GPS Engine Board Manual

SR-92

SIRF STAR Ⅲ

V 1.0

Easy to Use Ultra-High Performance

GPS Smart Antenna Module

With Power Control

Made in Taiwan

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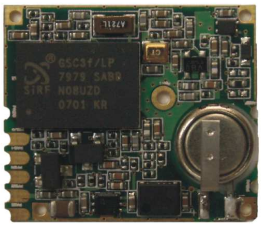
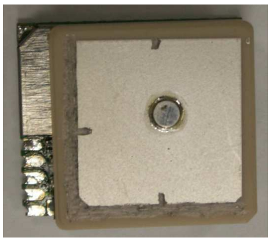
Specifications subject to change without prior notice!

Contents

1 Introduction

1.1 Overview





SR-92 is a low-power, ultra-high performance, easy to use GPS smart antenna module based on SiRF's third generation single chip. Its low power consumption and high performance enables the adoption of handheld applications. The slim design allows SR-92 to be placed on topside of the housing to have best GPS signal reception. The 5-pin I/O interface is then connected to the main board with either connector or wire soldering.

The integrated antenna design helps reduce the RF and EMI issues to minimum. Fast adoption and high yield production becomes possible.

The power control feature is very convenient to turn on/off power via GPIO control pin. It's especially useful in cases such as to turn off power as the user just wants to watch a movie and GPS function is not needed in the PMP case.

1.2 Main Features

Not only handheld but also any other GPS applications can share the following major features of SR-92.

- Easy adoption with best performance
- Integrated antenna and EMC protection
- Built-in backup battery allowing hot/warm starts and better performance
- No external component demand, just connect and use.
- Minimum RF and EMI efforts
- Small size of 18 (W) x 21 (L) x 7 (H) (mm) with patch antenna of 18x18x4mm.
- Fully implementation of ultra-high performance SiRF StarⅢ single chip architecture
- High tracking sensitivity of -159dBm
- Low power consumption of 40mA at full tracking
- Hardware power saving control pin allowing power off GPS via GPIO
- SR-92 could be arranged at best reception location inside housing
- Firmware upgradeable for future potential performance enhancements

1.3 Receiver Specifications

Features	Specifications
GPS receiver type	20 channels, L1 frequency, C/A code
Horizontal Position Accuracy	< 2.5m (Autonomous) < 2.0m (WAAS) (50% 24hr static, -130dBm)
Velocity Accuracy	<0.01 m/s (speed) <0.01° (heading) (50%@30m/s)
Time accuracy	1μs or less
TTFF (Time to First Fix) (50%, -130dBm, autonomous)	Hot Start: 1s Warm Start: 35s Cold Start: 42s
Sensitivity (Autonomous)	Tracking: –159dBm Acquisition: -142dBm
Measurement data output	Update time: 1 second NMEA output protocol: V.3.00 Baud rate: 4800 (default), 9600, 19200, 38400, 57600 bps (8-N-1) Datum: WGS-84 Default: GGA, GSA, RMC, and GSV Other options: VTG, GLL, ZDA, or SiRF binary
Max. Altitude	<18,000 m
Max. Velocity	<1,852 km/hr
SBAS Support	WAAS, EGNOS
Dynamics	<4g
Power consumption	40mA, continuous tracking mode
Power supply	3.3V
Dimension (single side)	18 (W) x 21 (L) x 7 (H) mm w/ 18x18x4 (mm) patch antenna
Operating temperature	-40℃ ~ +85℃
Storage temperature	-40℃ ~ +125℃

1.4 Protocols

Both NMEA and SiRF binary protocols could be supported via serial UART I/O port – RXA/TXA. The default supported protocol is NMEA protocol.

1. Serial communication channel
    i. No parity, 8-data bit, 1-stop bit (N-8-1)
    ii. User selectable factory set baudrate among 4800, 9600, 19200, 38400, and 57600 (default 4800) bps.
2. NMEA 0183 Version 3.00 ASCII output
    i. Default GGA (1 sec), GSA (1 sec), GSV (3 sec), RMC (1 sec)
    ii. Optional VTG, GLL, ZDA

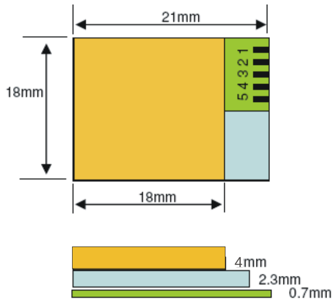
1.5 Antenna

SR-92 has a built-in patch antenna of dimension 18x18x4mm.

