GPS Engine Board ET-318

Version 2.0

07/19/2007

1. Product Information

- Product Name: ET-318
- Product Description:

ET-318 is a compact, high performance, and low power consumption GPS engine board. It uses SiRF Star III chipset which can track up to 20 satellites at a time and perform fast TTFF in weak signal environments. ET-318 is suitable for the following applications:

- Automotive navigation
- Personal positioning
- Fleet management
- Mobile phone navigation
- Marine navigation

- Product Features:
  - ✓ SiRF star III high performance GPS Chipset
  - ✓ Very high sensitivity (Tracking Sensitivity: -159 dBm)
  - ✓ Extremely fast TTFF (Time To First Fix) at low signal level
  - ✓ Two serial ports
  - ✓ Built-in LNA
  - ✓ Compact size (15.2mm * 14 mm * 2.6mm) suitable for space-sensitive application
  - ✓ One size component, easy to mount on another PCB board
  - ✓ Support NMEA 0183 and SiRF binary protocol

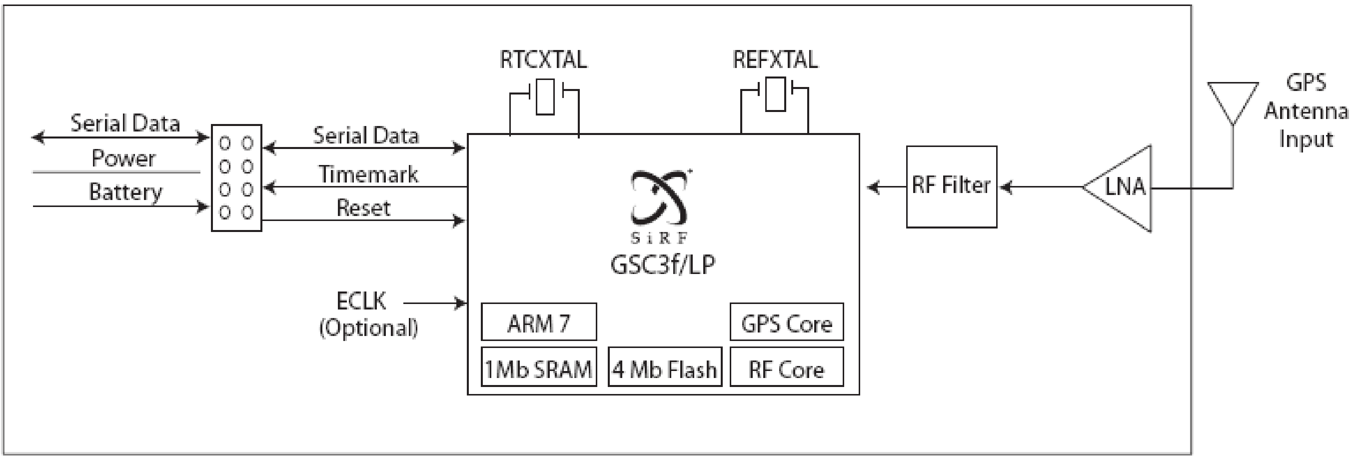
- Product Specifications

GPS Receiver	
Chipset	SiRF GSC3f/LP
Frequency	L1, 1575.42 MHz
Code	C/A Code
Protocol	NMEA 0183 v2.2 Default:GGA,GSA,GSV,RMC Support:VTG,GLL,ZDA) SiRF binary and NMEA Command
Available Baud Rate	4,800 to 57,600 bps adjustable
Channels	20

