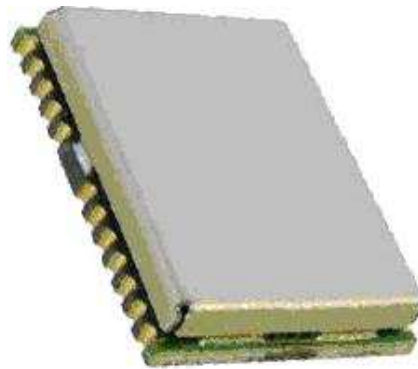


# Low-Power High-Performance and Low-Cost 65 Channel SMD GPS Module



## Data Sheet

Version 1.4

### Abstract

Technical data sheet describing the cost effective, high-performance GPS1513R based series of ultra high sensitive GPS modules.

The GPS1513R is a GPS module that is sensitive to *electrostatic dis- charge* (ESD). Please handle with appropriate care.

The Acceptability of Electronic Assemblies of the GPS1513R has been under IPC-A-610D specification





Version History

Rev.	Date	Description
1.1	10-12-08	Initial Draft – preliminary information
1.2	01-20-09	Preliminary
1.3	15-04-09	Minor corrections
1.4	15-08-09	Application note

Note

Flash version supports the features ;

1. Binary code (Configuration command programmable)
2. Selectable NMEA output data sentences
3. Selectable Serial Port Settings. (4800/9600/38400/115200bps. Default : 9600)
4. Selectable update rate (1 / 2 / 4 / 5 / 8 / 10 Hz update rate (ROM version only supports 1Hz default))
5. Firmware upgrade





## 1 Functional Description

### 1.1 Introduction

The GPS-1513R is a small form factor GPS module solution intended for a broad range of Original Equipment Manufacturer (OEM) products, where fast and easy system integration and minimal development risk is required.

The GPS-1513R GPS receiver's  $-161\text{dBm}$  tracking sensitivity allows continuous position coverage in nearly all application environments. Its high performance search engine is capable of testing 8,000,000 time-frequency hypotheses per second, offering industry-leading signal acquisition and TTFF speed.

The receiver is optimized for applications requiring high performance, low power, and low cost; suitable for a wide range of OEM configurations including mobile phone, PND, asset tracking, and vehicle navigation products.

The very small 13mm x 15.8mm form factor and the SMT pads allow standard surface mount device pick-and-place process in fully automated assembly process; enabling high-volume, very cost-efficient production.

### 1.2 Features

- 65 Channel GPS L1 C/A Code
- Perform 8 million time-frequency hypothesis testing per second
- Open sky hot start 1 sec
- Open sky cold start 29 sec
- Signal detection better than  $-161\text{dBm}$
- Multipath detection and suppression
- Accuracy 2.5m CEP
- Maximum update rate 10Hz
- Tracking current  $\sim 23\text{mA}$
- Supports active and passive antenna

### 1.3 Applications

- Automotive and Marine Navigation
- Automotive Navigator Tracking
- Emergency Locator
- Geographic Surveying
- Personal Positioning
- Sporting and Recreation

## 2 Characteristics

### 2.1 General Specification

Parameter	Specification
Receiver Type	65 Channels GPS L1 frequency, C/A Code
Time-To-First-Fix	Cold Start (Autonomous) 29s (Average, under open sky) Warm Start (Autonomous) 28s (Average, under open sky) Hot Start (Autonomous) 1s (Average, under open sky)
Sensitivity	Tracking & Navigation -161 dBm Reacquisition -158 dBm Cold Start (Autonomous) -148 dBm
Accuracy	Autonomous 2.5 m CEP Velocity 0.1 m/sec (without aid) Time 300 ns
Update Rate	Supports 1 / 2 / 4 / 5 / 8 / 10 Hz update rate (1Hz default)
Velocity Accuracy	0.1m/s
Heading Accuracy	0.5 degrees
Dynamics	4 G (39.2 m/sec)
Operational Limits	Velocity 515 m/s (1000 knots) Altitude <18000 meters (COCOM limit, either may be exceeded but not both)
Serial Interface	3.3V LVTTTL level
Datum	Default WGS-84 User definable
Input Voltage	3.3V DC +/-10%
Input Current	~23mA tracking
Dimension	15.8mm L x 13mm W x2.8mm H
Weight	2g

Table 1: GPS-1513R general specification

\*: GPGGA, GPGSA, GPGSV, GPRMC, GPVTG are default output message

## 2.2 Block Diagram

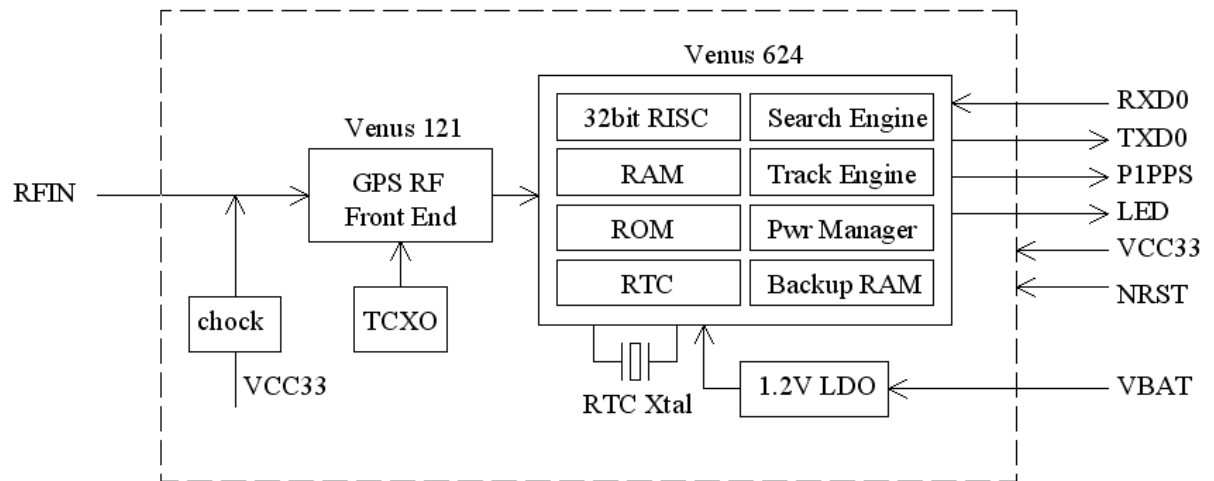


Figure 1: GPS-1513R Hardware Block Schematic

The GPS-1513R is a high performance GPS receiver in a compact surface mount package. It is based on the

Venus 6 positioning technology, providing exceptional signal acquisition performance, and continuous operation even in dense foliage and urban canyons. The module includes internal SAW filter and high performance integrated LNA, works with both active and passive antenna. The simple UART serial interface and the standard NMEA-0183 protocol make using GPS-1513R very easy and straightforward.

The GPS-1513R performs all the necessary system initialization, satellite signal acquisition & tracking, data demodulation, and calculation of navigation solution autonomously. The position, velocity, time information in NMEA format is generated at user selectable update rate of 1 / 2 / 4 / 5 / 8 / 10 Hz.



## 2.2 Serial Port Settings

The default configuration within the standard GPS firmware is:

- Standard configuration of serial port:
- Supporting 4800/9600 baud rate (Default Value : 9600), 8 data bits, no parity, 1 stop bit, no flow control

## 2.3 Improved TTFF

In order to improve the TTFF (Time To First Fix), The system designer has to supply the power from the system to the Pin 5 V-bat to support the RTC with a back-up power when no system power is available.

## 2.4 Communication Specifications

Item	Description
Interface	Full duplex serial interface
Bit rate	4800/9600/38400/115200bps (Optional, Default 9600)
Start bit	1bit
Stop bit	1bit
Data bit	8bit
Parity	None
Transmission data	SACII NMEA0183 Ver:3.01
Update rate	1Hz
Output sentence	GGA/GSA/GSV/RMC/MTG (typ)

Table 2: Communication specifications

## 2.5 Multi-path Mitigation

Multipath refers to the existence of signals reflected from objects in the vicinity of a receiver's antenna that corrupt the direct line-of-sight signals from the GPS satellites, thus degrading the accuracy of both code-based and carrier phase-based measurements. Particularly difficult is close-in multipath in which the reflected secondary signals arrive only slightly later (within about 100 nanoseconds) than does the direct-path signal, having been reflected from objects only a short distance from the receiver antenna.

GPS-1513R deploys the advanced multi-path detection and suppression algorithm to reduce multipath errors, the GPS signals themselves can be designed to provide inherent resistance to multipath errors

## 2.6 ELECTRICAL SPECIFICATIONS

Parameter	Minimum	Maximum	Condition
Supply Voltage (VCC33)	-	3.6	Volt
Backup Battery Voltage	-	3.6	Volt
Input Pin Voltage	-	VCC+0.5	Volt
Input Power at RFIN		+5	dBm
Storage Temperature	-	+100	degC

Table 4: Absolute Maximum Ratings

### OPERATING CONDITIONS

Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC33)	3	3.3	3.6	Volt
Acquisition Current (enhanced mode, exclude active)			75	mA
Acquisition Current (low power mode, exclude active)			55	mA
Tracking Current (exclude active antenna current)		28		mA
Backup Voltage (VBAT)	1.5		6	Volt
Backup Current (VCC33 voltage applied)			1.5	mA
Backup Current (VCC33 voltage off)			10	uA
Output Low Voltage			0.4	Volt
Output HIGH Voltage	2.4			Volt
Input LOW Voltage			0.8	Volt
Input HIGH Voltage	2			Volt
Input LOW Current	-10		10	uA
Input HIGH Current	-10		10	uA
RF Input Impedance (RFIN)		50		Ohm

Table 3: Operating Conditions

## 2.7 Antenna Consideration

A numbers of important properties of GNSS antennas affect functionality and performance, including;

- Frequency coverage
- Gain pattern
- Circular polarization
- Multipath suppression
- Phase Center
- Impact on receiver sensitivity
- Interference handling

The GPS-1513R is designed to use with a wide variety of active and passive antennas, but care must be taken during antenna selection to ensure optimum signal reception performance. There are many choices of antenna configurations; the best choice is often a tradeoff between size, gain, bandwidth and cost. The best way is to test multiple antenna solutions in the configuration of the final system to determine which provides the best overall performance.

Ceramic patch antenna is low-cost and provides good sensitivity. 50-ohm output ceramic patch antenna can be connected directly to RF input of the module. Usually the antenna and GPS-1513R are mounted on opposite side of the PCB to reduce possibility of picking up digital noise. To improve signal reception performance, use larger ground plane under the patch antenna If possible; larger the ground plane, larger the overall antenna gain. The center frequency of the ceramic patch antenna changes with ground plane size. For optimal operation, center frequency needs to be 1575MHz when mounted on the PCB. It is usual to ask the ceramic patch antenna vendor to select or tune a patch antenna that best matches the customer PCB.

Active antenna is essentially a passive antenna with built-in LNA and a coaxial cable to connect the antenna

to the module. It has the flexibility of being located remotely from the module, but requires antenna power. Active antenna usually costs more than passive patch antenna, but the performance in low signal environments is usually better. When using active antenna, an