To have the best performance, we suggest tuning the RF antenna together with product's outside shell of housing.

2 Hardware Interface

2.1 Module Dimension



The dimension of SR-92 is 18 mm (W) x 21 mm (L) x 7 mm (H) with a patch antenna of 18x18x4mm.

2.2 Pin Assignment

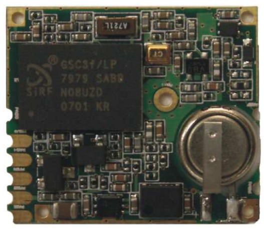
5-pin Interface

Pin	Name	Function	I/O
1	GND	Ground	Input
2	VCC	Power supply of 3.3 ~ 5.5 VDC	Input
3	TX	Port A serial data output (GPS out); N-8-1, NMEA v3.00 output	Output
4	RX	Port A serial data input (GPS in); N-8-1, accepts commands from external applications, e.g. SiRFDemo.	Input
5	PWR_CTRL	Hardware controlled power saving pin. If this function is used, it is usually connected to a GPIO pin of a micro-processor. “Low”: for normal run “High” or floating: turn off VCC for power saving Tie it to low if this pin is not used.	Input

2.3 Module Placement

The SR-92 module could be placed on any location of your product’s housing that has best signal reception. The 5-pin interface is then connected to your motherboard. There are two items that extrude the bottom PCB plane of SR-92. It may affect the placement of SR-92 into your product’s housing.

1. The antenna is soldered to SR-92 at the bottom via one soldering point. The soldering extrudes the bottom PCB plane of SR-92. It is suggested to reserve a hole of φ = 2 mm and depth of 1mm on the under housing.
2. The built-in battery is also soldered to SR-92 at the bottom via two soldering points. The soldering extrudes the bottom PCB plane of SR-92.



2.4 Power Saving

SR-92 supports various kinds of power saving mechanisms – Trickle Power, Adaptive Trickle Power, Push To Fix, and power switch. The first three kinds of power saving mechanisms are implemented in software and the power switch mechanism is implemented in hardware.

2.4.1 Power Saving of Trickle Power

The trickle power saving mechanism is achieved by switching off and on CPU and RF at a fixed time interval. The biggest time interval to report a position is 10 seconds. The on and off ratio is configurable. This feature is useful for applications that need to report position regularly while power saving is significant. This feature is done by firmware automatically if this feature is enabled. The standard firmware does not turn on this feature. It could be customized by request of MOQ.

2.4.2 Power Saving of Adaptive Trickle Power

The adaptive trickle power saving mechanism is basically the same as trickle power saving mechanism with difference that it would not turn the power off if the signal quality is not good enough for tracking. Thus, it keeps both benefits of performance and power saving intelligently. This feature is done by firmware automatically if this feature is enabled. The standard firmware does not turn on this feature. It could be customized by request of MOQ.

2.4.3 Power Saving of Push To Fix

The Push To Fix power saving mechanism will not report position data until a specified time interval expires or triggered by external event. Typically, to keep the up to date position data, it would wake up to collect ephemeris and almanac data every 30 minutes. The time interval is also configurable. This mechanism is especially useful for applications that need position data only on demand. This feature is done by firmware automatically if this feature is enabled. The standard firmware does not turn on this feature. It could be customized by request of MOQ.

2.4.4 Power Saving of Power Switch

The Power Switch power saving mechanism will turn off not only the CPU and RF but also the whole engine board. In the mean time, the backup battery will start to power GPS's RTC and internal memory for better performance.

The power saving is controlled by the external application via the control pin (PWR_CTRL; pin 5). The engine board will be on if PWR_CTRL pin is low. It would be off if the pin is high or floating. The designer has full control of the power supply status of the smart antenna. The power saving is also more complete. Applications such as PMP navigator may prefer to stop GPS while it just runs movie watching. There might be similar demand for different applications. This mechanism is achieved by hardware and external control of pin PWR_CTRL is required if this mechanism is used. Tie this pin to low if the mechanism is not used.

