

GPS Development Kit #DK-ER101

Installation & Data Documentation

Included items:

- 1- ER-101 GPS Engine Board Module
- 1- AT-25 GPS Antenna w/MCX connector
- 1- CD-ROM containing
 - a. Installation & Specification Data (MSWORD)
Open "Install_Document.doc"
 - b. NMEA Agent Software
 - c. Specifications on ET-201 Engine Board

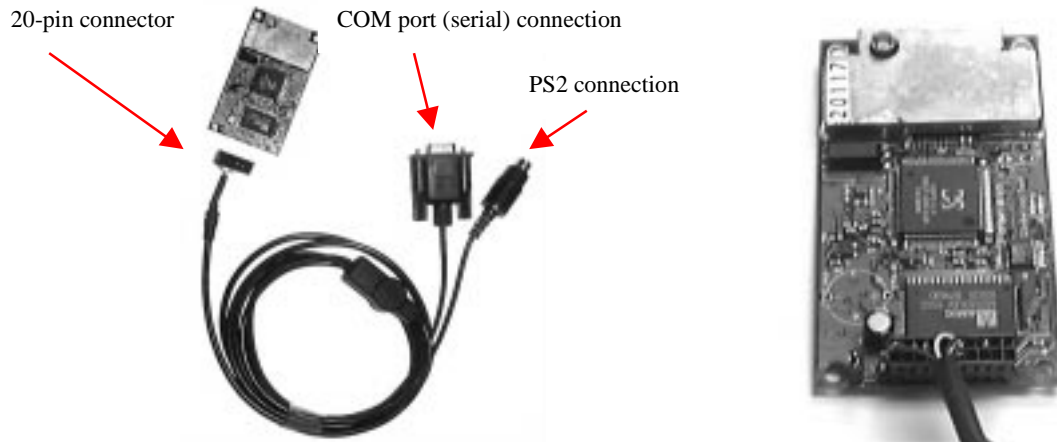
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Installing the ER-101 Module and NMEAagent Software

1. GPS Receiver Module Installation process:

- Plug in the ER-101 GPS module unit into the COM port (serial) and the PS2 port of your laptop BEFORE powering it up.
- Turn on your laptop.



Order additional connectors for your project from Digi-Key Corporation:

- Dual row 20-pin housing: WM18038-ND
- Crimp terminals: WM18056-ND (cable and PC connectors not included):

Cable color pin-assignment:

- RED = Pin 2 or Pin 4
- Black = Pin 16 or Pin 18
- Green = Pin 11
- White = Pin 12

- The supplied NMEAagent software is a shareware program supplied to verify that the GPS module is functioning and receiving data on your PC. Thereafter you may install and use any other 3-party NMEA compliant software for your application.

Software installation process:

- From the CD-ROM, click on the file “setup.exe” to load the software found in the NMEAagent folder.
- After all files have successfully been copied, double click on the “NMEAagent.exe” file launch program, (Default directory is C:\Program Files\NMEAagent).
- You may experience some errors during the installation process due to your particular computer configuration, but can find assistance on our web-site at the FAQ page for the serial GPS products. (<http://www.rayming.com/>)
- Upon completion of installing the NMEAagent software, your computer may need to be re-booted in order to function properly with the GPS receiver. Be sure that the GPS receiver is connected to your COM port before you re-apply power for the re-boot.
- After re-booting has completed, click on Start>Programs>NMEAagent>NMEAagent to open the program. From the NMEAagent menu bar, select the Display pull-down menu and click on “Show All.”
- For configuration of your COM port and other preferences, select the “Settings” from the pull down menu.
- To confirm that your GPS receiver is functioning properly, data should be displayed in the “NMEA Input From GPS” window. If the data appears, other windows (Satellite Positions, Satellite Information, and Position Information) will soon be receiving data and display the information as well.

NOTE: It is important that no other device is occupying the same COM port assigned the GPS module. This can be verified by going into your “System Properties” from the “Control Panel” and selecting the “Device Manager” tab. Expand the “Ports (COM & LPT)” and click on “Communications (COM 1),” or the COM port that the GPS module is connected to.)

ER-101 Specification

Product Feature

- SiRFstar GPS Architecture
- SiRFstarI high performance and low power consumption signal processor
- Support standard NMEA 0183 protocol
- All-in-view 12-channel parallel processing
- SnapLock 100ms re-acquisition time
- Cold start under 45 seconds, average
- Superior urban canyon performance
- FoliageLock for weak signal tracking
- Build-in SuperCap to reserve system data for rapid satellite acquisition.
- Full-duplex RS-232 port for navigation and control messages
- Differential GPS capability through 2nd RS-232 port

System Specification

1. *Electrical Characteristics*

<Receiver>

- **Frequency** L1, 1575.42MHz
- **C/A code** 1.023MHz chip rate
- **Sensitivity** 1.023MHz chip rate
- **Channels** 12
- **Sensitivity** -170dBW

<Accuracy>

- **Position Horizontal** 25m 95% (SA off),
- **Velocity** 0.1m/sec 95% (SA off),
- **Time** 1microsecond synchronized to GPS time

<Datum>

WGS-84

<Acquisition Rate>

- **Reacquisition** 0.1 sec., average (recovery time for being interrupted)
- **Hot start** 8 sec., average (with ephemeris and almanac valid)
- **Warm start** 38 sec., average (with almanac but not ephemeris)
- **Cold start** 45 sec., average (neither almanac nor ephemeris)

<Dynamic Condition>

- **Altitude** 18,000 meters (60,000 feet) max.
- **Velocity** 515 meters/sec. (1000knots) max.

<Power>

- **Voltage supply** 3.8Vdc ~ 6.5 VDC
- **Current supply** 150mA typical
- **Backup Power** +2.5V to +3.6V
- **Backup Current** 10uA typical

<Serial Port>

- **Ports** 2, one for GPS, one for DGPS
- **Electrical level** TTL level, RS-232 level
- **Communication** Full duplex asynchronous
- **Code type** ASCII
- **GPS Protocol** SiRF binary/NMEA 0183 changeable
- **GPS Function** SiRF binary >> position, velocity, altitude, status and control
NMEA 0183 (v2.2) >> GGA, GSA, GSV, RMC (VTG and GLL are optional)
- **GPS transfer rate** Software command setting
(Default : 4800bps for NMEA and 19200 bps for SiRF binary)
- **DGPS protocol** RTCM SC-104, ver 2.00, type 1, 2, and 9

<Time Mark> (1 PPS Pulse)

- **Level** TTL
- **Pulse duration** 100ms
- **Time reference** At the pulse positive edge
- **Measurement** Aligned to GPS sec., +/- 1us

