Rikaline **GPS-6051**

Marine GPS

User's Guide

Sep. 24, 2004

V1.1

Rikaline **International Corp.**

14F, 171, ChengGong Rd., Sanchong City, Taipei 241, Taiwan, R.O.C

Phone: +886-2-8973-1899 Fax: +886-2-8973-1896

E-Mail: info@rikaline.com.tw Web: www.rikaline.com.tw

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Rikaline International Corp. 14F, 171, ChengGong Rd., Sanchong City, Taipei 241, Taiwan, R. O.C
Tel: ++886 2 8973-1899 Fax: ++886 2 8973-1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

Rikaline International Corp. 14F, 171, ChengGong Rd., Sanchong City, Taipei 241, Taiwan, R. O.C
Tel: ++886 2 8973-1899 Fax: ++886 2 8973-1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

0. Quick Use

0.1 Check GPS Package

0.1.1 Standard Package

GPS-6051 (RS-422 Version): GPS Unit + Warranty Card + Quick Reference + 10 Meter Cable.
GPS-6051-U(USB Version): GPS Unit + Warranty Card + Quick Reference + 10 Meter Cable + USB Driver CD)

0.1.2 Optional Cable

1. A-6026-10 RS-422 Cable, 10 Meter
2. A-6026-20 RS-422 Cable, 20 Meter
3. A-6026-30 RS-422 Cable, 30 Meter
4. A-6026-50 RS-422 Cable, 50 Meter

1. A-6026-10U USB Cable, 10 Meter
2. A-6026-20U USB Cable, 20 Meter
3. A-6026-30U USB Cable, 30 Meter
5. A-6026-50U USB Cable, 50 Meter

0.2 Check Pin Assignment

1. Connect GPS with suitable power (8-25Vdc) to your system for RS-422 version.
2. Connect the USB port to your system if you use USB version.
3. When you use USB version, you need a USB driver as enclosed in the package. Connect GPS to your system and install the driver.

0.3 Manufacturing Default

1. Sentence: GGA, GSA, GSV, RMC, VTG
2. Baud Rate: 4800
3. Datum: WGS84
4. WAAS: OFF. Demand for WAAS ON could be special built.

0.4 Important features

1. Water proof.
2. Anti-UV material.
3. Operating temperature range from -40^{o}C to +85^{o}C (internal temperature)

0.5 Different Models

1. GPS-6051: RS-422 interface.
2. GPS-6051-U: USB interface.

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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-6051 Marine GPS** is a total solution GPS receiver, designed based on **SiRF Star II** Architecture. This positioning application 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 dual-channel through RS-422 or USB interface and saves critical satellite data by built–in backup memory. With low power consumption, the **GPS-6051** tracks up to 12 satellites at a time, re-acquires satellite signals in 100 ms and updates position data every second. 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.

1.2 Features

The GPS-6051 provides a host of features that make it easy for integration and use.

1. **SiRF Star II** chipset with embedded ARM7TDMI CPU available for customized applications in firmware.
2. High performance receiver tracks up to 12 satellites while providing first fast fix and low power consumption.
3. Differential capability (**Optional model**) utilizes real-time RTCM corrections producing 1-5 meter position accuracy.
4. A rechargeable battery sustains internal clock and memory. It is recharged during normal operation.
5. User initialization is not required.
6. Optional communication levels, RS-422 or USB meet various applications.
7. FLASH based program memory: New software revisions upgradeable through serial interface.
8. Built-in WAAS demodulator (Optional for special demand).
9. Water proof designed for all weather.

1.3 Technology specifications

1.3.1 Physical Dimension

Single construction integrated antenna/receiver.
Size: 75.6.0(OD) x 72.7(H) (mm)
2.98"(OD) x 2.86"(H).
Weight: 400g (including 10-meter cable)

1.3.2 Environmental Characteristics

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

1.3.3 Electrical Characteristics

1) Input voltage: +8.0 ~ 25.0 VDC.
2) Backup power: 3V Rechargeable Lithium cell battery, up to 460 hours (19 days) discharge.

