SYSThink	Ultra High sensitivity and Low Power
SY-1513-SF3	SIRF3-GSC3f-LP-7989/7990
www.china-systhink.com	GPS Receiver Module

Introduction

The SY-1513-SF3 is a complete GPS engine module that features super sensitivity, ultra low power and small form factor. The GPS signal is applied to the antenna input of module, and a complete serial data message with position, velocity and time information is presented at the serial interface with NMEA protocol or custom protocol.

Its －159dBm tracking sensitivity extends positioning coverage into place like urban canyons and dense foliage environment where the GPS was not possible before. The small form factor and low power consumption make the module easy to integrate into portable device like PNDs, mobile phones, cameras and vehicle navigation systems.

Applications

* LBS (Location Based Service)
* PND (Portable Navigation Device)
* Security Monitoring
* Mobile phone&Personal locator

Figure 1: SY-1513-SF3 Top View

Technical parameters

* Build on high performance, low-power SIRFIII chipset

* Ultra high sensitivity: -159dBm

* Extremely fast TTFF at low signal level

* Built-in LAN amplifier

* Low power consumption: Max 45mA@3.0V

* NMEA-0183 compliant protocol or custom protocol

* Operating voltage: 3.0V to 5.0V

* Operating temperature range: -40 to 85℃

* SMD type with stamp holes

* Small form factor: 15x13x3.0mm

* RoHS compliant (Lead-free)

Pin Definition

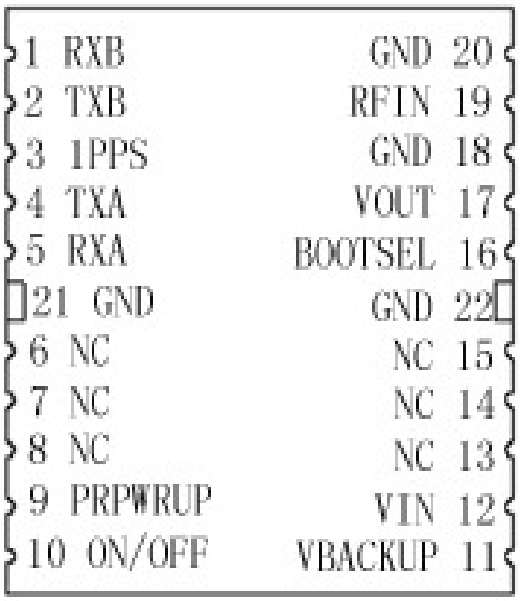
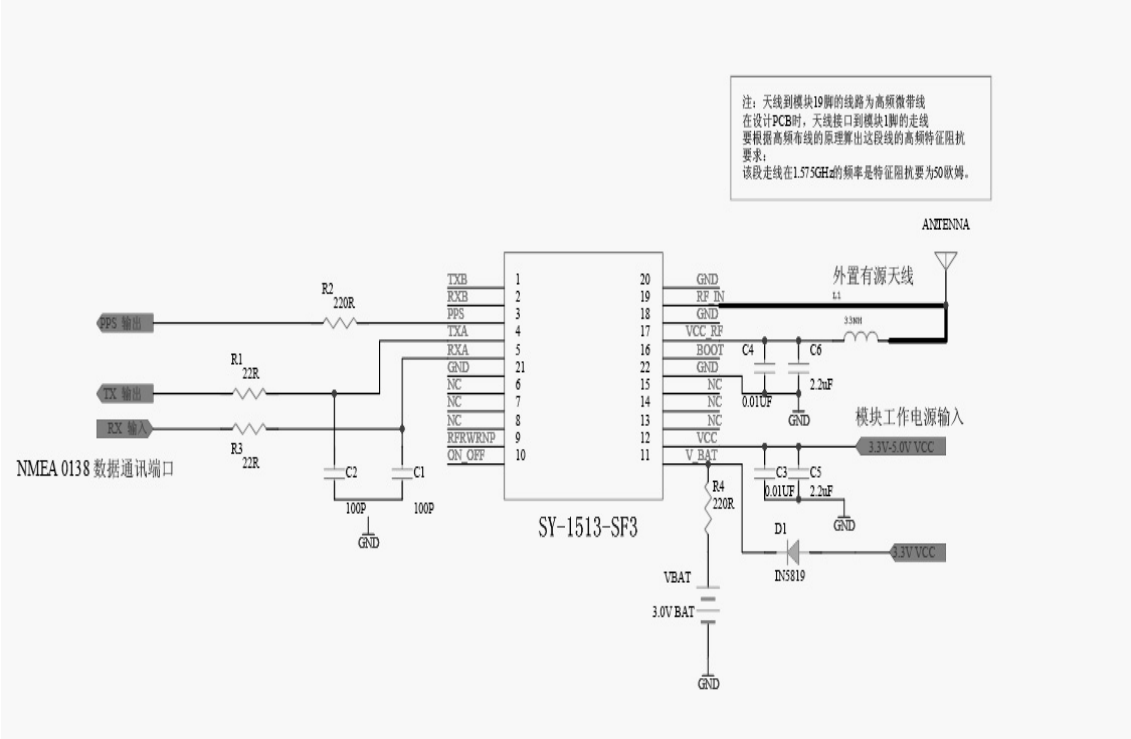


Figure 2: SY-1513-SF3 Pin Package



Typical application circuit that uses active antenna

Mechanical Specification

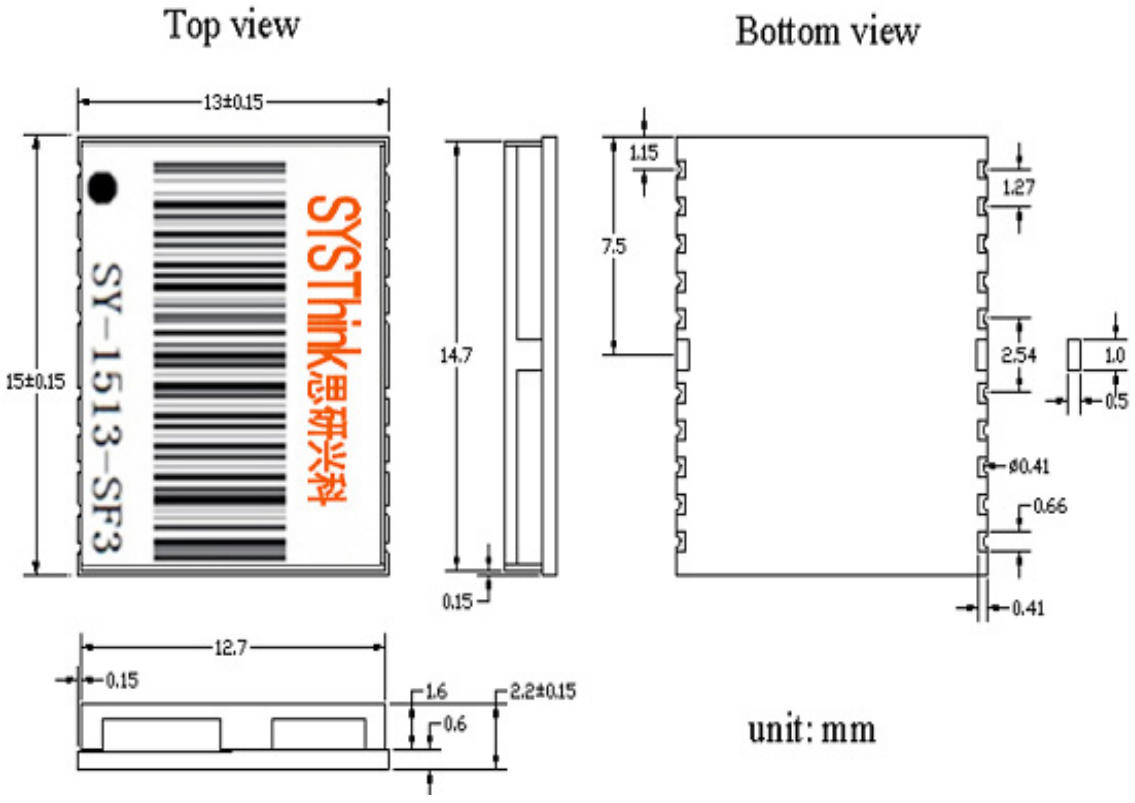


Figure 3: SY-1513-SF3 Dimensions

Performance Indicators

Parameter	Specifications
Receiver Type	L1 frequency band, C/A code, 20-channels
Sensitivity	Tracking -159dBm Acquisition -155dBm
Accuracy	Position 5m CEP without SA Velocity 0.1m/s without SA Timing (PPS) 60ns RMS
Acquisition Time	Cold Start 38s Warm Start 35s Hot Start 1s Re-Acquisition <1s
Power Consumption	Tracking 40mA @3V Vcc Acquisition 45mA Sleep/Standby TBD
Navigation Data Update Rate	1Hz
Operational Limits	Altitude Max 18,000m Velocity Max 515m/s Acceleration Less than 4g

Interfaces Configuration

Power Requirements: Regulated power for the SY-1513-SF3 is required. The input voltage Vcc should be 3.3V ±10%, maximum, current is no less than 100mA. Suitable decoupling must be provided by external decoupling circuitry.

Antenna Requirements: The SY-1513-SF3 GPS receiver is designed for supporting the active antenna or passive antenna connected with pin RF_IN. The gain of active antenna should be no less than 15dB. The maximum noise figure should be no more than 2.5dB and output impedance is at 50 Ohm.

UART Ports: The module supports two full duplex serial channels UART0 and UART1. All serial connections are at 3V CMOS logic levels, if need different voltage levels, use appropriate level shifters. The baud rate of both serial ports are fully programmable, the data format is however fixed: X, N, 8, 1, i.e. X baud rate, no parity, eight data bits and one stop bit, no other data formats are supported, LSB is sent first. The modules default baud rate is set up 9600bps, however, the user can change the default baud rate to any value from 4800 bps to 115kbps. UART0 is used e.g. for booting and NMEA interface. UART1 can be utilized for UBP protocol.

Boot Mode Select: The pin Boot is used to set the boot mode of

the SY-1513-SF3 GPS Receiver. By default the receiver will boot in normal GPS mode. If there are corrupted data in FLASH, it may be necessary to boot the receiver in test mode by pulling Boot pin high during a power cycle or hardware reset to update the firmware.

Backup Battery Power: In case of a power failure on pin Vcc, real-time clock and backup RAM are supplied through pin V_BAT. This enables the SY-1513-SF3 GPS Receiver to recover from power failure with either a hot start or a warm start (depending on the duration of Vcc outage). If no Backup Battery is connected, the receiver performs a cold start upon powered up.

Pin Description

Pin No.	Pin name	I/O	Description	Remark
1	RXB	I	UART Serial Data Input 1	Pull up if not used
2	TXB	O	UART Serial Data Output 1	Leave Open in not
3	PPS	O	Time Pulse(1PPS)	Leave Open in not used
4	TXA	O	UART Serial Data Output	Pull up (75KΩ) if not used

5	RXA	I	UART Serial Data Input	Pull up (75KΩ) if not used
6	NC		No connection	
7	NC		No connection	
8	NC		No connection	
9	RFPWRNP	O	Indicate power state (See Table 6-2)	
10	ON-OFF	I	Edge triggered soft on/off request. Should only be used to wake up module when RFPWRUP pin is low.	
11	VBACKUP	P	Backup battery supply voltage	
12	VIN	P	DC suppiy voltage	
13	NC		No connection	
14	NC		No connection	
15	NC		No connection	
16	BOOT_ INT	I	Boot Mode	Leave Open if not used
17	Vout	P	Linear regulator power output, 2.85V (Do not use this as power source of backup battery) (See Table 6-2)	
18	GND	G	Ground	
19	RF_IN	I	GPS Signal Input	
20	GND	G	Ground	
21	GND	G	Ground	
22	GND	G	Ground	

Electrical Characteristics

Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	Vcc	-0.3	5.0	V
Input Pins				
Input Pin Voltage I/O	Reset	-0.3	3.6	V
Input Pin Voltage I/O	RXA, RXB	-0.3	3.6	V
Input Pin Voltage I/O	BOOT	-0.3	3.6	V
Backup Battery	V_BAT	2.0	3.6	V
Environment				
Storage Temperature	Tstg	-40	125	° C
Peak Reflow Soldering Temperature <10s	Tpeak		260	° C
Humidity				95 %

Note: Absolute maximum ratings are stress ratings only, and f unctional operation at the maxims is not guaranteed. Stress b eyond the limits specified in this table may affect device re liability or cause permanent damage to the device. For functi onal operating conditions, refer to the operating conditions tables as follow.

Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		3.0	3.3	5.0	V
Power supply voltage ripple	Vcc_PP	Vcc=3.0V			30	mV
Consumption current	Icc	Vcc=3.0V		40	45	mA
Input high voltage	V_{IH}		0.7xVcc		Vcc+1.0	V
Input low voltage	V_{IL}		-0.3		0.3xVcc	V
Output high voltage	V_{OH}		0.8xVcc		Vcc	V
Output low voltage	V_{OL}		0		0.2xVcc	V
Operating temperature	Topr		-40		85	° C

Software Protocol

NMEA 0183 Protocol

The NMEA protocol is an ASCII-based protocol, Records start with a $ and with carriage return/line feed. GPS specific messages all start with $GPxxx where xxx is a three-letter identifier of the message data that follows. NMEA messages have a checksum, which allows detection of corrupted data transfers.

The SY-1513-SF3 supports the following NMEA-0183 messages: GGA, GLL, GSA, GSV, RMC and VTG.