<Active Antenna Connector>

- MCX and SMA

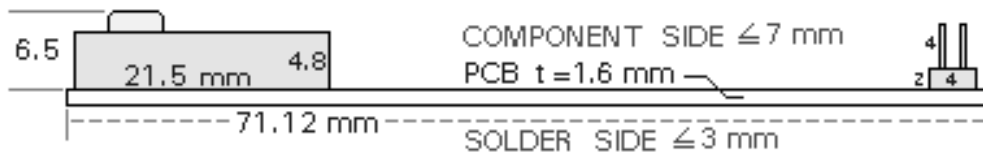
2. *Environmental Characteristics*

<Temperature>

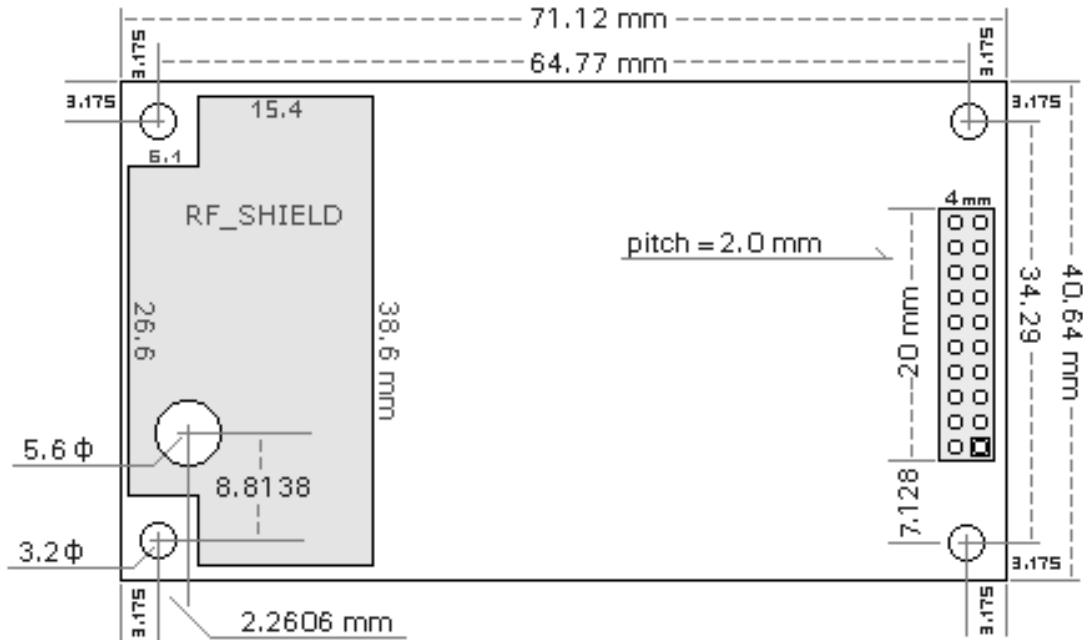
- **Operating** -15 deg. C to +70 deg. C
- **Available** -40 deg. C to +80 deg. C
- **Storage** -40 deg. C to +80 deg. C

3. *Physical Characteristics*

<Dimension>



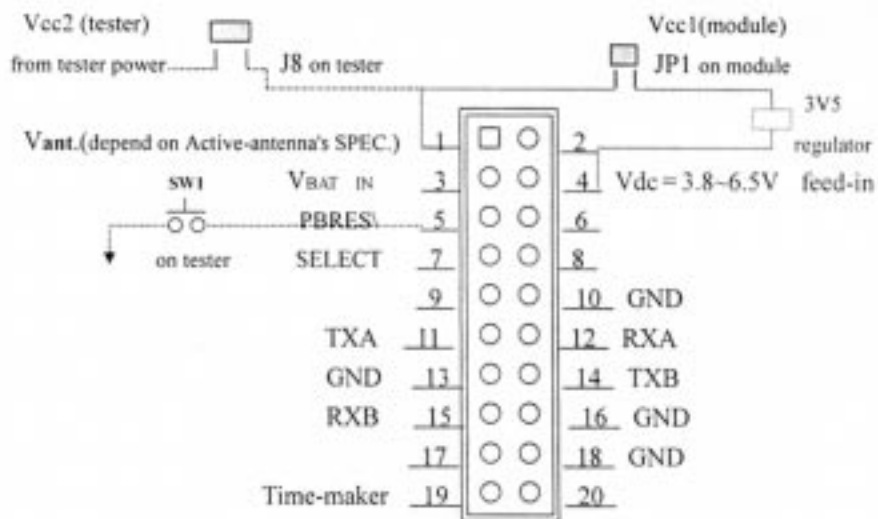
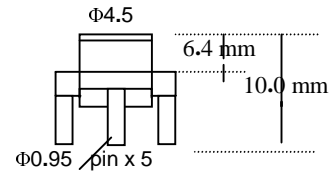
PCB Side View



PCB Top View

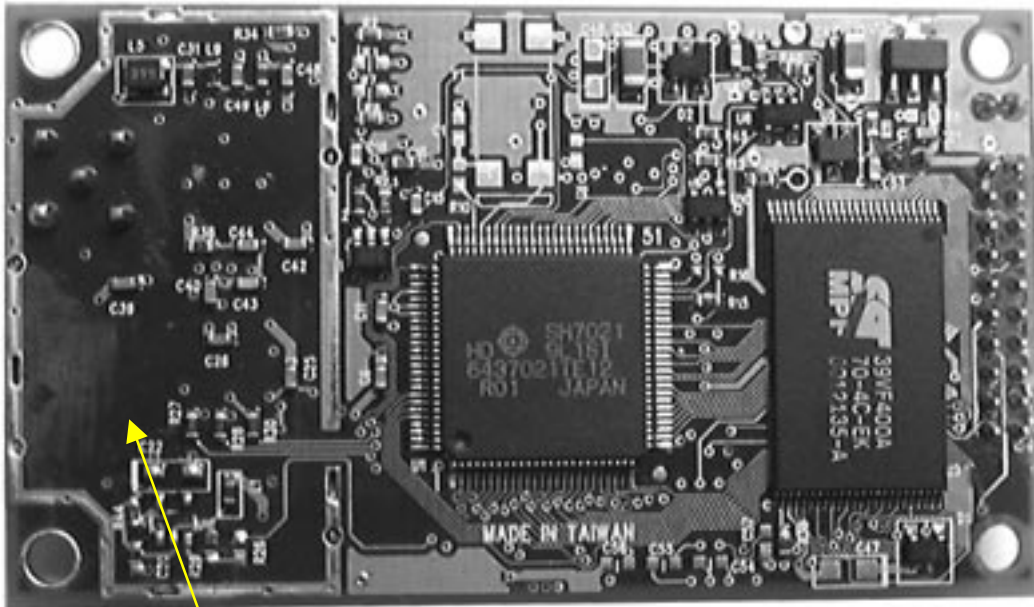
MCX CONNECTOR

- 1, need external Active-antenna & its power Vant.
- 2, need external Vdc = 3.8 --- 6.5 Vcc
- 3, current supply I = 150 mA
- 4, PCB SIZE : 40.64mm x 71.12mm
- 5, Connector (pitch=2.0 mm) pin-assignment :



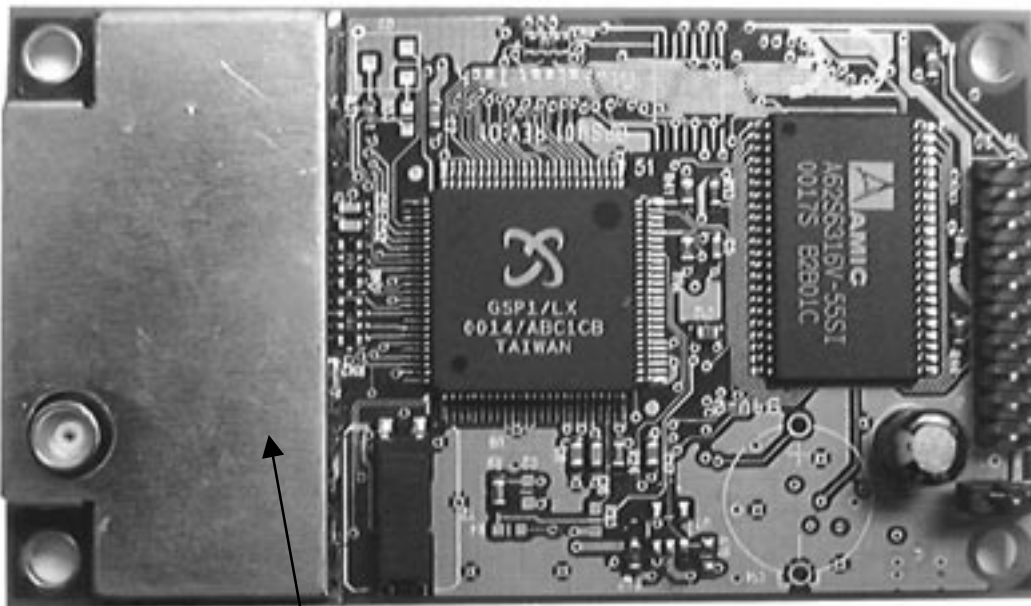
NOTE : TXA & RXA is GPS-DATA TXB & RXB is DGPS-DATA

