ZENSTAR III

GPS Receiver

User's Guide

CHYNA SEA VENTURES LTD.

WWW.ZENSTARGPS.COM

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Usage Notice

Please read before using the GPS receiver:

- GPS(Global Position System) is operated by the US Department of Defense. The Organization is responsible for accuracy and maintenance of the system with full authority. Any change made by the organization will affect accuracy and function of GPS.
- For your driving safety, we strongly suggest that you do not operate the device during driving.
- If you are inside a building, tunnel or near large structures while navigating, it will affect GPS satellite signal receiving. At this time, this device will have poor positioning capability.
- If you have a radar detector in your car, this will interfere with signal reception. If this situation happens, it is recommended to discontinue using your radar detector.
- Please do not expose this device to sunlight for extended periods to avoid damage to the internal precision circuit.

Introduction

1.1 Overview

The ZENSTAR III Smart GPS Receiver is a complete GPS receiver, designed with SiRF Star III Architecture. This positioning application meets strict needs such as car navigation, mapping, surveying, security, agriculture and others. Only a clear view of sky and a certain power supply are necessary to the unit. It communicates with other electronic utilities via compatible dual-channel through the USB connector and saves critical satellite data with built–in backup memory. With low power consumption, the ZENSTAR tracks up to 20 satellites at a time, re-acquires satellite signals in 100 ms and updates position data every second. Trickle-Power allows the unit to operate a fraction of the time and Push-to-Fix permits user to have a quick position fix even when the receiver usually stays off.

1.2 Features

ZENSTAR III provides a host of features for easy integration and use.

1. High performance receiver tracks up to 20 satellites.

2. High sensitivity(-159 dBm) for indoor fixes. The SiRFstarIII GPS module can acquire in only seconds even at low signal levels. As part of SiRF's patented multi-mode GPS, the SiRFstarIII GPS module can track signal levels as low as -159 dBm. The SiRFstarIII supports real-time navigation in urban canyons as well as high sensitivity acquisition needed for indoor environments.

3. Differential capability utilizes real-time RTCM corrections producing 1-5 meter position accuracy.

4. Compact design ideal for applications with minimal space.

5. A rechargeable battery sustains internal clock and memory. The battery is recharged during normal operation.

6. Optional communication levels, RS-232 and TTL.

7. LED display status: The LED provides users visible positioning status. LED "ON" when power connected and "BLINKING" when ZENSTAR has positioned.

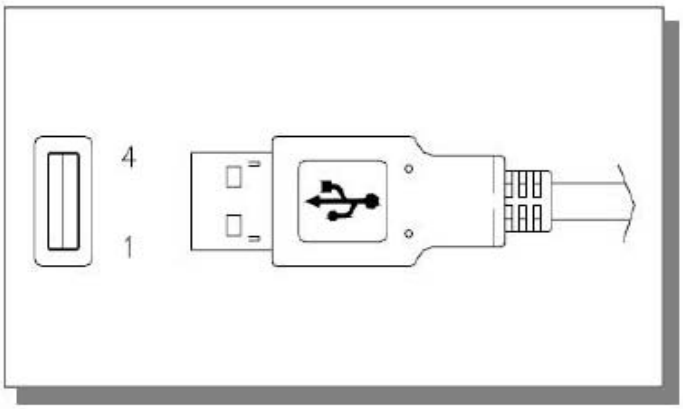
8. Built-in WAAS Demodulator.

9. Water proof design.

1.3 Technical Specification

USB connector:

The ZENSTAR is equipped with a USB A Type connector. The function definition is as follows:



Pin	Signal Name
1	+5V
2	D +
3	D -
4	Ground

1.3.2 Environmental Characteristics
1)Working Temperature: -40~+85°C
2) Storage temperature: -40 ~85°C
3) Humidity：95%

1.3.3 Electrical Characteristics
1) Input voltage: +3.3~+5.2V DC
2) Backup battery: +3.0 DC (Inner Rechargeable Lithium battery.)

