4.1-1*

4.3.4.1.3 OUTPUT FORMAT

$XXXXX, <Field 1>, ……<Field X> *hh <CR><LF>
1 2 3 4

1. Message ID
   ASCII code
2. Field **4.3.4.1-2*
   ASCII code
   Place delimiter “,” between header and fields, or between each field
3. Checksum
   8bit EX-OR of all character between “$” and “*” in the sentence (not including “$” and “*”)
4. Terminator
   Carriage return and line feed

4.3.4.1.4 SENTENCE

(1) GPGGA: GPS fix data *4.3.4.1-3*

$GPGGA, hhmmss.sss, ddmm.mmmm, N/S, dddmm.mmmm, E/W, v, ss, dd.d,
1 2 3 4 5 6 7 8
hhhhh.h, M, gggg.g, M, XXX.X, 0000*hh<CR><LF>
9 10 11 12 13

1. UTC of position fix *4.3.4.1-4*
   hh: Hours (Unit: Hours)
   mm: Minutes (Unit: Minutes)
   ss.sss: Seconds (Unit: Seconds)
   Output to 3 places of decimals
2. Latitude *4.3.4.1-5*
   dd: Degrees (Unit: Degrees)
   mm.mmmm: Minutes (Unit: Minutes)
   Output to 4 places of decimals
3. North/South latitude *4.3.4.1-5*
   N: North latitude
   S: South latitude
4. Longitude *4.3.4.1-5*
   ddd: Degrees (Unit: Degrees)
   mm.mmmm: Minutes (Unit: Minutes)
   Output to 4 places of decimals
5. East/West longitude *4.3.4.1-5*
   E: East longitude
   W: West longitude
6. GPS quality indicator
   0: Fix not available
   1: GPS fix valid
   2: DGPS fix valid
7. Number of satellites in use
   Range: 00~12
8. HDOP *4.3.4.1-6*
   Output to 1 place of decimals
9. Antenna altitude above/below mean sea level *4.3.4.1-5*
   Unit: Meters
   Output to 1 place of decimals
10. Unit of antenna altitude
    M: Meters
11. Geoidal separation *4.3.4.1-5*
    Unit: Meters
    Output to 1 place of decimals
12. Unit of geoidal separation
    M: Meters
13. Age of DGPS correction data
    Unit: Seconds
    Output to 1 place of decimals

(2) GPGSA: GNSS DOP and active satellites

GPGSA, A, X, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, pp.p, hh.h,
1 2 3 4
vv.v*hh<CR><LF>
5

1. Mode
   1: Fix not available
   2: 2D fix
   3: 3D fix
2. ID numbers of GPS satellites used in solution
   Range: 01~32
   Maximum numbers of satellites: 12
   Null for unused field but ",”s are output.
3. PDOP *4.3.4.1-6*
   Output to 1 place of decimals
4. HDOP *4.3.4.1-6*
   Output to 1 place of decimals
5. VDOP *4.3.4.1-6*
   Output to 1 place of decimals

(3) GPGSV: GNSS satellites in view

```
$GPGSV, n, m, ss, xx, ee, aaa, cn, xx, ee, aaa, cn, xx, ee, aaa, cn,
        1  2  3    8   9   10  11   8   9   10  11   8   9   10  11
                  <      4      >  <      5      >  <      6      >
xx, ee, aaa, cn*hh<CR><LF>
 8   9   10  11
<      7      >
```

1. Total numbers of messages
   Range: 1~3
2. Message number
   Range: 1~3
3. Total numbers of satellites in view
4. Information of 1st satellite **4.3.4.1-7*
5. Information of 2nd satellite **4.3.4.1-7*
   Null for unused fields (delimiter included)
6. Information of 3rd satellite **4.3.4.1-7*
   Null for unused fields (delimiter included)
7. Information of 4th satellite **4.3.4.1-7*
   Null for unused fields (delimiter included)
8. Satellite ID number
   Range: 01~32
9. Satellite elevation
   Range: 00~90
   Unit: Degrees
10. Satellite azimuth
    Range: 000~359
    Unit: Degrees
    True north is 0 degree, and CW.
11. Satellite SNR (C/No)
    Range: 00~99
    Unit: dBHz
    Null when not tracking at navigation start

(4) GPRMC: Recommended minimum specific GNSS data *4.3.4.1-3*

GPRMC, hhmmss.sss, A/V, ddmm.mmmm, N/S, dddmm.mmmm, E/W, ssss.ss, hhh.hh,
1 2 3 4 5 6 7 8
ddmmyy,,*hh<CR><LF>
9