3 Software Interface

3.1 NMEA Output Messages

The NMEA-0183 Output Messages are shown as below:

NMEA Record	Descriptions
GPGGA	Global positioning system fixed data: time, position, fixed type
GPGLL	Geographic position: latitude, longitude, UTC time of position fix and status
GPGSA	GPS receiver operating mode, active satellites, and DOP values
GPGSV	GNSS satellites in view: ID number, elevation, azimuth, and SNR values
GPRMC	Recommended minimum specific GNSS data: time, date, position, course, speed
GPVTG	Course over ground and ground speed
GPZDA	PPS timing message (synchronized to PPS)

The SR-92 adopts interface protocol of National Marine Electronics Association's NMEA-0183 Version 3.00 interface specification. SR-92 supports 7 types of NMEA sentences (GPGGA, GPGLL, GPGSA, GPGSV, GPRMC, GPVTG, and GPZDA).

The default output sentences are GPGGA, GPGSA, GPGSV, and GPRMC. The UART communication parameters are 4800 bps, 8 data bits, 1 stop bit, and no parity. Other output sentences, baud rate, and related configurations could be requested based on MOQ.

Single message example

$GPGGA,101229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*3E

$GPGLL,2446.8619,N,12100.2579,E,060725.000,A,A*7E

$GPGSA,A,3,05,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*11

$GPGSV,3,1,12,07,62,081,37,16,61,333,37,01,60,166,37,25,56,053,36*74

$GPGSV,3,2,12,03,43,123,33,23,32,316,34,14,17,152,30,20,16,263,33*78

$GPGSV,3,3,12,19,17,210,29,06,08,040,,15,06,117,27,21,05,092,27*7E

$ GPRMC,151229.487,A,3723.2475,N,12148.3416,W,0.13,309.62,120598,,,A*5F

$GPVTG,,T,,M,0.00,N,0.0,K,A*13

$GPZDA,060526.000,20,06,2006,,*51

3.2 GPGGA - Global Positioning System Fix Data

- Example $GPGGA,101229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*3E
- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPGGA		GGA protocol header
UTC Time	101229.487		hhmmss.sss hh: hour, mm: minute, ss: second
Latitude	3723.2475		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12158.3416		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	W		E: East Longitude, W: West Longitude
Position Fix Indicator	1		0: Fix not available or invalid, 1: GPS SPS Mode, fix valid, 2: Differential GPS, SPS Mode, fix valid, 3~5: Not supported, 6: Dead Reckoning Mode, fix valid
Satellites Used	07		Number of satellites used in positioning calculation (0 to 12)
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude	9.0	meters	
Unit	M		Meters
Geoidal separation		meters	
Units	M		Meters
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
checksum	*3E		
<CR><LF>			End of sentence

3.3 GPGLL - Geographic Position - Latitude / Longitude

- Example

  $ GPGLL,2446.8619,N,12100.2579,E,060725.000,A,A*7E
- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPGLL		GLL protocol header
Latitude	2446.8619		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.2579		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	E		E: East Longitude, W: West Longitude
UTC Time	060725.000		hhmmss.sss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Mode Indicator	A		A: Autonomous, D: DGPS, E: DR
checksum	*7E		
<CR><LF>			End of sentence

3.4 GPGSA - GNSS DOP and Active Satellites

- Example

  $GPGSA,A,3,05,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*11

- Explanation

Contents	Example	Explanation
Message ID	$GPGSA	GSA protocol header
Mode 1	A	M: Manual—forced to operate in 2D or 3D mode A: 2D Automatic—allowed to automatically switch 2D/3D
Mode 2	3	1: Fix not available 2: 2D (< 4 Satellites used) 3: 3D (> 3 Satellite s used)
Satellite used in solution	05	Satellite on Channel 1
Satellite used in solution	02	Satellite on Channel 2
…		Display of quantity used (12 max)
PDOP	1.8	Position Dilution of Precision
HDOP	1.0	Horizontal Dilution of Precision
VDOP	1.5	Vertical Dilution of Precision
checksum	*11	
<CR><LF>		End of sentence

3.5 GPGSV - GNSS Satellites in View

- Example

  $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

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPGSV		GSV protocol header
Number of messages	2		Range 1 to 3
Message number	1		Range 1 to 3
Satellites in view	07		Number of satellites visible from receiver
Satellite ID number	07		Channel 1 (Range 1 to 32)
Elevation	79	degrees	Elevation angle of satellite as seen from receiver channel 1 (00 to 90)
Azimuth	048	degrees	Satellite azimuth as seen from receiver channel 1 (000 to 359)
SNR (C/No)	42	dBHz	Received signal level C/No from receiver channel 1 (00 to 99, null when not tracking)
…			
Satellite ID number	27		Channel 4 (Range 1 to 32)
Elevation	27	degrees	Elevation angle of satellite as seen from receiver channel 4 (00 to 90)
Azimuth	138	degrees	Satellite azimuth as seen from receiver channel 4 (000 to 359)
SNR (C/No)	42	dBHz	Received signal level C/No from receiver channel 4 (00 to 99, null when not tracking)
checksum	*71		
<CR><LF>			End of sentence