1.3.4 Performance

1) Tracks up to 12 satellites.
2) Update rate: 1 second.
3) Acquisition time

Reacquisition	0.1 sec., averaged
Hot start	8 sec., averaged
Warm start	38 sec., averaged
Cold start	45 sec., averaged

4) Position accuracy:

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A) Non DGPS (Differential GPS)
Position 5-25 meter CEP with SA off
Velocity 0.1 meters/second, with SA off
Time 1 microsecond synchronized GPS time
B) DGPS (Differential GPS)
Position 1 to 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

(DGPS function built by demand)

1.3.5 Interfaces

1) Dual channel RS-422 or USB compatible level, with user selectable baud rate (4800-Default, 9600, 19200, 38400).
2) NMEA 0183 Version 2.2 ASCII output (GPGGA, GPGLL, GPGSA, GPGSV, GPRMC, GPVTG).
3) Real-time Differential Correction input (RTCM SC-104 message types 1, 5 and 9).
4) SiRF protocol (for optional model).

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2. Operational characteristics

2.1 Initialization

As soon as the initial self-test is complete, the GPS-6051 begins the process of satellite acquisition and tracking automatically. Under normal circumstances, it takes approximately 45 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-6051 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-6051 Auto-locate feature is capable of automatically determining a navigation solution without intervention from the host system. However, acquisition performance can be improved when the host system initializes the GPS-6051 in the following situation:

1) Moving further than 1,500 kilometers.
2) Failure of data storage due to the inactive internal memory battery.

2.2 Navigation

After the acquisition process is complete, the GPS-6051 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-6051 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-6051 to output a position whenever a differential solution is available.

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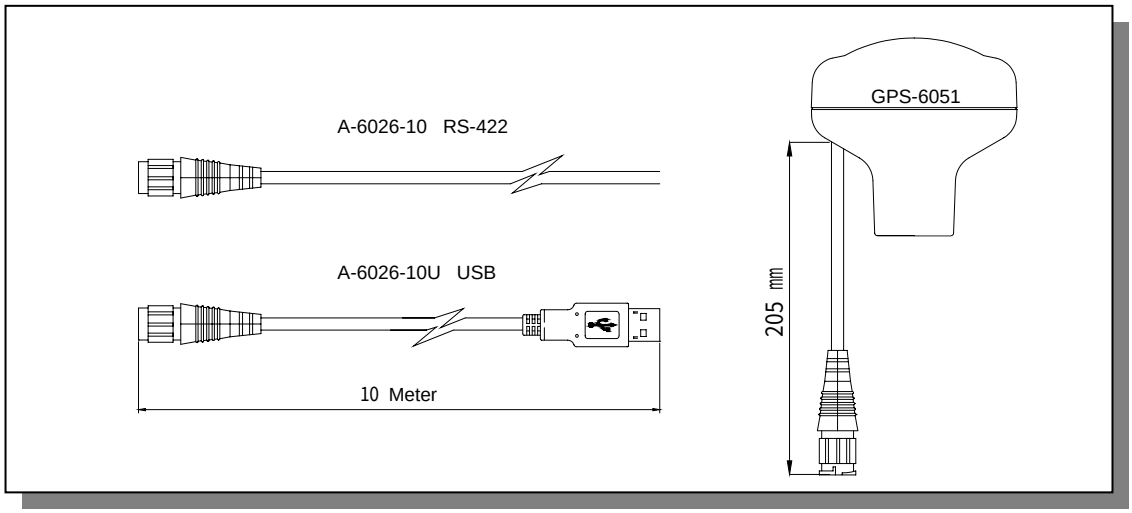
3. Hardware interface

3.1 Dimension

Size: 75.6.0(OD) x 72.7(H) (mm)
2.98"(OD) x 2.86"(H).

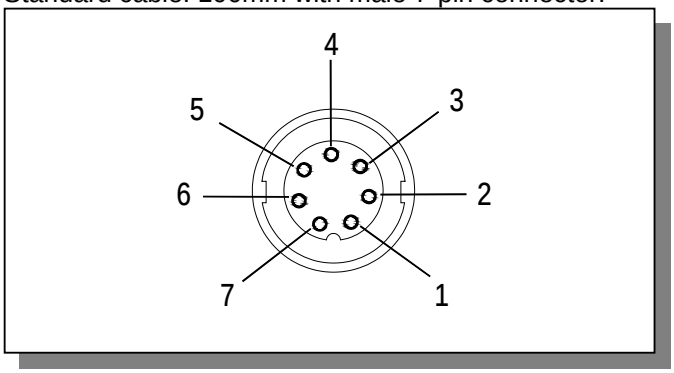
3.2 Hardware Interface

The GPS-6051 includes an antenna in a unique style waterproof gadget. Simply connect the 7-pin male connector to one of the optional accessories you choose and link it to your navigation devices.



3.3 Connector

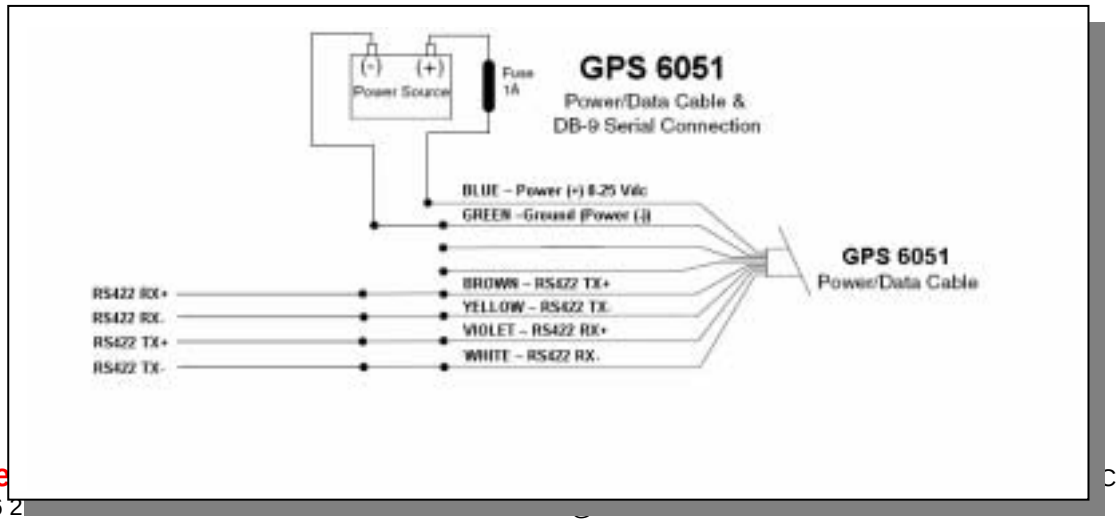
Standard cable: 100mm with male 7-pin connector.



Pin	Signal
1	NC
2	RS-422 Tx +
3	RS-422 Tx -
4	RS-422 Rx +
5	RS-422 Rx -
6	GND
7	+ 8~25Vdc
8	Shield