Table 1: NMEA-0183 Output Messages

NMEA Record	DESCRIPTION
GGA	Global positioning system fixed data
GLL	Geographic position—latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed

GGA-Global Positioning System Fixed Data

Table 2 contains the values of the following example:

$GPGGA,164318.000,2238.1910,N,11401.8300,E,1,07,1.1,94.3,M,
2.3,M,,0000*7C

Table 2: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Position	164318.000		hhmmss.sss
Latitude	2238.1910		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	11401.8300		ddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 2-1
Satellites Used	07		Range 0 to 12
HDOP	1.1		Horizontal Dilution of Precision
MSL Altitude	94.3	meters	
Units	M	meters	
Geoids Separation	2.3	meters	
Units	M	meters	
Age of Diff.Corr.		second	Null fields when

			DGPS is not Used
Diff.Ref.Station ID	0000		
Checksum	*7C		
<CR> <LF>			End of message termination

Table 2-1: Position Fix Indicators

Value	Description
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

GLL-Geographic Position - Latitude/Longitude

Table 3 contains the values of the following example:

$GPGLL, 2238.1910,N,11401.8300,E,164318.000,A,A*5C

Table 3: GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	2238.1910		ddmm.mmmm
N/S indicator	N		N=north or S=south

Longitude	11401.8300		ddmm.mmmm
E/W Indicator	E		E=east or W=west
UTC Position	164318.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Checksum	A*5C		
<CR> <LF>			End of message temination

GSA-GNSS DOP and Active Satellites

Table 4 contains the values of the following example:

$GPGSA, A, 3, 28, 23, 02,17,20, 04,13,,,,,, 2.1,1.1,1.8*33

Table 4: GSA Data Format

Name	Example	Units	Description
Message	$GPGSA		GSA protocol header
Mode 1	A		M=Manual-forced to operate in 2D or 3D mode A=Automatic-allowed to automatically switch 2D/3D
Mode 2	3		1= Fix not available 2=2D 3=3D
Satellite Used	28		Sv on Channe 11
Satellite Used	23		Sv on Channel 2
…	…		…

Satellite Used			Sv on Channel 12
PDOP	2.1		Position Dilution of Precision
HDOP	1.1		Horizontal Dilution of Precision
VDOP	1.8		Vertical Dilution of Precision
Checksum	*33		
<CR> <LF>			End of message termination

GSV-GNSS Satellites in View

Table 5 contains the values of the following example:

$GPGSV,3,1,12,17,58,054,45,04,53,333,47,10,42,205,,28,35,169,23*72

$GPGSV,3,2,12,02,30,280,27,13,18,104,41,23,14,078,39,05,12,212,*78

$GPGSV,3,3,12,20,10,039,31,12,04,323,,27,01,269,,09,01,275,*75

Table 5: GGA Data Format

Name	Example			Units	Description
Message ID	$GPGSV				GSV protocol header
Number of Message	3	3	3		Range 1 to 3

Message Number	1	2	3		Range 1 to 3
Satellites in View	12	12	12		
Satellite ID	17	02	20		Channel 1(Range 1 to 32)
Elevation	58	30	10	degrees	Channel 1(Maximum 90)
Azinmuth	054	280	039	degrees	Channel 1(True, Range 0 to 359)
SNR(C/NO)	45	27	31	dBHz	Range 0 to 99,null when not tracking
…					…
Satellite ID	28	39	0		Channel 4
Elevation	35	05	09	degrees	Channel 4(Maximum 90)
Azimuth	169	12	01	degrees	Channel 4(True, Range 0 to 359)
SNR(C/NO)	23	212	275	dBHz	Range 0 to 99, null when not tracking
Checksum	*72	*78	*75		
<CR> <LF>					End of message termination

RMC-Recommended Minimum Specific GNSS Data

Table 6 contains the values of the following example:

$GPRMC,164318.000,A,2238.1910,N,11401.8300,E,0.00,,180610,,,A

*7B

Table 6: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header

UTS Position	164318.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2238.1910		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11401.8300		Ddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.00	Knots	
Course Over	309.62		Degrees True
Ground			
Date	180610		Dummy
Magnetic variation		Degrees	E=east or W=west
Checksum	*7B		
<CR> <LF>			End of message termination

VTG-Course Over Ground and Ground Speed

Table 7 contains the values of the following example:

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

Table 7: VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	0		Degrees Measured heading

Reference	T		True
Course	0	Degrees	Measured heading
Reference	M		Magnetic
Speed	0.00	Knots	Measured horizontal speed
Units	N		Knots
Speed	0.0	Km/hr	Measured horizontal speed
Units	K		Kilometer per hour
Checksum	A*13		
<CR> <LF>			End of message termination

RECOMMENDED REFLOW PROFILE