Rikaline **GPS-27**

GPS Board

User's Guide

SiRF Star III V1.0 Feb 20, 2006

Rikaline **International Corp.**

14F, 171, Chen-Gong Road, San-Chong City, Taipei 241, Taiwan
Phone: +886-2-8973-1899 Fax: +886-2-8973-1896
E-Mail: info@rikaline.com.tw Web: www.rikaline.com.tw

TABLE OF CONTENTS

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

1. Introduction

1.1 Overview

The *Rikaline* **GPS-27 GPS Engine Board** is designed based on **SiRF Star III** new generation architecture with low power consumption, small size (16 x 20mm) and easy integrated for a broad spectrum of OEM system applications. It acquires satellite 20 channel parallel and tracking 12 at a time. The 200,000 effective correlators ensure fast TTFF and fast TTFF at low signal level.

The GPS-27 meets strict needs such as car navigation, mapping, surveying, security, agriculture and so on. Only clear view of sky and certain power supply are necessary to the unit. It communicates with other electronic utilities via compatible TTL and saves critical satellite data by built–in backup memory. The Trickle-Power allows the unit operates a fraction of the time and Push-to-Fix permits user to have a quick position fix even though the receiver usually stays off.

To minimize the space and cost, we provide you GPS-27 without patch antenna and some components which you may have in your main board.

1.2 Features

The GPS-27 provides a host of features that make it easy for integration and use.

1. **SiRF Star III** chipset with embedded ARM7TDMI CPU available for customized applications in firmware.
2. High performance receiver acquires 20 channel parallel and tracks up to 12 satellites while providing first fast fix and low power consumption.
3. Differential capability utilizes real-time RTCM corrections producing 1-5 meter position accuracy.
4. Compact design ideal for applications with minimal space.
5. User initialization is not required.
6. Dual communication channels and user selectable baud rates allow maximum interface capability and flexibility.
7. Optional customer design for any possible size down to 16 x 20mm.
8. FLASH based program memory: New software revisions upgradeable through serial interface.
9. Built-in WAAS and EGNOS demodulator.

1.3 Technical specifications

1.3.1 Physical Characteristics

Dimension: 16(L) x 20(W) x 3(H) mm
0.63"(L) x 0.79"(W) x 0.12"(H).
Weight: 2.8g

1.3.2 Environmental Characteristics

1) Operating temperature: -40°C to +85°C
2) Storage temperature: -55°C to +100°C.

1.3.3 Electrical Characteristics

1) Input voltage: +2.85Vdc (Base Band & RF) and +1.5Vdc (RTC)

1.3.4 Performance

1) Acquisition: 20 channel parallel
2) Tracking: up to 12 satellites
3) Update rate: 1 second
4) Acquisition time

Rikaline **International Corp.** 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

Reacquisition	0.1 sec., averaged
Snap Start	3 sec, averaged
Hot start	6 sec, averaged
Warm start	38 sec., averaged
Cold start	42 sec., averaged

4) Position accuracy:
   A) Non DGPS (Differential GPS)

Position	<10 M at 2D RMS
Velocity	0.1 meters/second, with SA off
Time	1 microsecond synchronized GPS time

   B) DGPS (Differential GPS) or WAAS / EGNOS

Position	1 ~ 5 meter, typical
Velocity	0.05 meters/second, typical

5) Dynamic Conditions:

Altitude	18,000 meters (60,000 feet) max
Velocity	515 meters / second (1000 knots) max
Acceleration	4 G, max
Jerk	20 meters/second, max

6) Time Mark PPS

Level	TTL
Pulse Duration	100ms
Time Reference	at the pulse positive edge
Measurements	Aligned to GPS second, ± 1 microsecond

1.3.5 Interfaces

1) Dual channel TTL compatible level, with user selectable baud rate (4800, **9600-Default**, 19200, 38400).
2) NMEA 0183 Version 2.2 ASCII output (GPGGA, GPGLL, GPGSA(5), GPGSV(5), GPRMC, GPVTG).
3) SiRF protocol--- Position, Velocity, Altitude, Status and Control

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

2. Operational characteristics

2.1 Initialization

As soon as the initial self-test is complete, the GPS-27 begins the process of satellite acquisition and tracking automatically. Under normal circumstances, it takes approximately 42 seconds to achieve a position fix, 38 seconds if ephemeris data is known. After a position fix has been calculated, information about valid position, velocity and time is transmitted over the output channel.