* NC: not connected

3.3.1 Function definition of standard female 7-pin connector



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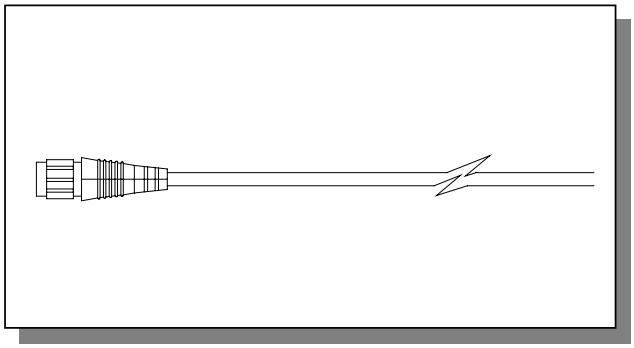
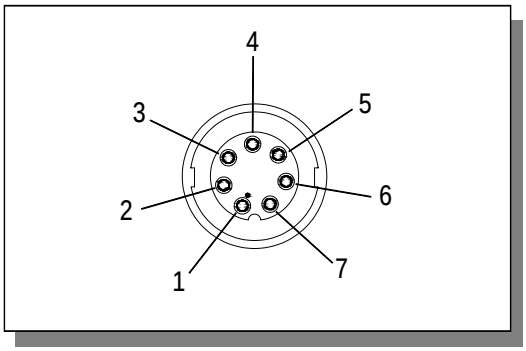
3.4 Accessories

3.4.1 Standard Cable

A-6026-10 10-meter, RS-422 interface for GPS-6051
A-6026-10U 10-meter, USB interface for GPS-6051-U

3.4.1.1 xxxxxx Female connector function definition:





Color	Signal
Brown	RS-422 Tx +
Yellow	RS-422 Tx -
Violet	RS-422 Rx +
White	RS-422 Rx -
Green	GND
Blue	+ 8~25Vdc
Shield	Shield

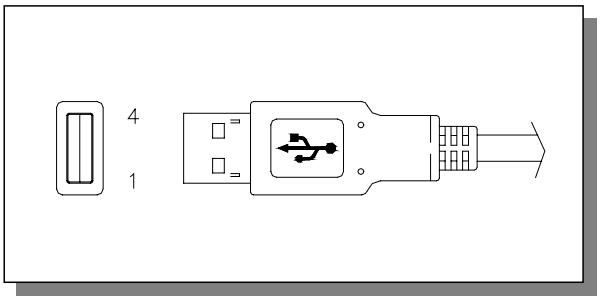
* NC: not connected

Pin	Signal
1	NC
2	RS-422 Tx +
3	RS-422 Tx -
4	RS-422 Rx +
5	RS-422 Rx -
6	GND
7	+ 8~25Vdc
8	Shield

* NC: not connected

3.4.1.2 USB Connector

The function definition of the A type USB connector is as follows:



PIN	Signal
1	+ 5V
2	D +
3	D -
4	Ground

3.4.2 Optional Cable

3.4.2.1 For GPS-6051

A-6026-20 20-meter, RS-422 interface
A-6026-30 30-meter, RS-422 interface
A-6026-50 50-meter, RS-422 interface

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Tel: ++886 2 8973-1899 Fax: ++886 2 8973-1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

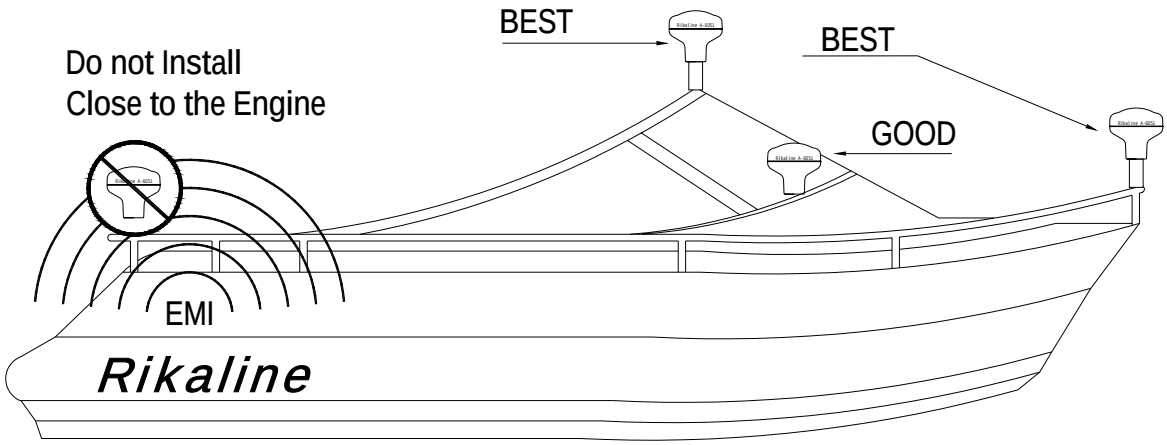
3.4.2.1 For GPS-6051-U

A-6026-20U 20-meter, USB interface
A-6026-30U 30-meter, USB interface
A-6026-50U 50-meter, USB interface

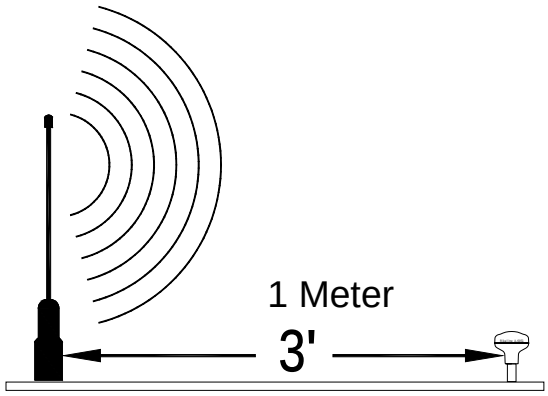
3.5 Installation Instruction

3.5.1 Location of Installation

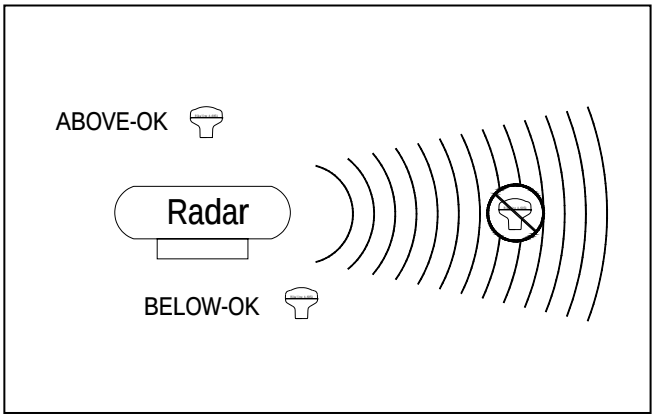
3.5.1.1 Suitable place on Boat



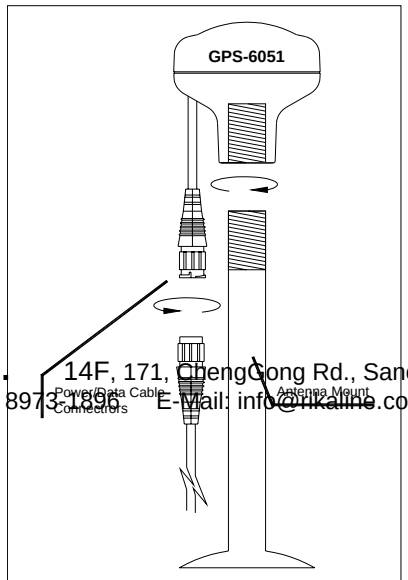
3.5.1.2 Minimum distance to other Antenna



Position to Radar



3.5.2 Installation



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Tel: ++886 2 8973-1899 Fax: ++886 2 8973-1898 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

Rikaline International Corp. 14F, 171, ChengGong Rd., Sanchong City, Taipei 241, Taiwan, R. O.C
Tel: ++886 2 8973-1899 Fax: ++886 2 8973-1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

4. USB Driver

4.1 System Requirements

IBM, Pentium or above and other compatible PC; 16 MB and above memory; Windows 98/Me/2000; VGA Graphic Adapter.

4.2 Installation

1. Copy entire <GPS-6051 USB> folder from CD to hard disk.
2. Connect GPS-6051 USB connector to computer. While the computer automatically starts the installation program, please direct the driver to the <GPS-6051 USB> folder.
3. After the installation is complete, go to <Device Manager> and select <Ports (COM & LPT)> to verify if a virtual COM port <USB to Serial Port> was created.