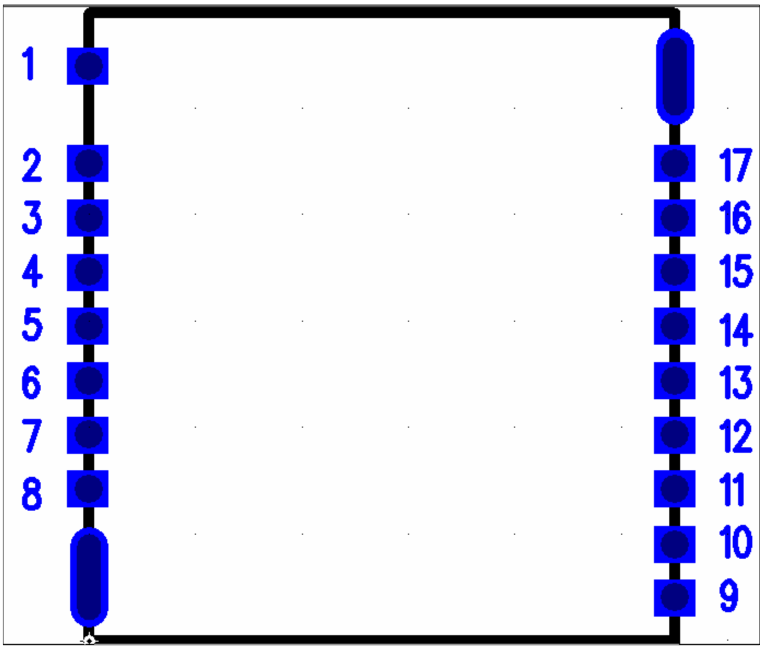
Flash	4Mbit
Sensitivity	Tracking:-159dBm
Cold Start	42 seconds, average
Warm Start	38 seconds, average
Hot Start	1 second, average
Reacquisition	0.1 second, average
Accuracy	Position: 10 meters, 2D RMS 5 meters, 2D RMS, WAAS enabled Velocity: 0.1 m/s Time: 1us synchronized to GPS time
Maximum Altitude	< 18,000 meter
Maximum Velocity	< 515 meter/second
Maximum Acceleration	< 4G
Update Rate	1 Hz
DGPS	WAAS, EGNOS, MSAS
Datum	WGS-84
Interface	
I/O Pins	2 serial ports
Physical Characteristic	
Type	17-pin stamp holes
Dimensions	15.2 mm * 14 mm * 2.6 mm
DC Characteristics	
Power Supply	3.3Vdc ± 5%
Backup Voltage	2.0 ~ 3.6Vdc ± 10%
Power Consumption	Acquisition: 42mA Tracking: 25mA
Environmental Range	
Humidity Range	5% to 95% non-condensing
Operation Temperature	-40℃ to 85℃
Storage Temperature	-40℃ to 125℃

2. Technical Information

■ Block Diagram



■ Module Pin Assignment:



Pin	Signal Name	I/O	Description
1	GND	G	Analog Ground
2	RF_IN	RF	GPS Signal input
3	GND	G	Analog Ground
4	NRESET	I	Reset (Active low)
5	VCC_IN	PWR	DC Supply Voltage input
6	VBAT	PWR	Backup voltage supply
7	RXB	I	Serial port B
8	TXB	O	Serial port B
9	GND	G	Analog Ground
10	BOOTSEL		Boot mode
11	TXA	O	Serial port A
12	RXA	I	Serial port A
13	GPIO1	I	General –purpose I/O
14	GPIO14	I	General –purpose I/O
15	TIMEMARK	O	One pulse per second
16	GPIO13	I	General –purpose I/O
17	GPIO15	I	General –purpose I/O

Definition of Pin assignment

VCC_IN

This is the main DC supply for a 3.3V +- 5% DC input power module board.

GND

GND provides the ground for digital part.

BOOTSEL

Set this pin to high for programming flash.

RXA

This is the main receiver channel and is used to receive software commands to the board from SIRFdemo software or from user written software.
PS: Pull up if not used.

RXB

This is the auxiliary receiving channel and is used to input differential corrections to the board to enable DGPS navigation.
PS: Pull up if not used.

TXA

This is the main transmitting channel and is used to output navigation and measurement data to SiRFdemo or user written software.

TXB

For user's application (not currently used).

RF_IN

This pin receiver signal of GPS analog .due to the RF characteristics of the signal the design has to certain criteria. The line on the PCB from the antenna(or antenna connector) has to be a controlled microstrip line at 50Ω.

Backup battery (V_BAT)

This is the battery backup input that powers the SRAM and RTC when main power is removed. Typical current draw is 15uA. Without an external backup battery, the module/engine board will execute a cold star after every turn on. To achieve the faster start-up offered by a hot or warm start, a battery backup must be connected. The battery voltage should be between 2.0v and 5.0v.

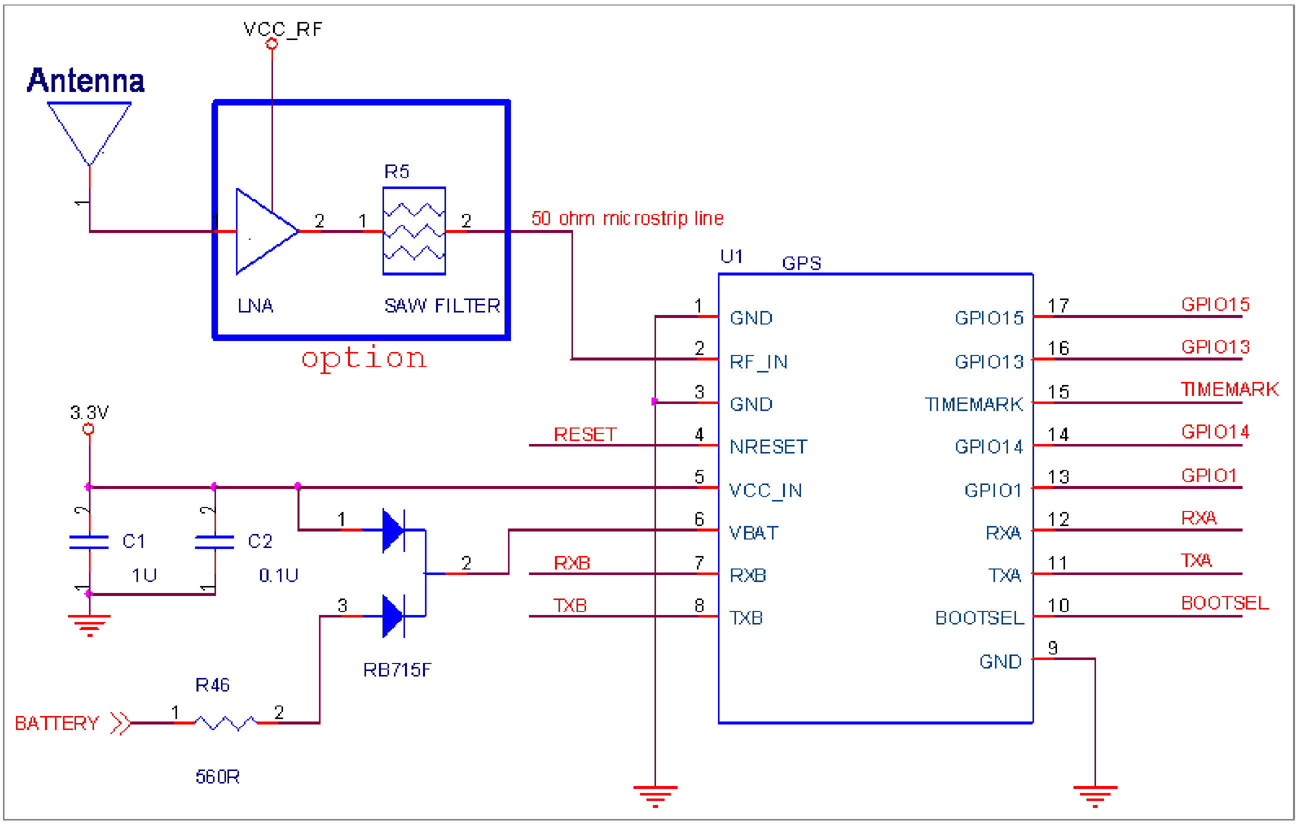
TIMEMARK

This pin provides one pulse-per-second output from the board, which is synchronized to GPS time. This is not available in Trickle Power mode.

GPIO Functions

Several I/Os are connected to the digital interface connector for custom applications.

■ Application Circuit



GPS Active Antenna Specification(Recommendation)