1. UTC of position fix *4.3.4.1-4*
   hh: Hours (Unit: Hours)
   mm: Minutes (Unit: Minutes)
   ss: Seconds (Unit: Seconds)
   Output to 3 places of decimals
2. Status
   A: Data valid
   V: Data not valid
3. Latitude *4.3.4.1-5*
   dd: Degrees (Unit: Degrees)
   mm.mmmm: Minutes (Unit: Minutes)
   Output to 4 places of decimals
4. North/South latitude *4.3.4.1-5*
   N: North latitude
   S: South latitude
5. Longitude *4.3.4.1-5*
   ddd: Degrees (Unit: Degrees)
   mm.mmmm: Minutes (Unit: Minutes)
   Output to 4 places of decimals
6. East/West longitude *4.3.4.1-5*
   E: East longitude
   W: West longitude
7. Speed over ground *4.3.4.1-8*
   Unit: Knots
   1knot=1852m/h
   Output to 2 places of decimals
8. Course over ground *4.3.4.1-8*
   Unit: Degrees true
   True north is 0.00 degree, and CW.
   Output to 2 places of decimals
9. Date *4.3.4.1-4*
   dd: Day
   mm: Month
   yy: Year (lower 2 digits)

(5) GPVTG: Course over ground and ground speed **4.3.4.1-3*

$GPVTG, hhh.hh, T,, M, ssss.ss, N, ssss.ss, K*hh<CR><LF>
1 2 3 4 5 6 7

1. Course over ground **4.3.4.1-8*
   Unit: Degrees true
   True north is 0.00° and CW
   Output to 2 places of decimals
2. Unit of 1
   T: Degrees true
3. M: Degrees magnetic
4. Speed over ground **4.3.4.1-8*
   Unit: Knots
   Output to 2 places of decimals
5. Unit of 4
   N: Knots
   1knot=1852m/h
6. Speed over ground **4.3.4.1-8*
   Unit: Km/h
   Output to 2 places of decimals
7. Unit of 7
   K: Km/h

(6) GPZDA: Time and date **4.3.4.1-3*

$GPZDA, hhmmss.sss, dd, mm, yyyy,,*hh<CR><LF>
1 2 3 4

1. UTC **4.3.4.1-4*
   hh: Hours (Unit: Hours)
   mm: Minutes (Unit: Minutes)
   ss.sss: Seconds (Unit: Seconds)
   Output to 2 places of decimals
2. Date **4.3.4.1-4*
   dd: Day
3. Date **4.3.4.1-4*
   mm: Month
4. Date **4.3.4.1-4*
   yyyy: Year

(7) GPGLL: Geographic position –latitude/longitude-

$GPGLL, ddmm.mmmm, N/S, dddmm.mmmm, E/W, hhmmss.sss, A/V*hh<CR><LF>
1 2 3 4 5 6

1. Latitude **4.3.4.1-5*
   dd: Degrees (Unit: Degrees)
   mm.mmmm: Minutes (Unit: Minutes)
   Output to 4 places of decimals
2. North/South latitude **4.3.4.1-5*
   N: North latitude
   S: South latitude
3. Longitude **4.3.4.1-5*
   ddd: Degrees (Unit: Degrees)
   mm.mmmm: Minutes (Unit: Minutes)
   Output to 4 places of decimals
4. East/West longitude **4.3.4.1-5*
   E: East longitude
   W: West longitude
5. UTC of position fix **4.3.4.1-4*
   hh: Hours (Unit: Hours)
   mm: Minutes (Unit: Minutes)
   ss.sss: Seconds (Unit: Seconds)
   Output to 3 places of decimals
6. Status
   A: Data valid
   V: Data not valid

**4.3.4.1-1*: Sentences that are not requested to output will not be output.
**4.3.4.1-2*: Number of fields depends on message ID. Separate each field with a "," delimiter.
For details, refer to chapter 4.3.4.1.4 "Sentence".
**4.3.4.1-3*: Fields except "Age of DGPS correction data" of GPGGA are fixed length.
**4.3.4.1-4*: When fixing not available, time and date calculated by internal oscillator will be output.
**4.3.4.1-5*: When fixing not available, last fixed position will be output.
**4.3.4.1-6*: When fixing not available, actual values (in case of limit of DOP mask) or "99.9" (in case of shortage of receiving satellites).
When GPS or DPGS fix and each DOP value is above 50.0, "99.9" will be output.
**4.3.4.1-7*: When fixing not available, the value of satellite information may be incorrect because satellite information is calculated by internal clock and last fixed position.
**4.3.4.1-8*: When fixing not available, "999.99"(heading) and "9999.99"(velocity) will be output in these fields.

4.3.4.2 OUTPUT MESSAGE AT LOW POWER MODE

Following sentence will be output together with positioning data in low power mode.

$PSRF150, X,*hh<CR><LF>
1

1. Enable/disable information for command input
   0: Command input disable from now
   1: Command input enable from now

4.3.4.3 INITIAL OUTPUT VALUE

4.3.4.3.1 FACTORY RESET

Following values are output in case of first power-on after shipping or inputting "clear memory" by initialization command.

Parameter	Value
Latitude	36°00.0000′ N
Longitude	136°00.0000′ E
Antenna altitude	0m
Time and date	23:57:48, Date of almanac saved in flash ROM
Speed over ground	0.00knot, 0.00km/h
Course over ground	0.00°
Satellite information	Satellite information saved in Flash ROM

4.3.4.3.2 COLD START

Following values are output in case of second or later power-on without back-up battery, or inputting "cold start" by initialization command, or occurring internal error. And when internal error occurs, following values are also output. This start needs experience of GPS fix.

Parameter	Value
Latitude	36°00.0000′ N (power-on) Last fixed latitude (command)
Longitude	136°00.0000′ E (power-on) Last fixed longitude (command)
Antenna altitude	0m (power-on) Last fixed altitude (command)
Time and date	23:57:48, Date of almanac saved in flash ROM (power-on) Time calculated by internal RTC (command)
Speed over ground	0.00knot, 0.00km/h
Course over ground	0.00°
Satellite information	Satellite information saved in Flash ROM

4.3.4.3.3 WARM/HOT START

Following values are output in case of in case of second or later power-on with back-up battery, or inputting "warm start" or "hot start" by initialization command. This start mode needs experiences of GPS fix.

Parameter	Value
Latitude	Last fixed latitude
Longitude	Last fixed longitude
Antenna altitude	Last fixed altitude
Time and date	Time calculated by internal RTC
Speed over ground	0.00knot, 0.00km/h
Course over ground	0.00°
Satellite information	Information calculated by last fixed position, Time calculated by internal clock oscillator

4.3.4.4 INITIAL OUTPUT MESSAGE

When applying main power supply (VCC), following message will be output. Same messages may be output several seconds after applying main power supply (VCC).

$GSU-50 : Position Co.,Ltd.2003<CR><LF>
$Firmware Checksum: X<CR><LF> *4.3.4.4-1*
$TOW: X<CR><LF> *4.3.4.4-1*
$WK: X<CR><LF> *4.3.4.4-1*
$POS: X<CR><LF> *4.3.4.4-1*
$CLK: X<CR><LF> *4.3.4.4-1*
$CHNL: X<CR><LF> *4.3.4.4-1*
$Baud rate: X System clock: X<CR><LF> *4.3.4.4-1*
$HW Type: X<CR><LF> *4.3.4.4-1*
$Asic Version: X<CR><LF> *4.3.4.4-1*
$Clock Source: X<CR><LF> *4.3.4.4-1*
$Internal Beacon: X<CR><LF> *4.3.4.4-1*
$PSRF150,1,*12<CR><LF> *4.3.4.4-2*

4.3.4.4-1: Length of "X"s are variable, and each X is assigned by hardware and firmware.
4.3.4.4-2: This message is output once after power-on at full power mode.

4.3.4.5 OUTPUT MESSAGE AFTER COMMAND INPUT

4.3.4.5.1 ACKNOWLEDGE MESSAGE

When command is input successfully, the following message will be output.

$Ack Input XXX. <CR><LF>
1 2
1. Acknowledge message
2. Message ID
Command message ID

4.3.4.5.2 NEGATIVE ACKNOWLDGE MESSAGE

When command is not input successfully, one or other of following messages will be output.

$Nak Input XXX. <CR><LF>
1 2
1. Negative acknowledge message
2. Message ID
Command message ID

$NoOpHandler: Id:XXX Msg:<CR><LF><CR><LF>
1
1. Negative acknowledge message
"X"s part is variable length.

4.4 ENVIRONMENT

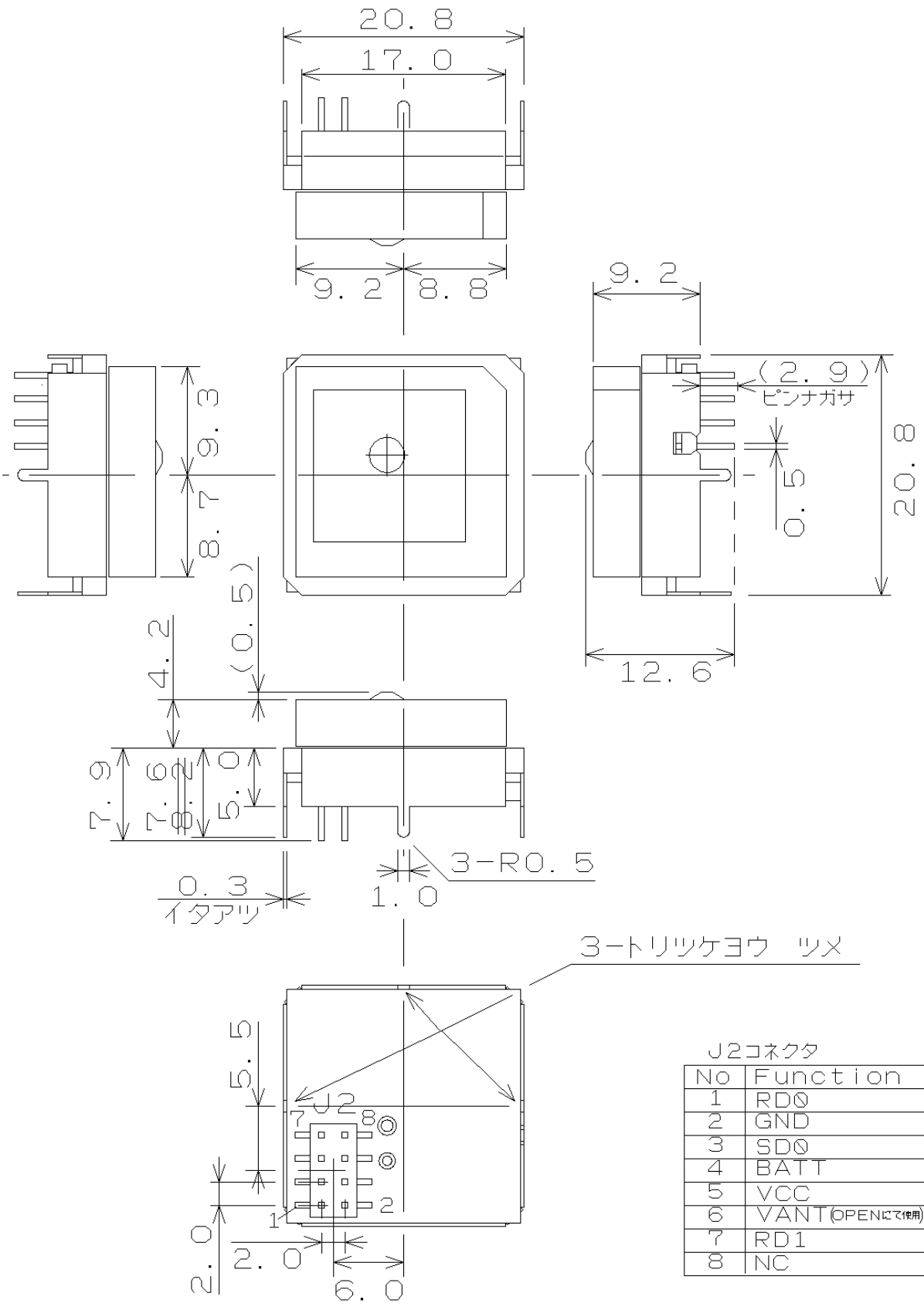
Parameter	Rating value	Unit	Notes
Operational temperature	-30~+80	℃	Refer to 3
Storage temperature	-40~+85	℃	
Humidity	95 or less	%RH	Non condensing, +55℃
Vibration	44.1	m/s^2	Non operation, 10~200Hz

5 PACKAGE

The packaging method is domestic transportation packing specified by our company, and the label which the following contents are written down on the box. Contents are our company name, part name, customer's name, shipping date, and gross quantity of shipping.
Refer to Exhibit "Packaging specification".
This specification is not applied for samples.

6 GUARANTEE

The failure product could be repaired or exchanged within 1year from our designated factory's shipping date under normal-use.
This specification is not applied for samples.



J2コネクタ

No	Function
1	RD0
2	GND
3	SD0
4	BATT
5	VCC
6	VANT(OPENにて使用)
7	RD1
8	NC

ヘンコウ	B	
	A	ピンナガサ　ツメナガサ　シュウセイ

UNIT:mm
キニュウガイスンポウコウサ　±0.2mm

キシュメイ	メイショウ	ズバン
GPS-54D	ガイケイ　スンポウズ	G73ECD706A

ショウニン	ケンズ	セッケイ	セイズ
		オオタキ	オオタキ
		2005.08.24	2005.08.24

Position
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