ER – 101 Receiver Engine Board (bottom)



Back-side of shielded-lower (1/2)

ER – 101 Receiver Engine Board (top)



Active antenna in

Shielded-lower (1/2)

Connector (10 x2 pin-header)

Interface Connection

*** Pin-out of the 20-pin interface connector**

Pin Number	Name	Description	Type
1	VANT	Antenna DC Voltage	Input
2	VDC	+6.5V~+3.8V DC Power Input	Input
3	BAT	Backup Battery	Input
4	VDC	(Shorted with pin 2)	Input
5	PBRES	Push Button Reset Input (Active Low)	Input
6	RESERVED	(Reserved)	
7	SELECT	Down-load data from RS232 to flash ROM	
8	RESERVED	(Reserved)	
9	RESERVED	(Reserved)	
10	GND	Ground	
11	TXA	Serial Data Output A (GPS Data)	Output
12	RXA	Serial Data Input A (Command)	Input
13	GND	Ground	
14	TXB	Serial Data Output B (No Used)	Output
15	RXB	Serial Data Input B (DGPS Data)	Input
16	GND	Ground	
17	RESERVED	(Reserved)	
18	GND	Ground	
19	TIMEMARK	1PPS Time Mark Output	Output
20	RESERVED	(Reserved)	

Due to continuous product improvements, all specifications may be subject to change without notice

GPS Receiver Engine Board NMEA Software Commands

1. NMEA Output Command

A) The **GGA-Global Positioning System Fix Data** describes **Time; position and fix related data** for a GPS receiver.

Format:

\$GPGGA,HHMMSS.sss,DDMM.mmm,d,DDDMM.mmm,d,q,ss,h.h,a.a,z,,,*CC
<CR><LF>

\$	Beginning of NMEA sentence
GPGGA	Message Header
HHMMSS.sss	UTC of position fix
HH:	hours (00 .. 24)
MM:	minutes (00.59)
SS.sss	seconds (00.000..59.999)
DDMM.mmmm,d	Latitude –N(+)/S(-)
DD:	Degree (00..90)
MM.mmmm:	Minutes (00.0000..59.9999)
d:	direction, N-north, S-south
DDDMM.mmmm,d	Latitude –E(+)/W(-)
DDD:	Degree (00.180)
MM.mmmm:	Minutes (00.0000..59.9999)
d:	Direction, E-east, W-west
q	GPS quality indicator
q:	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
ss	Number of satellites in use (in tracking) ss=0..12
h.h	Horizontal dilution of precision h.h : HDOP
a.a	Antenna altitude re: mean-sea-level (geoid)
M	Units of antenna altitude, meters

NULL	Geoidal separation (Not supported)
NULL	Units of geoidal separation (Not yet supported)
x.x	Age of Differential GPS data(NULL)
Xxxx	Differential reference station ID
*CC<CR><LF>	Check Sum and sentence termination delimiter

Ex.:

\$GPGGA,084131.430,2505.9144,N,12145.0509,E,1,05,2.0,59.1,M,,,,0000*38

Checksum Field: The absolute value calculated by exclusive-OR the 8 data bits of each character in the Sentence, between, but excluding "\$" and "". The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is transmitted first.