3.6 GPRMC - Recommended Minimum Specific GNSS Data

- Example

  $GPRMC,151229.487,A,3723.2475,N,12148.3416,W,0.13,309.62,120598,,,A*5F

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPRMC		RMC protocol header
UTC Time	151229.487		hhmmss.sss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Latitude	3723.2475		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12148.3416		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	W		E: East Longitude, W: West Longitude
Speed over ground	0.13	knots	Receiver's speed
Course over ground	309.62	degrees	Receiver's direction of travel Moving clockwise starting at due north
Date	120598		ddmmyy dd: Day, mm: Month, yy: Year
Magnetic variation		degrees	This receiver does not support magnetic declination. All "course over ground" data are geodetic WGS84 directions.
Mode Indicator	A		A: Autonomous, D: D-GPS, N: Data not valid
checksum	*5F		A: Autonomous M: Manual D: DGPS S: Simulation E: Dead Reckoning N: Data Invalid
<CR><LF>			End of sentence

3.7 GPVTG - Course over Ground and Ground Speed

- Example

  $GPVTG,309.62,T,,M,0.18,N,0.5,K,A*0F

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPVTG		VTG protocol header
Course over ground	309.62	degrees	Receiver's direction of travel Moving clockwise starting at due north (geodetic WGS84 directions)
Reference	T		True
Course over ground		degrees	Receiver's direction of travel
Reference	M		Magnetic
Speed over ground	0.18	knots	Measured horizontal speed
Unit	N		Knots
Speed over ground	0.5	km/hr	Measured horizontal speed
Unit	K		km/hr
Mode Indicator	A		A: Autonomous, D: DGPS, E: DR

checksum	*0F		
<CR><LF>			End of sentence

3.8 GPZDA - SiRF Timing Message

- Example

  $GPZDA,181813,14,10,2006,00,00*4A

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPZDA		ZDA protocol header
UTC time	181813		Either using valid IONO/UTC or estimated from default leap seconds
Day	14		Day according to UTC time (01 to 31)
Month	10		Month according to UTC time (01 to 12)
Year	2006		Year according to UTC time (1980 to 2079)
Local zone hour	00	hour	Offset from UTC (set to 00)
Local zone minutes	00	minute	Offset from UTC (set to 00)
checksum	*4F		
<CR><LF>			End of sentence

4 Electrical and Environmental Data

Electrical Data

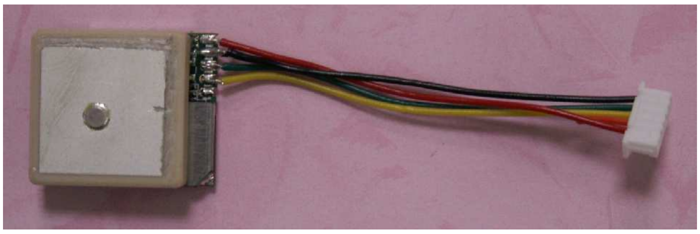
Power Supply	3.3 ~ 5.5VDC
Power Consumption (w/o antenna)	40mA/average tracking
Backup Battery Supply	Nominal voltage: 3.0 V
Digital I/O	V_{IH}: 2~3.15V, V_{IL}: 0~0.85V V_{OH}: >2.1V, V_{OL}< 0.72V
Protocols	NMEA (default), SiRF Binary

Environmental Data

Operating temperature	-40 ~ 85℃
Storage temperature	-40 ~ 125℃
Vibration	5Hz to 500Hz, 5g
Shock	Half sine 30g/11ms

5 Application

To have best performance, it is suggested to place SR-92 at the location of best RF signal reception, say, the upper side of product housing. The motherboard is usually perpendicular to the upper side housing. In this case, just connect the 5-pin to the motherboard via connection wires.



Please note that the backup battery is already included in SR-92. You saved the space, charging circuit and related materials.

To control the power of SR-92, connect the PWR_CTRL pin to a GPIO of micro-processor. One can pull low it during normal run. To cut off the power of SR-92, pull high or just let it floating. Tie the PWR_CTRL pin to low if the power saving control feature is not needed.