Frequency: 1575.42+2 MHz

Axial Ratio: 3 dB Typical

output Impedance: 50Ω

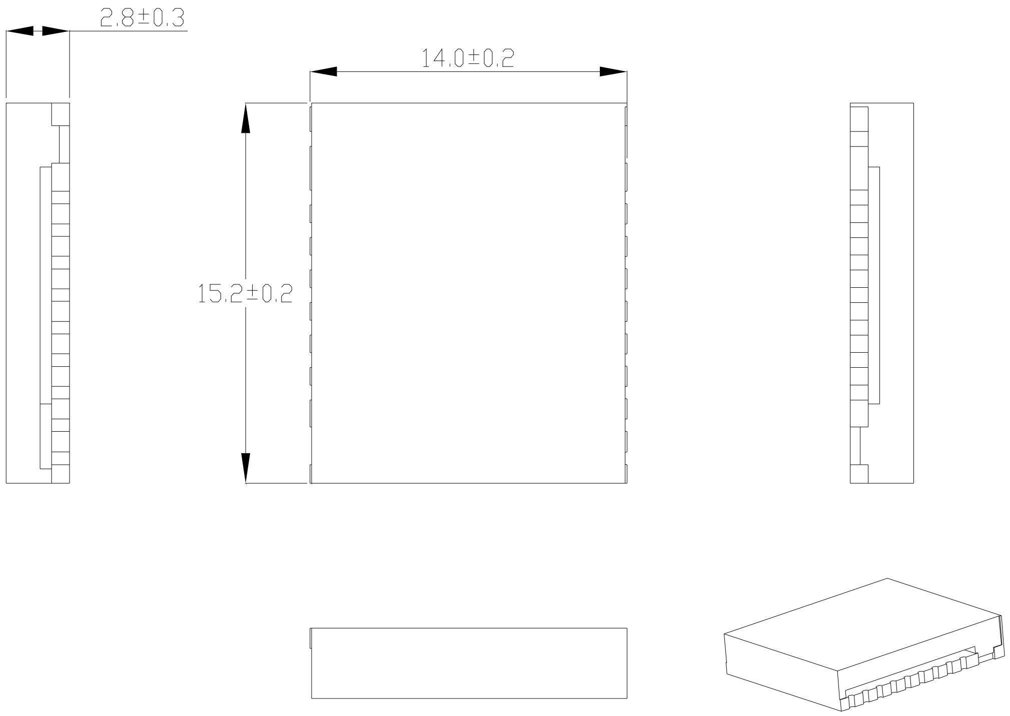
Polarization: RHCP

Amplifier Gain :18~22dB Typical

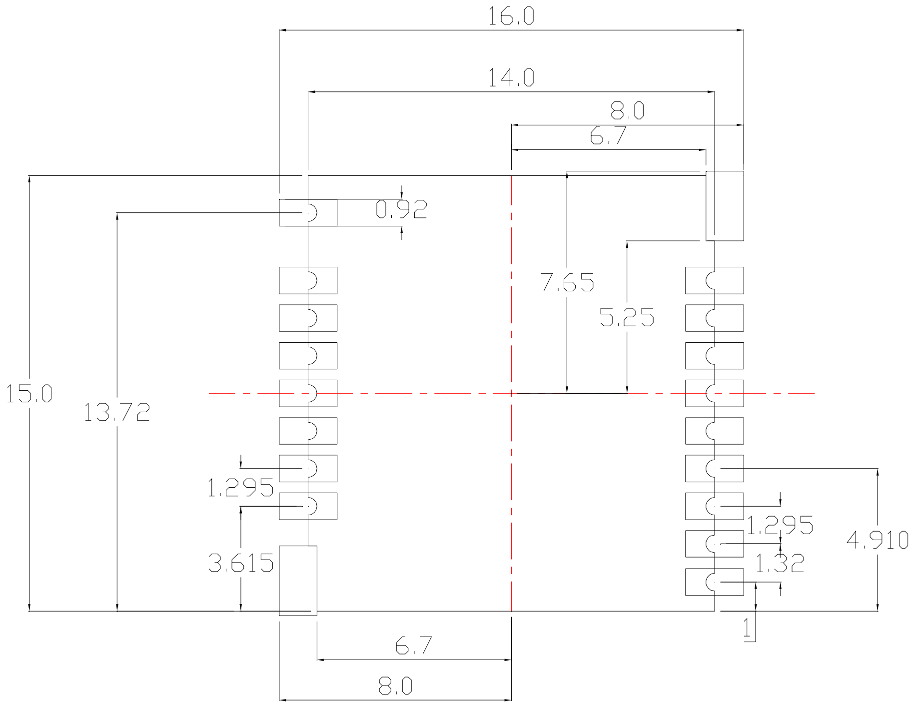
Output VSWR: 2.0 Max.