B) RMC-Recommended minimum specific GPS/Transit data and fix related data for a GPS receiver

Format:

\$GPRMC,HHMMSS.sss,a,DDMM.mmm,d,DDMM.mmm,d,z,z,y,y,ddmmyy,d,d,v
*hh<CR><LF>

\$	Beginning of NMEA sentence
GPRMC	Message Header
HHMMSS.sss	UTC of position fix
HH:	hours (00 .. 24)
MM:	minutes (00.59)
SS.sss	seconds (00.000..59.999)
a	Status (A=valid, V=invalid) Invalid if over current DOP mask
DDMM.mmmm,d	Latitude – N(+)/S(-)
DD:	Degree (00..90)
MM.mmmm	Minutes (00.0000.59.9999)
d:	Direction, N-north, S-south

DDMM.mmmm,d	Longitude – E(+)/W(-) DDD: Degrees (00 .. 180) MM.mmmm: Minutes (00.000 .. 59.9999) d: Direction, E-east, W-west
z.z	Speed over ground (knots). 0 if over current DOP mask
y.y	Course over ground (reference to true north). 0 if over current DOP mask
Ddmmyy	UTC date of position fix dd: Day (1...31) mm: Month (01..12) yy: Year (00 .. 99)
d,d	(Null)Magnetic variation (degrees) (0.0..180.0)
v	(Null)Variation sense (E=east, W=west)
*hh<CR><LF>	Check Sum and sentence termination delimiter

Ex.: \$GPRMC,084119.430,A,2505.9101,N,12145.1214,E,19.80,265.26,260799,,*39

C) The GSA - GPS DOP and Active Satellites GPS receiver operating mode, satellites used in the navigation solution reported by the \$ --GGA sentences, and DOP values.

Format:

\$GPGSA,a,x,s1,s2,s3,s4,s5,s6,s7,s8,s9,sA,sB,sC,p,p,h,h,v,v*hh<CR><LF>

GPGSA	GSA message header
a,	Mode: A – Automatic M – Manual (forced to operate in 2D or 3 D mode)
x,	Mode: 1 = Fix not available 2 = 2D 3 = 3D
sl,...., sC	1 –12 PRN number of satellites used in solution (NULL for unsued fields)

p.p, PDOP

h.h HDOP

v.v VDOP

***hh<CR><LF>** Check Sum and sentence termination delimiter

Ex:

\$GPGSA,A,3,09,17,08,26,23,29,,,,,2.5,1.7,1.8*33

D) The GSV - GPS Satellites in view

Number of satellites in view, PRN numbers, elevation, azimuth, and SNR value. Four satellites max. per transmission, additional satellite data sent in second or third message. Total number of messages being transmitted and the number of the message being transmitted is indicated in the first two indicated in the first two fields.

```
$GPGSV,<a>,<m>,<nn>,<ss>,<ee>,<aaa>,<cc>,<ss>,<ee>,<aaa>,<cc>,<ss>,<ee>,<aaa>,<cc>,<ss>,<ee>,<aaa>,<cc>*hh<CR><LF>
```

<a> Total number of messages (1 .. 3)

<m> Message number (1 .. 3)

<nn> Total number of satellites in view for each visible satellite (four groups per message)

<ss> Satellite PRN number (1 .. 32)

<ee> Elevation, degrees (00 .. 90)

<aaa> Azimuth, degrees True (000 .. 359)

<cc> SNR (C/No) (00 .. 99)
Null when not tracking

***hh<CR><LF>** Check Sum and sentence termination delimiter

Ex.: \$GPGSV,2,1,06,09,70,054,45,17,64,249,43,08,59,203,46,26,27,048,39*7E
\$GPGSV,2,2,06,23,46,336,43,29,12,270,39*7A

E) The GLL - Geographic Position-Latitude/Longitude

Format:

\$GPGLL,DDMM.mmmm,d,DDDMM.mmmm,d,HHMMSS.ss,a*CC<CR><LF>

\$	Beginning of NMEA sentence
GPGLL	Message Header
DDMM.mmm,d	Latitude - N(+)/S(-)
DD:	degree (00.90)
MM.mmmm:	minutes (00.000..59.9999)
d:	direction, N – north, S – south
DDDMM, mmmm, d	Latitude – E(+)/W (-)
DDD:	degree (00..180)
MM.mmmm:	minutes (00.000..59.9999)
d:	direction, E – east, W – west
HHMMSS.ss	UTC of position fix
HH:	Hours (00...24)
MM:	Minutes (00.59)
SS.ss:	Seconds (00.00..59.99)
a	Status :A – valid B – Invalid
*CC<CR><LF>	Check Sum and sentence termination delimiter

F) The VTG - Course Over Ground and Ground Speed The actual course and speed relative to the ground.

Format:

\$GPVTG,t,t,T,m.m,M,s.s,N,g,g,K*hh<CR><LF>

t,t	Course Over Ground (degrees True) 0 if over current DOP mask
T	Units: T - degrees True

m.m	Course Over Ground (degrees Magnetic) 0 if over current DOP mask
M	Units: M - degrees Magnetic
s.s	Speed (knots). 0 if over current DOP mask
N	Units: N – knots
g.g	Speed (Km/hr). 0 if over current DOP mask
K	Units: K - Km/hr
*hh<CR><LF>	Check Sum and sentence termination delimiter

2. NMEA Input Command

A) Set Serial Port **ID:100 Set PORTA parameters and protocol**

This command message is used to set the protocol (SiRF Binary, NMEA, or USER1) and/or the communication parameters (baud, data bits, stop bits, parity). Generally, this command would be used to switch the module back to SiRF Binary protocol mode where a more extensive command message set is available. For example, to change navigation parameters. When a valid message is received, the parameters will be stored in battery backed SRAM and then the receiver will restart using the saved parameters.

Format:

\$PSRF100,<protocol>,<baud>,<DataBits>,<StopBits>,<Parity>*CKSUM
<CR><LF>

<protocol>	0=SiRF Binary, 1=NMEA, 4=USER1
<baud>	1200, 2400, 4800, 9600, 19200, 38400
<DataBits>	8,7. Note that SiRF protocol is only valid f8 Data bits
<StopBits>	0,1
<Parity>	0=None, 1=Odd, 2=Even

Ex. 1: Switch to SiRF Binary protocol at 9600,8,N,1
 \$PSRF100,0,9600,8,1,0*0C<CR><LF>

Ex. 2: Switch to User1 protocol at 38400,8,N,1
 \$PSRF100,4,38400,8,1,0*38<CR><LF>

****Checksum Field:** The absolute value calculated by exclusive-OR the 8 data bits of each character in the Sentence, between, but excluding “\$” and “*”. The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII characters (0-9,A-F) for transmission. The most Significant character is transmitted first.

**<CR><LF> : Hex 0D 0A

B) Navigation Initialization ID 101 Parameters required for start

This command is used to initialize the module for a warm start, by providing current position in X, Y, Z coordinates, clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters will enable the receiver to acquire signals more quickly, and thus, produce a faster navigational solution.

When a valid Navigation Initialization command is received, the receiver will restart using the input parameters as a basis for satellite selection and acquisition.

Format

\$PSRF101, <X>, <Y>, <Z>, <ClkOffset>, <TimeOfWeek>, <WeekNo>, <chnlCount>, <ResetCfg>

*CKSUM<CR><LF>

<X>	X coordinate position. INT32
<Y>	Y coordinate position. INT32
<Z>	Z coordinate position. INT 32
<ClkOffset>	Clock offset of the receiver in Hz, Use 0 for last saved value if available. If this is unavailable, a default value of 75000 for GSP1, 95000 for GSP 1/LX will be used. INT32
<TimeOf Week>	GPS Time Of Week. UINT32
<WeekNo>	GPS Week Number. UINT16 (Week No and Time of Week calculation from UTC time)

<chnlCount> Number of channels to use.1-12. If your CPU throughput is not high enough, you could decrease needed throughput by reducing the number of active channels
 UBYTE

<ResetCfg> Bit mask
 0x01=Data Valid warm/hotstarts=1
 0x02=clear ephemeris warm starts=1
 0x04=clear memory. Cold start=1
 UBYTE

Ex.: Start using known position and time.

□ PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*7F

C) Set DGPS Port ID:102 Set PORT B parameters for DGPS input

This command is used to control Serial Port B that is an input only serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. The default communication parameters for PORT B are 9600 Baud, 8 data bits, 0 stop bits, and no parity. If a DGPS receiver is used which has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters will be stored in battery backed SRAM and then the receiver will restart using the saved parameters.

Format:

\$ PSRF102,<Baud>,<DataBits>,<StopBits>,<Parity>*CKSUM<CR><LF>

<baud> 1200,2400,4800,9600,19200,38400
 <DataBits> 8
 <StopBits> 0,1
 <Parity> 0=None,Odd=1,Even=2

Ex. : Set DGPS Port to be 9600,8,N,1

□ PSRF102,9600,8,1,0*12

D) Query/Rate Control ID:103 Query standard NMEA message and/or set output rate

This command is used to control the output of standard NMEA message GGA, GLL, GSA, GSV RMC, VTG. Using this command message, standard NMEA message may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending

on the needs of the receiving program. NMEA message settings are saved in battery backed memory for each entry when the message is accepted.

Format:

□PSRF103,<msg>,<mode>,<rate>,<cksumEnable>*CKSUM<CR><LF>

- <msg> 0=GGA,1=GLL,2=GSA,3=GSV,4=RMC,5=VTG
- <mode> 80=SetRate,1=Query
- <rate> Output every <rate>seconds, off=0,max=255
- <cksumEnable> 0=disable Checksum,1=Enable checksum for specified message.

Example 1: Query the GGA message with checksum enabled
□PSRF103,00,01,00,01*25

Example 2: Enable VTG message for a 1Hz constant output with checksum enabled
□PSRF103,05,00,01,01*20

Example 3: Disable VTG message
□PSRF103,05,00,00,01*21

E) LLA Navigation initialization ID:104 Parameters required to start using Lat/Lon/Alt

This command is used to initialize the module for a warm start, by providing current position (in Latitude, Longitude, Altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters will enable the receiver to acquire signals more quickly, and thus, will produce a faster navigational solution. When a valid LLA Navigation Initialization command is received, the receiver will restart using the input parameters as a basis for satellite selection and acquisition.

Format:

□PSRF104,<Lat>,<Lon>,<Alt>,<ClkOffset>,<TimeOfWeek>,<WeekNo>,<ChannelCount>,<ResetCfg>*CKSUM<CR><LF>

- <Lat> Latitude position, assumed positive north of equator and negative south of equator float, possibly signed
- <Lon> Longitude position, it is assumed positive east of Greenwich and negative west of Greenwich Float, possibly signed

<Alt>	Altitude position float, possibly signed
<ClkOffset>	Clock Offset of the receiver in Hz, use 0 for last saved value if available. If this is unavailable, a default value of 75000 for GSP1, 95000 for GSP1/LX will be used. INT32
<TimeOfWeek>	GPS Time Of Week UINT32
<WeekNo>	GPS Week Number UINT16
<ChannelCount>	Number of channels to use. 1-12 UBYTE
<ResetCfg>	bit 0x01=Data Valid warm/hot starts=1 mask 0x02=clear ephemeris warm start=1 0x04=clear memory. Cold start=1 UBYTE

Ex.: Start using known position and time.

□PSRF104,37.3875111,-121.97232,0,96000,237759,922,12,3*37

F) Development Data On/Off ID:105 Switch Development Data

G) Messages On/Off

Use this command to enable development debug information if you are having trouble getting commands accepted. Invalid commands will generate debug information that should enable the user to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range. This setting is not preserved across a module reset.

Format: □PSRF105,<debug>*CKSUM<CR><LF>

<debug> 0=Off,1=On

Ex.: Debug On PSRF105,1*3E

Ex.: Debug Off PSRF105,0*3F