1.3.4 Performance
1) Tracks up to 20 satellites.
2) Update rate: 1 second.
3) Acquisition time (average)
Hot start: <1 second(open sky)。」
Cold start: <48 second(open sky)。」
4) Position accuracy:
Position: <10m 90% no SA
Velocity: 0.1 m/sec no SA Time: 1 second synchronized GPS time
5) Dynamic Conditions: Altitude: 60,000 ft max Velocity: 515 m/sec (1,000 knots) max Acceleration: 4G max

1.3.5 Interfaces
1) Dual channel TTL compatible level, with user selectable baud rate (4800-Default, 9600, 19200, 38400)
2) NMEA 0183 Version 3.01 ASCII output (GPGGA, GPGSA, GPGSV, GPRMC, option GPGLL,GPVTG).

Operational Characteristics

2.1 Initialization Setup

After the initial self-test is complete, the ZENSTAR III will begin the process of satellite acquisition and tracking. The acquisition process is fully automatic and, under normal circumstances, will take approximately 48 seconds to achieve a position fix (38 seconds if ephemeris data is known). After calculating a position fix, valid position and time information will be transmitted over the output channel(s).

The ZENSTAR utilizes initial data such as last stored position, data and time as well as satellite orbital data to achieve maximum acquisition performance. If significant inaccuracy exists in the initial data, or if the orbital data is obsolete, it may take a long time to achieve a navigation solution. The ZENSTAR Auto-locate feature is capable of automatically determining a navigation solution without intervention from the host system. However, to improve acquisition performance, initialize the ZENSTAR with the host system if one or more of the following events occurs: 1) The GPS receiver is not in use for more than 3 months or transportation over distances further than 500 kilometers. 2) Failure of the external memory battery without system standby power.

2.2 Navigation

After the acquisition process is complete, the ZENSTAR will begin sending valid navigation information over its output channels. This data includes:

1) Latitude/longitude/altitude
2) Velocity
3) Date/time
4) Error estimates
5) Satellite and receiver status

Appendix A Software Protocol

The protocol of the ZENSTAR GPS design is based on NMEA (National Marine Electronics Association) 0183 ASCII format. The full protocol is defined in "NMEA 0183, Version 3.01" and "RTCM (Radio Technical Commission for Maritime Services), Recommended Standards For differential Navistar GPS Service, Version 2.1, RTCM Special Committee No.104."

A.1 NMEA Transmitted Message

The ZENSTAR GPS receiver uses FirstGPSTM as the core, and outputs a NMEA-0183 standard format message. The default communication parameters for NMEA output are 4800 baud, 8 data bits, stop bit, and no parity.

Table **A-1 NMEA-0183** Output Messages

NMEA Sentence	Description
GPGGA	Global positioning system fixed data
GPGLL	Geographic position latitude \ longitude
GPGSA	GNSS DOP and active satellites
GPGSV	GNSS satellites in view
GPRMC	Recommended minimum specific GNSS data
GPVTG	Course over ground and ground speed
GPZDA	Data and Time

A.1.1 Global Positioning System Fix Data (GGA)

Samples:$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*18

Value	Description
0	0 Fix not available or invalid
1	GPS SPS Mode fix valid
2	Differential GPS, SPS Mode fix valid
3	GPS PPS Mode fix valid

Name	Description	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	161229.487		Hhmmss.sss
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N = north or S = south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E = east or W = west
Position Fix Indicator	1		See Table4-3
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision

Name	Description	Units	Description
MSL Altitude	9.0	Meters	
Units	M	Meters	
Geoid Separation		Meters	
Units	M	Meters	
Age of Diff. Corr.		Second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*18		

Table **A-3** Position Fix Indicator

A.1.2 Geographic Position - Latitude/Longitude (GLL) Samples:

$GPGLL,3723.2475,N,12158.3416,W,161229.487,A*2C

Table **1-4** GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	3723.2475		dd mm.mmmm
N/S Indicator	N		N = north or S = south
Longitude	12158.3416		ddd mm.mmmm
E/W Indicator	W		E = east or W = west
UTC Position	161229.487		hh mm ss.sss
Status	A		A = data valid or V = data not valid
Checksum	*2C		

A.1.3 GNSS DOP and Active Satellites (GSA)Samples:

$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33

Table **A-5 GSA** Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 4-6
Mode 2	3		See Table 4-7
Satellite Used *1	07		SV on Channel 1
Satellite Used *1			SV on Channel 2
…..			……..
Satellite Used *1			SV on Channel N
PDOP	1.8		Position Dilution of Precision
HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		

*1 Satellite used in solution.

Table **A-6** Mode 1

Value	Description
M	Manual – forced to operate in 2D or 3D mode
3	Automatic – allowed to automatically switch 2D/3D

Value	Description
1	Fix Not Available
2	2D
3	3D

A.1.4 GNSS Satellites In View (GSV)

Samples:

$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,

42*71

$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41

Table A-8 GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages1	2		Range 1 to 3
Message Number 1	1		Range 1 to 3
Satellites in View	07		Range 1 to 12
Satellite ID	07		Channel 1 (Range 1 to 32)
Elevation	79	degrees	Channel 1 (Maximum 90)
Azimuth	048	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
…..	……		
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27	degrees	Channel 4 (Maximum 90)
Azimuth	138	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
Checksum	*71		

NOTE: Item <4>,<5>,<6> and <7> repeat for each satellite in view to a maximum of four (4) satellite per sentence. Additional satellites in view information must be sent in sentences. These fields will be null if unused.

A.1.5 Recommended Minimum Specific GNSS Data (RMC)

Samples:

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,12059 8,

,*10

Table A-9 RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Position	161229.487		Hh mm ss.sss
Status	A		A = data valid or V = data not valid
Latitude	3723.2475		dd mm.mmmm
N/S Indicator	N		N = north or S = south
Longitude	12158.3416		ddd mm.mmmm
E/W Indicator	W		E = east or W = west

Name	Example	Units	Description
Speed Over Ground	0.13	knots	
Course Over Ground	309.62	degrees	True
Date	120598		dd mm yy
Magnetic Variation1	02.6	degrees	
E/W Indicator	W		E = east or W = west
Checksum	*10		

A.1.6 Course Over Ground and Ground Speed (VTG)Samples:

$GPVTG,309.62,T, ,M,0.13,N,0.2,K*6E

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	Degrees	Measured heading
Reference	T		
Course		Degrees	Measured heading
Reference	M		Magnetic*1
Speed	0.13	Knots	Measured horizontal speed
Units	N		
Speed	0.2	Km/hr	Measured horizontal speed
Units	K		Kilometer per hour
Checksum	*6E		

Note *1:All "course over ground" data are geodetic WGS84.

A.1.7 Time & Date (ZDA)

Samples:

$GPZDA,114523.62,12,04,2001,10,34*6E

Table **1-11** ZDA Data Format

Name	Example	Units	Description
Message ID	$GPZDA		ZDA protocol header
Hour, Min, Sec, Sub Sec	114523.62		Hhmmss.ss
Day	12		day in UTC, 01 to 31
Month	4		month in UTC, 01 to 12
Year	2001		year in UTC
Local Zone Hours	10		local zone hours, +/- 13 hours
Local Zone Minutes	34		local zone minutes, 0 to +59
Checksum	*6E		

Appendix B Coordinate System and Output Settings

B.1 Coordinate System

The ZENSTAR has the world standard coordinate system WGS84 built in.

B.2 Output Settings

Coordinate System: WGS84。

Baud rate: 9600

Output message: GGA, GLL, GSA, GSV, RMC, VTG , ZDA