Noise Figure: 2.0 dB Max

■ Dimensions



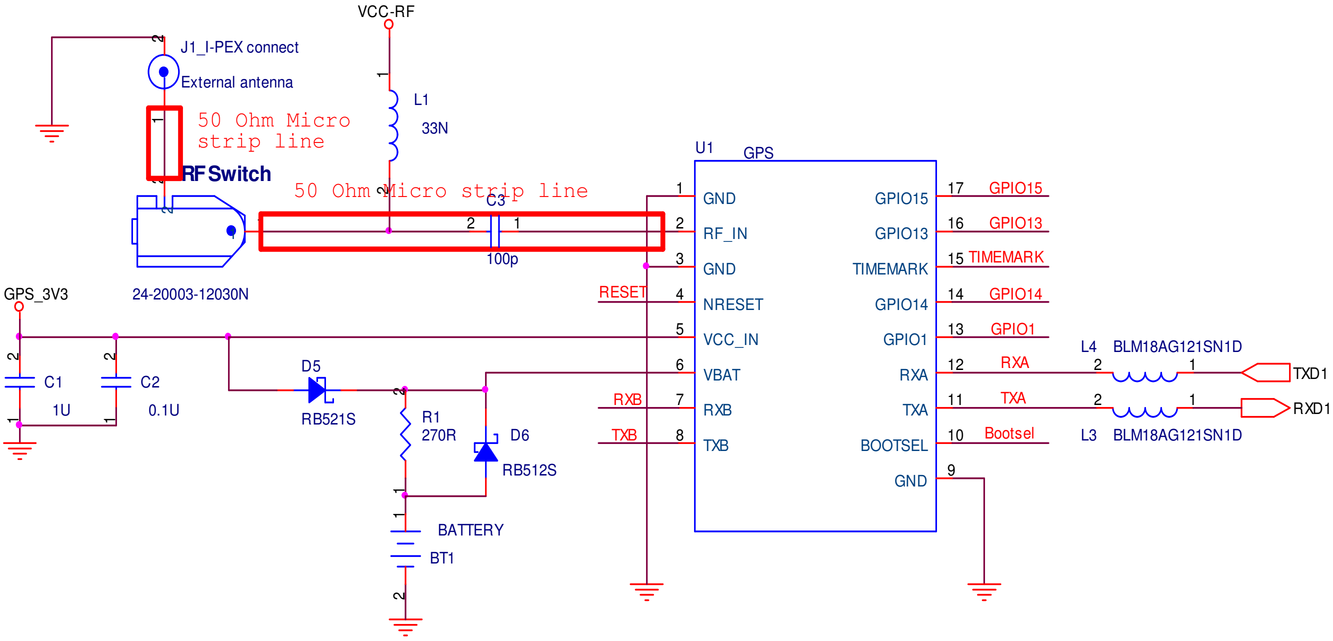
■ Recommend Layout PAD



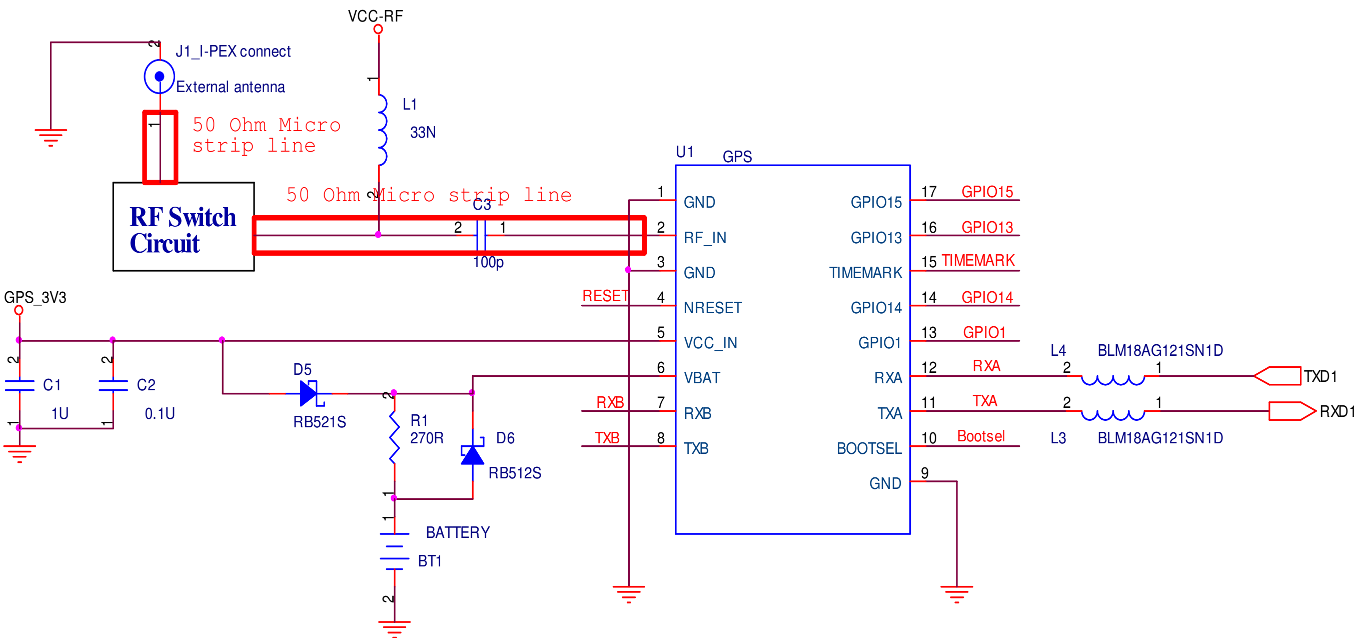
ET318 Application guideline

Application Circuit

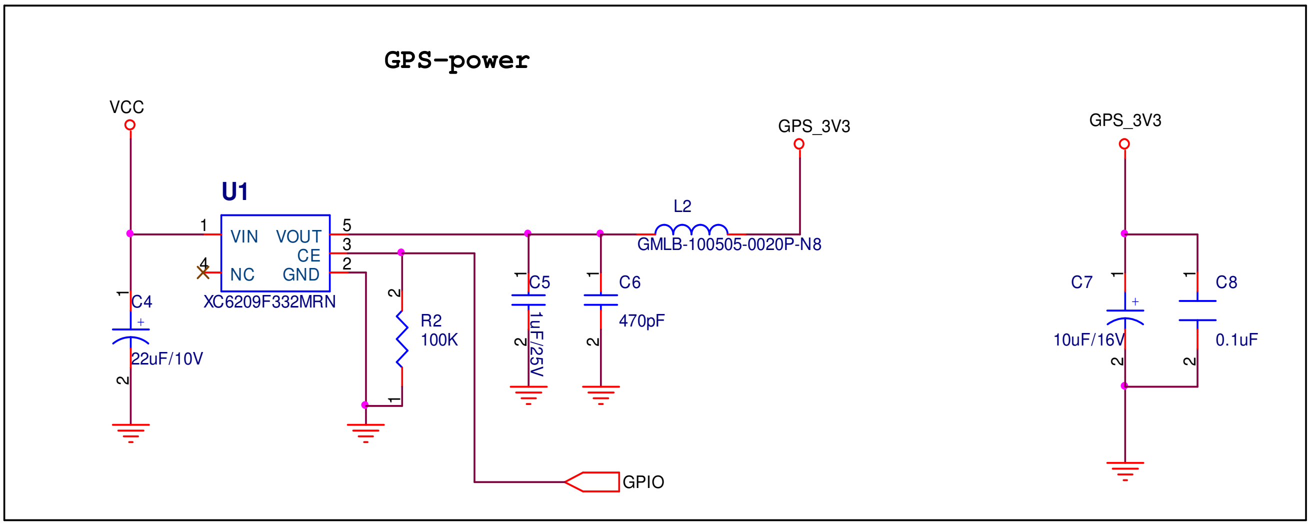
1.



2.



3.GPS Power



<u>Layout Rule</u>

.Do not routing the other signal or power trace under the engine board .

*** RF:**

This pin receives signal of GPS analog via external active antenna .It has to be a has to be a controlled impedance at 50 ohm .

Do not have RF traces closed the other signal path and routing it on the top layer.

Keep the RF traces as short as possible

*** Antenna:**

Keep the active antenna on the top of your system and confirm the antenna radiation pattern、axial ratio、power gain、noise figure、VSWR are correct when you Setup the antenna in you case.

GPS Passive (or Active)Antenna Specification(Recommendation)

Frequency: 1575.42±2 MHz

Axial Ratio: 3 dB Typical

output Impedance: 50Ω

Polarization: RHCP

Output VSWR: 1.5 Max.

Active option

Low Noise Amplifter:

Amplifier Gain :18~22dB Typical

Output VSWR: 2.0 Max.

Noise Figure: 2.0 dB Max.

Definition of Pin assignment

VCC_IN

This is the main DC supply for a 3.3V ± 5% DC input power module board.

GND

GND provides the ground for digital part.

BOOTSEL

Set this pin to high for programming flash.

RXA

This is the main receive channel for receiving software commands to the engine board from SiRFdemo software or from user written software.

Option to add EMI solutions

RXB

This is the auxiliary receiving channel and is used to input differential corrections to the board to enable DGPS navigation.

PS: Pull up if not used.

TXA

This is the main transmits channel for outputting navigation and measurement data to user's navigation software or user written software.

Output TTL level, 0V ~ 2.85V

Option to add EMI solutions

TXB

For user's application (not currently used).

RF_IN

This pin receives signal of GPS analog via external active antenna .It has to be a has to be a controlled impedance at 50 ohm .Do not have RF traces closed the other signal path and routing it on the top layer.

Keep the RF traces as short as possible.

TIMEMARK

This pin provides one pulse-per-second output from the board, which is synchronized to GPS time. This is not available in Trickle Power mode.

Backup battery (V_BAT)

This is the battery backup input that powers the SRAM and RTC when main power is removed. Typical current draw is 15uA. Without an external backup battery, the module/engine board will execute a cold star after every turn on.

To achieve the faster start-up offered by a hot or warm start, a battery backup must be connected. The battery voltage should be between 2.0v and 5.0v.

GPIO Functions

Several I/Os are connected to the digital interface connector for custom applications. (For example, on/off LED)

Other

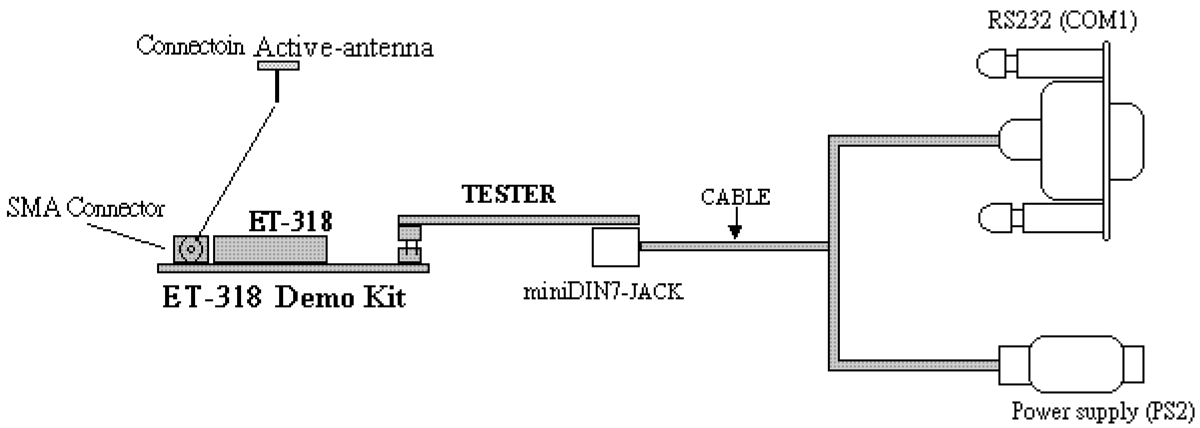
VCC_RF:

This is providing bias voltage for active antenna via a inductance.

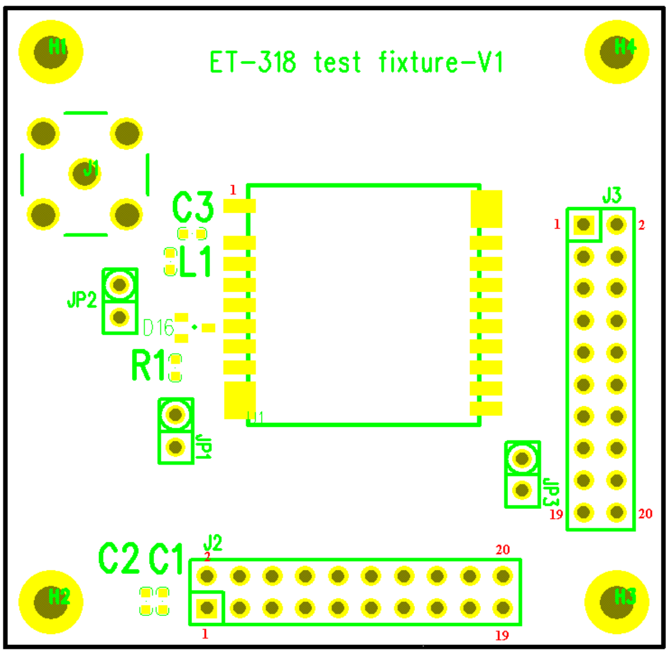
ET-318 Demo Kit Test Description

Test Board Connection ET-318 Demo Kit:

Demo Kit J2 (Male) Connection Test Board J5 (Female)



Definition of Pin assignment



J2:

Pin	Signal Name	Pin	Signal Name
1	VCC	2	VCC
3	NC	4	NC
5	NC	6	NC
7	NC	8	NC
9	NC	10	GND

J3:

Pin	Signal Name	Pin	Signal Name
1	GPIO15	2	NC
3	GPIO13	4	NC
5	TIMEMARK	6	NC
7	GPIO14	8	NC
9	GPIO1	10	NC