4.3 Important

Verify the COM port # to start using your own navigating software.

1. Click **<Start>** menu, select **<Settings>,** then enter <**Control Panel>.**
2. After entering **<Control Panel>**, select **<System>.**
3. Select **<Device Manager>.**
4. Find the **<Connect Port>** and check the Virtual COM Port, which was created by the USB driver. Please note that the Virtual COM Port number might be different from every computer. Before using navigating software, please confirm the COM Port numbers created by your computer and provided by your navigation software. They must be the same Com Port numbers. Otherwise, the navigating software won't receive the satellite signal for the un-match COM Port setting.

5. Ordering Information

5.1 Product Options

5.1.1 OutPut Level (or Data)

GPS-6051: RS-422 Interface With 10-meter Cable.
GPS-6051-U: USB Interface With 10-meter Cable.

5.1.2 Color Option

White (Standard)
Other Color: by demand

5.2 Accessories

5.2.1 RS-422 Cables

A-6026-10 10-meter, RS-422 interface for GPS-6051
A-6026-20 20-meter, RS-422 interface for GPS-6051
A-6026-30 30-meter, RS-422 interface for GPS-6051
A-6026-50 50-meter, RS-422 interface for GPS-6051

5.2.2 USB Cables

A-6026-10U 10-meter, USB interface for GPS-6051-U
A-6026-20U 20-meter, USB interface for GPS-6051-U
A-6026-30U 30-meter, USB interface for GPS-6051-U
A-6026-50U 50-meter, USB interface for GPS-6051-U

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Tel: ++886 2 8973-1899 Fax: ++886 2 8973-1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

6. Warranty

The GPS-6051 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, ChengGong Rd., Sanchong City, Taipei 241, Taiwan, R. O.C
Tel: ++886 2 8973-1899 Fax: ++886 2 8973-1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw

Appendix A Software Interface (For professional users only)

The GPS-6051 interface protocol is based on the National Marine Electronics Association's NMEA 0183 ASC II interface specification, which is defined in NMEA 0183, Version 2.2 and the Radio Technical Commission for Maritime Services (RTCM Recommended Standards For Differential Navstar GPS Service, Version 2.1, RTCM Special Committee No.104).

A.1 NMEA Transmitted Messages

The GPS-6051 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 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

A.1.1 Global Positioning System Fix Data (GGA)

Table A-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 A-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 A-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

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A.1.2 Geographic Position with Latitude/Longitude (GLL)

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

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

Table A-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

A.1.3 GNSS DOP and Active Satellites (GSA)

Table A-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 A-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 A-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 A-7 Mode 2

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

A.1.4 GNSS Satellites in View (GSV)

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Table A-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 A-8 GSV Data Format

Name	Example	Units	Description
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		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.

A.1.5 Recommended Minimum Specific GNSS Data (RMC)

Table A-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 A-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.

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

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

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

Table A-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
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.

A.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-6051 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-6051 may decode the data correctly to generate accurate messages and save them in battery-back SRAM for later computing.

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Appendix B Earth Datums & Output Setting

(For professional users only)

B.1 Earth Datums

The GPS-6051 is built in earth datum with WGS84.

B.2 Setting

B.2.1 Manufacturing Default

Datum: WGS84.
Baud Rate: 4800.
Output: GGA, GSA, GSV, RMC, VTG.

B.2.2 Baud Rate and Output Sentences Setting

B.2.2.1 By SiRFdemo Program

1// Connect your GPS-6051 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-6051 for more than than 30 days, user must re-set again when power on.

B.2.2.2 By other SiRF based demo program

There are a few companies or private website providing some very good demo software.

Rikaline International Corp. 14F, 171, ChengGong Rd., Sanchong City, Taipei 241, Taiwan, R. O.C
Tel: ++886 2 8973-1899 Fax: ++886 2 8973-1896 E-Mail: info@rikaline.com.tw web: www.rikaline.com.tw