The GPS-27 utilizes initial data, such as last stored position, date, time and satellite orbital data, to achieve maximum acquisition performance. If significant inaccuracy exists in the initial data, or the orbital data is obsolete, it may take more time to achieve a navigation solution. The GPS-27 Auto-locate feature is capable of automatically determining a navigation solution without intervention from the host system.

2.2 Navigation

After the acquisition process is complete, the GPS-27 sends valid navigation information over output channels. These data include:

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

The GPS-27 sets the default of auto-searching for real-time differential corrections in RTCM SC-104 standard format, with the message types 1, 5, or 9. It accomplishes the satellite data to generate a differential (DGPS) solution. The host system, at its option, may also command the GPS-27 to output a position whenever a differential solution is available.

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

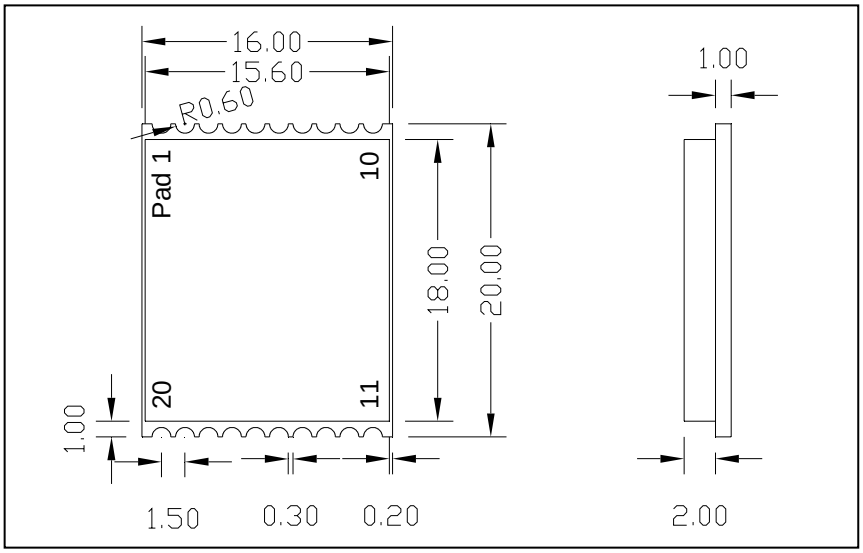
3. Hardware interface

3.1 Physical Characteristics

Dimension: 16(L) x 20(W) x 3(H) mm
0.63"(L) x 0.79"(W) x 0.12"(H).
Weight: 2.8g

3.2 Hardware

Units: In mm



3.3 Connectors

3.3.1 Antenna Connector

It is designed with 50 Ohm feed. Integrator may use any GPS RF connector they prefer and put it in a proper location of the system board.

3.3.2 Interface Connector

20-pads for soldiering on the system board.

3.4 Pad Assignment

Table 3-1 Pad definition of the 20 Digital Interface

Pad Number	*Name*	*Description*
1	ANT	Antenna Input (50 Ohm)
2	VCC ANT	For External Antenna Power
3	GND	Ground
4	BOOTSET	Booting Mode Selection
5	PPS	Time Mark Output
6	GPIO	Spare I\O
7	GPS STATE	Positioning Status
8	GND	Ground
9	VCC_BB	Base Band Power Input (2.85V)
10	GND	Ground
11	RX (TTL)	Serial Data Input
12	TX (TTL)	Serial Data Output
13	DGPS	Deferential GPS Input

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

14	P-T-F	Push-To-Fix
15	VCC_RTC	RTC Back up (1.5V)
16	GND	Ground
17	VCC_RF	RF Input (2.85V)
18	RESET	System Restart
19	GND	Ground
20	GND	Ground

Table 3-2 Operating Conditions

Parameter	Symbol	Min	Type	Max	Units
Power Supply Voltage	VCC (BB & RF)	2.7	2.85	2.8	V
Power Supply Voltage	VCC (RTC)	1.4	1.5	1.6	V
Operating Temperature	TOPR	-40		85	ºC
Operating Current	ICC		90		mA

Table 3-3 Battery Conditions

Parameter	Symbol	Min	Typ	Max	Units
RTC (Battery) Power	VCC_RTC	1.4	1.5	1.6	V
Supply Current			10		µA

3.4.1 Antenna Input

For antenna power input.