11	TXA	12	RXA
13	GND	14	TXB
15	RXB	16	GND
17	NC	18	GND
19	NC	20	NC

11	RESET	12	NC
13	NC	14	NC
15	NC	16	NC
17	NC	18	NC
19	NC	20	NC

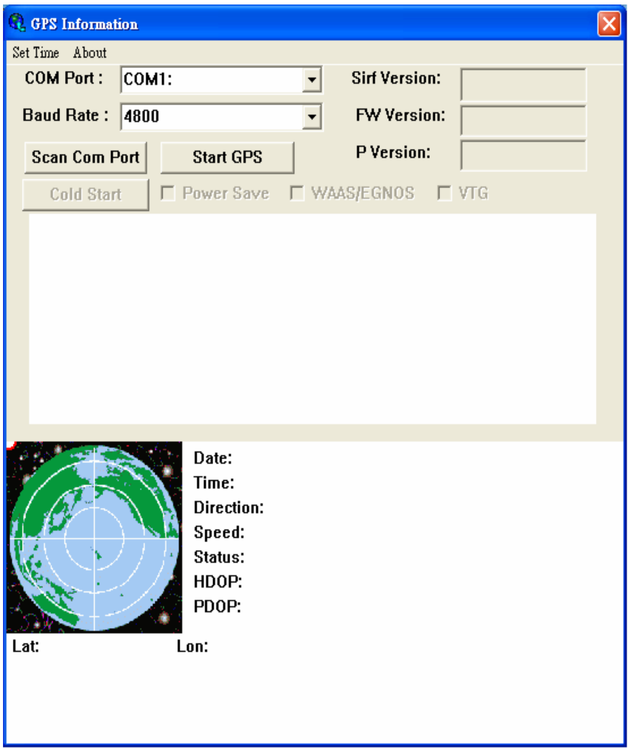
JP1: VBAT

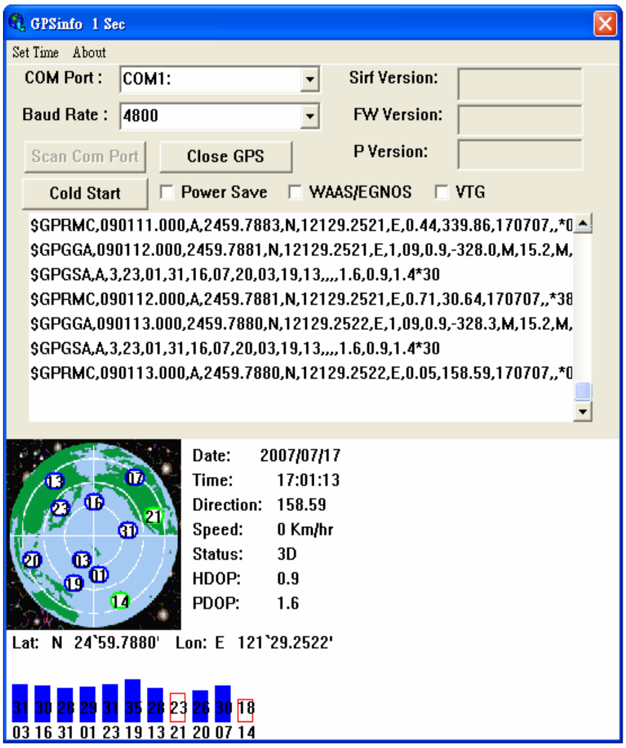
JP2: Active Antenna VCC

JP3: Bootsel

Test Software GPSinfo:

1. Select COM Port & Baud Rate
2. Press Start GPS





SOFTWARE COMMAND

NMEA Output Command

GGA-Global Positioning System Fixed Data

Table B-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 B-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 B-3
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude[1]	9.0	meters	
Units	M	meters	
Geoid Separation[1]		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

SiRF Technology Inc. does not support geoid corrections. Values are WGS84 ellipsoid heights.

Table B-3 Position Fix Indicator

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 B-4 contains the values for the following example:

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

Table B-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

GSA-GNSS DOP and Active Satellites

Table B-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 B-5 GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode1	A		See Table B-6
Mode2	3		See Table B-7
Satellite Used[1]	07		Sv on Channel 1
Satellite Used[1]	02		Sv on Channel 2
…..			
Satellite Used[1]			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 B-6 Mode1

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

Table B-7 Mode 2

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

GSV-GNSS Satellites in View

Table B-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 B-8 GSV Data Format

Name	Example		Description
Message ID	$GPGSV		GSV protocol header
Number of Messages[1]	2		Range 1 to 3
Message Number[1]	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1(Range 1 to 32)
Elevation	79	degrees	Channel 1(Maximum90)
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(Maximum90)
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

Depending on the number of satellites tracked multiple messages of GSV data may be required.

RMC-Recommended Minimum Specific GNSS Data

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

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

Table B-10 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[2]		degrees	E=east or W=west
Checksum	*10		
<CR><LF>			End of message termination

SiRF Technology Inc. does not support magnetic declination. All “course over ground” data are geodetic WGS48 directions.

VTG-Course Over Ground and Ground Speed

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

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
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

2.2 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

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

Example 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 are convertted to two ASCII characters (0-9,A-F) for transmission. The most significant character is transmitted first.

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

B). Navigation lnitialization 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 INT32

<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

0×01=Data Valid warm/hotstarts=1

0×02=clear ephemeris warm start=1

0×04=clear memory. Cold start=1

UBYTE

Example: 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, 8data 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

Example: 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> 0=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 soution.

When a valid LLANavigationInitialization 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 mask 0×01=Data Valid warm/hot starts=1

0×02=clear ephemeris warm start=1

0×04=clear memory. Cold start=1

UBYTE

Example: 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 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

Example: Debug On $ PSRF105,1*3E

Example: Debug Off $ PSRF105,0*3F

G). Select Datum ID:106 Selection of datum to be used for coordinate Transformations

GPS receivers perform initial position and velocity calculations using an earth-centered earth-fixed (ECEF) coordinate system. Results may be converted to an earth model (geoid) defined by the selected datum. The default datum is WGS 84 (World Geodetic System 1984) which provides a worldwide common grid system that may be translated into local coordinate systems or map datums. (Local map datums are a best fit to the local shape of the earth and not valid worldwide.)

Examples:

Datum select TOKYO_MEAN

$PSRF106,178*32

Name	**Example**	**Units**	**Description**
Message ID	$PSRF106		PSRF106 protocol header
Datum	178		21=WGS84 178=TOKYO_MEAN 179=TOKYO_JAPAN 180=TOKYO_KOREA 181=TOKYO_OKINAWA
Checksum	*32		
<CR> <LF>			End of message termination