3.4.2 VCC ANT

For powering the active antenna. We provide you a flexible voltage of the antenna. It depends on your design either 3.3V, 5V or others.

3.4.3 BOOT SET

For booting mode selection.

3.4.4 PPS Time mark

This function provides 1 pulse per second output from the board, which is synchronized to within 1 microsecond of GPS time. The output is a CMOS (TTL) level signal.

3.4.5 SPARE GPIO Functions

This I/Os of CPU is connected to the digital interface connector for consumer applications.

3.4.6 GPS State

To have GPS positioning status visible. Default (to LED): Blinking (Power ON) and ON (position fix)

3.4.7 VCC BASE BAND

It requires **2.85Vdc** stable power input for the base band.

3.4.8 Rx (TTL)

This pad is for data Input to control the GPS output or GPS system setting

3.4.9 Tx (TTL)

It outputs standard NMEA 0183 V2.2 sentences, SiRF binary or either one of NMEA and SiRF binary with customer's software.

3.4.10 DGPS

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

Real-time Differential Correction input (RTCM SC-104 version 2.00 message types 1, 5 and 9). For use with Radio-Beacon for positioning correction. It always requires baud rate at 9600.

3.4.11 Push-to-Fix Description

The Push-to-Fix mode is for the applications that requires infrequent position reporting. The receiver generally stays in a low-power mode, up to 2 hours, but wakes up periodically to refresh position, time, ephemeris data and RTC calibration. A position request acts as a wakeup to the receiver, which is then able to supply a position within the hot-start time specification.

3.4.12 VCC RTC

It requires **1.5Vdc** and the function is to keep the GPS clock running in the system for quick position fix next time.

3.4.12 VCC RF

It requires **2.85Vdc** for RF part.

3.4.13 RESET

This function provides an active-low reset input to the board. It causes the board to reset and start searching for satellites. It is an optional input and, if not utilized, it may be left open.

3.4.14 GND

The GND provides the ground for the board. All GND should be connected.

3.5 Other Function Description

3.5.1 TricklePower™ Description

In this state, the CPU is in a low power standby state and the receiver clocks are off with only the RTC clock active. After a set amount of time, the RTC generates an NMI signal to wake up the ARM-7 microprocessor and reset the receiver back to tracking state.

3.5.2 Backup power

This power is to backup the Memory and RTC when main power is off. The typical current draw is 10 μA when system on, 2-3 μA when system off.

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

4. Software Interface

4.1 NMEA Transmitted Messages

The GPS-27 supported by SiRF Technology Inc. also outputs data in NMEA-0183 format as defined by the National Marine Electronics Association (NMEA), Standard. The default communication parameters for NMEA output are 4800 baud, 8 data bits, stop bit, and no parity.

Table 4-1 NMEA-0183 Output Messages

NMEA Record	Description
GPGGA	Globle 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

4.1.1 Global Positioning System Fix Data (GGA)

Table 4-2 contains the values for the following example:

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

Table 4-2 GGA Data Format

Name	Example	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 Table 5-3
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
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		
<CR> <LF>			End of message termination

Table 4-3 Position Fix Indicator

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

4.1.2 Geographic Position with Latitude/Longitude (GLL)

Table 4-4 contains the values for the following example:

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

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

Table 4-4 GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
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
UTC Position	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Checksum	*2C		
<CR> <LF>			End of message termination

4.1.3 GNSS DOP and Active Satellites (GSA)

Table 4-5 contains the values for the following example:

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

Table 4-5 GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 5-6
Mode 2	3		See Table 5-7
Satellite Used (1)	07		Sv on Channel 1
Satellite Used (1)	02		Sv on Channel 2
……			….
Satellite Used			Sv on Channel 12
PDOP	1.8		Position Dilution of Precision
HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR> <LF>			End of message termination

(1) Satellite used in solution.

Table 4-6 Mode 1

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

Table 4-7 Mode 2

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

4.1.4 GNSS Satellites in View (GSV)

Table 4-8 contains the values for the following 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

Table 4-8 GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages	2		Range 1 to 3

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

Message Number	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		
<CR> <LF>			End of message termination

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

4.1.5 Recommended Minimum Specific GNSS Data (RMC)

Table 4-9 contains the values for the following example:

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598, ,*10

Table 4-9 RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
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
Speed Over Ground	0.13	Knots	
Course Over Ground	309.62	Degrees	True
Date	120598		Ddmmyy
Magnetic Variation (1)		Degrees	E=east or W=west
Checksum	*10		
<CR> <LF>			End of message termination

(1) SiRF Technology Inc. does not support magnetic declination. All “course over ground” data are geodetic WGS84 directions.

4.1.6 Course Over Ground and Ground Speed (VTG)

Table 4-10 contains the values for the following example:

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

Table 4-10 VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	Degrees	Measured heading
Reference	T		True
Course		Degrees	Measured heading
Reference	M		Magnetic (1)
Speed	0.13	Knots	Measured horizontal speed

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

Units	N		Knots
Speed	0.2	Km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Checksum	*6E		
<CR> <LF>			End of message termination

(1) SiRF Technology Inc. does not support magnetic declination. All “course over ground” data are geodetic WGS84 directions.

4.2 RTCM Received Data

The default communication parameters for DGPS Input are 9600 baud, 8 data bits, stop bit, and no parity. Position accuracy of less than 5 meters can be achieved with the GPS-27 by using Differential GPS (DGPS) real-time pseudo-range correction data in RTCM SC-104 format, with message types 1, 5, or 9. As using DGPS receiver with different communication parameters, GPS-27 may decode the data correctly to generate accurate messages and save them in battery-back SRAM for later computing.

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

5. Earth Datums & Output Setting

5.1 Earth Datums

The GPS-27 is built in earth datum with WGS84.

5.2 Setting

5.2.1 Manufacturing Default

Datum: WGS84.
Baud Rate: 9600.
Output: GGA, GLL, GSA(5), GSV(5), RMC, VTG

5.2.2 Baud Rate and Output Sentences Setting

5.2.2.1 By SiRFdemo Program

1// Connect your GPS-6010 to PC (either COM or USB)
2// Execute SiRFdemo.exe (Program is in the CD)
3// When “Data Source Setup” shows, select the port (COM 1, 2 or 3….) you used, click “OK”.
4// Click “Action”, select “Open Data Source”, Then you will see lots of sentences shows. All the sentences start with $GPxxxx. This is NMEA protocol. If you do not see these sentences, please click “View”, “Select Message”, then click “Development”. The message will appear. If it still shows nothing, then continue below steps.
5// There is a screen “Selection of Target Receiver Software” might appear, please select “SiRFstar II”.
6// Click “Action”, Select “Switch to SiRF Protocol”. Then you will see SiRF binary and the sentences start with #Time, shows every 4 lines and you can not see the sentences start with $GP. These sentences are for setting or viewing the GPS receiver’s performance. If your software is using standard NMEA protocol, please do the following:
7// Click “Action”, Select “Switch to NMEA Protocol”. You will see GGA, GSV, GSA and RMC in black and the Baud Rate is 4800. These are the default we put inside the receiver. Please click “OK”. Then you can use it as a standard GPS receiver. If your software uses different sentence, please choose the sentences you need.

After above actions, the new setting will be kept in SRAM. If no power supplied to GPS-6010 for more than 30 days, user must re-set again when power on.

Details please refer to SiRFDemo

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

6. Ordering Information

6.1 Product Options

6.1.1 Standard Product

GPS-27: Small, low cost GPS engine board, Integrated without patch antenna

Different software setting is built by demand.

6.2 Accessories

A-10302 Active Antenna, 2-Meter, MCX 180° connector
A-10302-M Active Antenna, 2-Meter, MMCX 180° connector
A-10302-SA Active Antenna, 2-Meter, SMA 180° connector

A-10302-M Active Antenna, 2-Meter, MMCX 180° connector
A-10305-M Active Antenna, 5-Meter, MMCX 180° connector
A-10305-SA Active Antenna, 5-Meter, MMCX 180° connector

Different antenna connector or different degree of the connector is built by demand.

7. Warranty

The GPS-27 is warranted to be free from defects in material and functions for one year from the date of purchase. Any failure of this product within this period under normal conditions will be replaced at no charge to the customers.

Rikaline International Corp. 14F, 171, Cheng-Gong Road, SanChung City, Taipei 241, Taiwan
Tel: ++886 2 8973 1899 Fax: ++886 2 8973 1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw