

# REB-1315LP Operational Manual

Version 1.6  
2007/09/13

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### 1. Introduction

RoyalTek REB-1315LP small form factor board is the newest generation of RoyalTek GPS module. The module is powered by latest SiRF Star III single chip and RoyalTek proprietary navigation technology that provides you with stable and accurate navigation data. The smallest form factor and miniature design is the best choice to be embedded in a device such as portable navigation device, personal locator, speed camera detector and vehicle locator.

#### Product Features

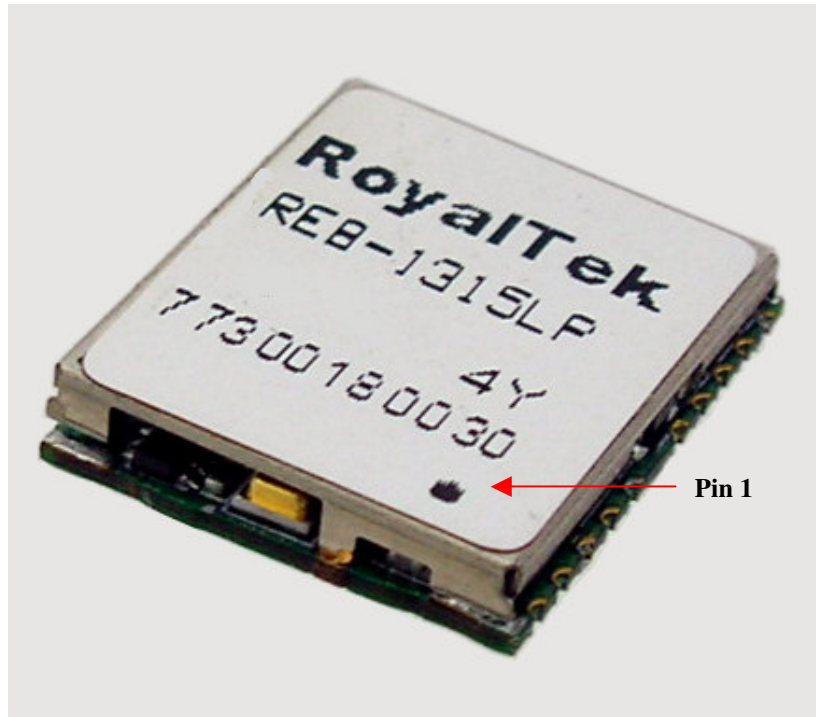
- ✧ 20 parallel channels
- ✧ SMT type with stamp holes
- ✧ TCXO design
- ✧ 0.1 second reacquisition time
- ✧ Small form factor with embedded SiRF Star III single chip technology.
- ✧ NMEA-0183 compliant protocol/ customize protocol
- ✧ Enhanced algorithm for navigation stability
- ✧ Excellent sensitivity for urban canyon and foliage environments.
- ✧ DGPS (WAAS, EGNOS ) support
- ✧ Auto recovery while RTC crashes
- ✧ Build-in LNA and saw filter

#### 1.1 Product Applications

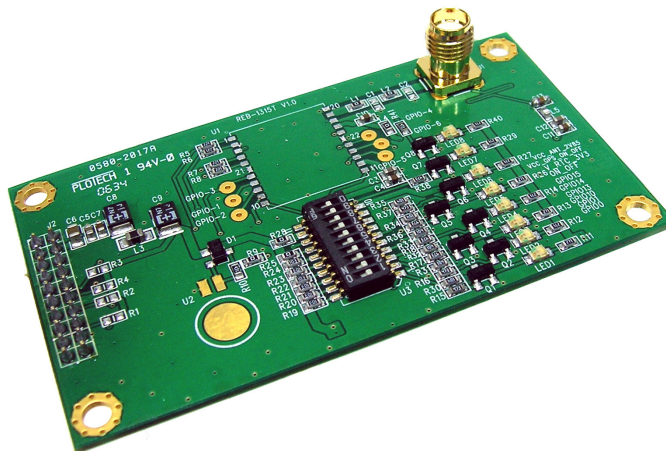
- ✧ Automotive navigation
- ✧ Personal positioning and navigation
- ✧ Marine navigation
- ✧ Timing application

### 1.2 Product Pictures

#### (1) REB-1315LP



#### (2) REB-1315LP Interface board



#### The interface board pin definition

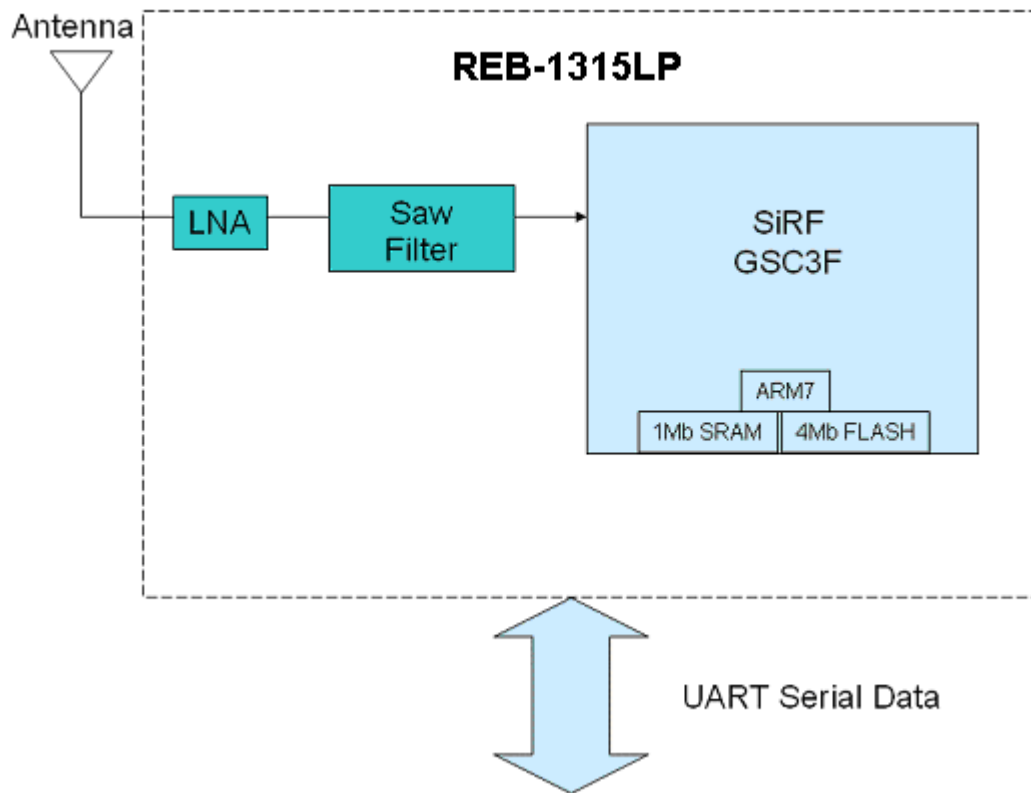
#### RoyalTek Evaluation Kit REV-2000 for REB-1315LP

(Please refer to RoyalTek Evaluation Kit REV-2000 for REB-1315LP Operational Manual for more information)

### 1.3 REB-1315LP Series Block Diagram

System block diagram description:

- a. External antenna.
- b. 4 Mega bits flash memory.
- c. 22 pin I/O pin.



### 1.4 REB-1315LP Technical Specification

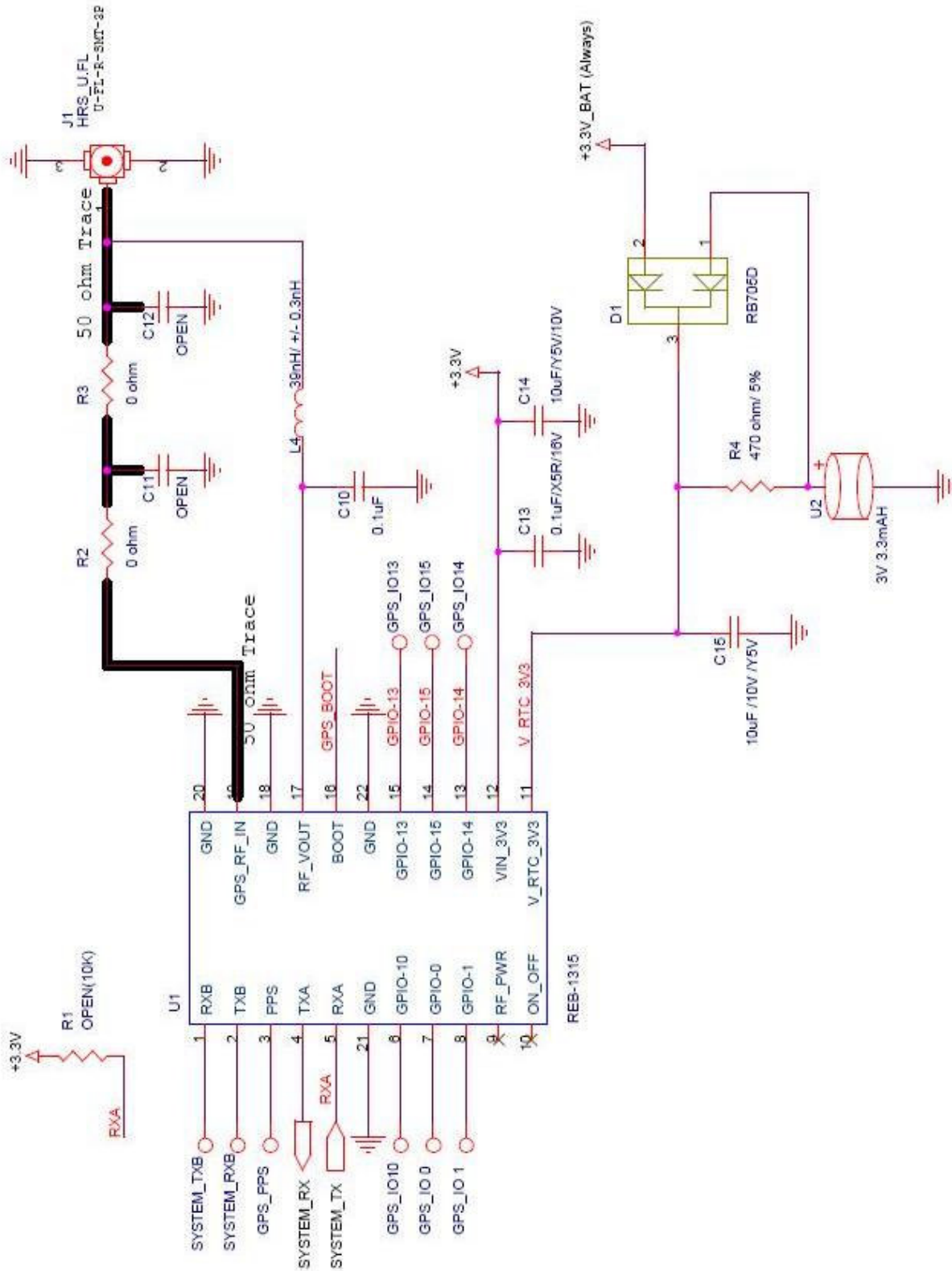
Impedance : 50Ω

No	Function	Specification
GPS receiver		
1	Chipset	SiRF Star III, GSC3f/LP (Digital, RF in a single package)
2	Frequency	L1 1575.42MHz.
3	Code	C.A. Code.
4	Channels	20 parallel
5	Chipset Sensitivity	-159dBm
6	Chipset cold start	35 sec @ open sky (avg.)
7	Chipset warm start	35 sec @ open sky (avg.)
8	Chipset hot start	1 sec @ open sky (avg.)
9	Reacquisition	0.1sec typical
10	Position accuracy	10meters at 2D RMS.
11	Maximum altitude	18000 m
12	Maximum velocity	514 m/s
13	Trickle power mode	Duty cycle $\leq$ 34%. (Variable)
14	Update rate	Continuous operation: 1Hz
15	Testability	It shall be able to be tested by SiRF testmode 4 and single channel simulator.
16	Protocol setup	It shall store the protocol setup in the SRAM memory.
17	DGPS	WAAS, EGNOS
Interface		
18	LNA	15dB Gain. (Typical)
19	I/O Pin	22pin
Mechanical requirements		
20	Weight	$\leq$ 3.5g
Power consumption		
21	Vcc	DC 3.3 $\pm$ 5%
22	Current	GPS : Typ. 48mA@3.3V (Avg Acquisition w/o ext. Antenna) Typ. 45mA@3.3V (tracking w/o ext. Antenna) Typ. 12mA@3.3V (Standby mode w/o ext. Antenna)
Environment		
23	Operating temperature	-40 ~ 85°C

24	Humidity	$\leq 95\%$
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## 1.5 Application Circuit

Reference schematic:





Note:

(1) Ground Planes:

These pin(18、20、21、22) should be connect to ground.

(2) Serial Interface:

( I )The TXA pin is the serial output data. Default output GPS protocol. (NMEA sentence ).

( II ). The RXA pin is the serial input data. Default output GPS protocol. (NMEA sentence)

( III ) The TXB pin is the serial output data (Default Null)

( IV ) The RXB pin is the serial input data (Default Null).

(3) Backup Battery:

It's recommended to connect a backup battery to V\_RTC\_3V3 pin.

In order to enable the warm start and hot start features of the GPS receiver.

If you use backup battery, should be adding a bypassing capacitor (10uF) at V\_RTC\_3V3 pin. It can reduce noise and increase the stability.

(4) RF\_IN:

Connecting to the antenna has to be routed on the PCB. The transmission line must to be control impedance from RF\_IN pin to the antenna or antenna connector of your choice. (Impedance  $50\Omega$ )

(5) Power:

Connect VIN\_3V3 pin to DC 3.3V. The power supply must add bypass capacitor (10uF and 1uF).It can reduce the Noise from power supply and increase power stability.

(6) Active antenna bias voltage:

The RF\_VOUT pin(pin 17) is provide voltage 2.85V. If you use active antenna, you can use this pin to provide bias voltage for active antenna, but you must design the RF chock circuit to avoid the RF signal jamming.

PS:

(1) This pin can provided maximum current is 30mA @ 2.85V.

(2) The input gain ranges are 19~ 22dB.

(7) GPIO:

The GPIOs functions are for customer used.

If no use GPIO functions, it don't connect anything.

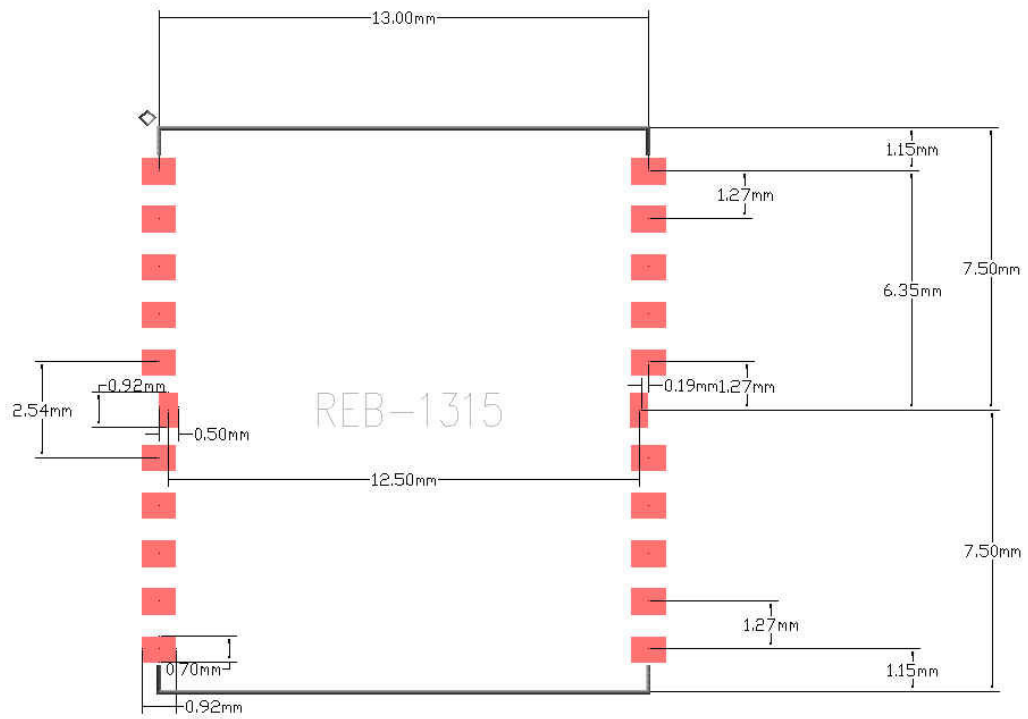
(8) GPS\_RTC1 3.3V/3.3VSUB :

The GPS\_RTC1 provide one kinds input voltage.

If you select pin 12 VIN\_3V3 voltage then you can ignore 3.3VSUB.

If you choice 3.3VSUB voltage then the power can use by different power supply.

**Recommend Layout PAD :**

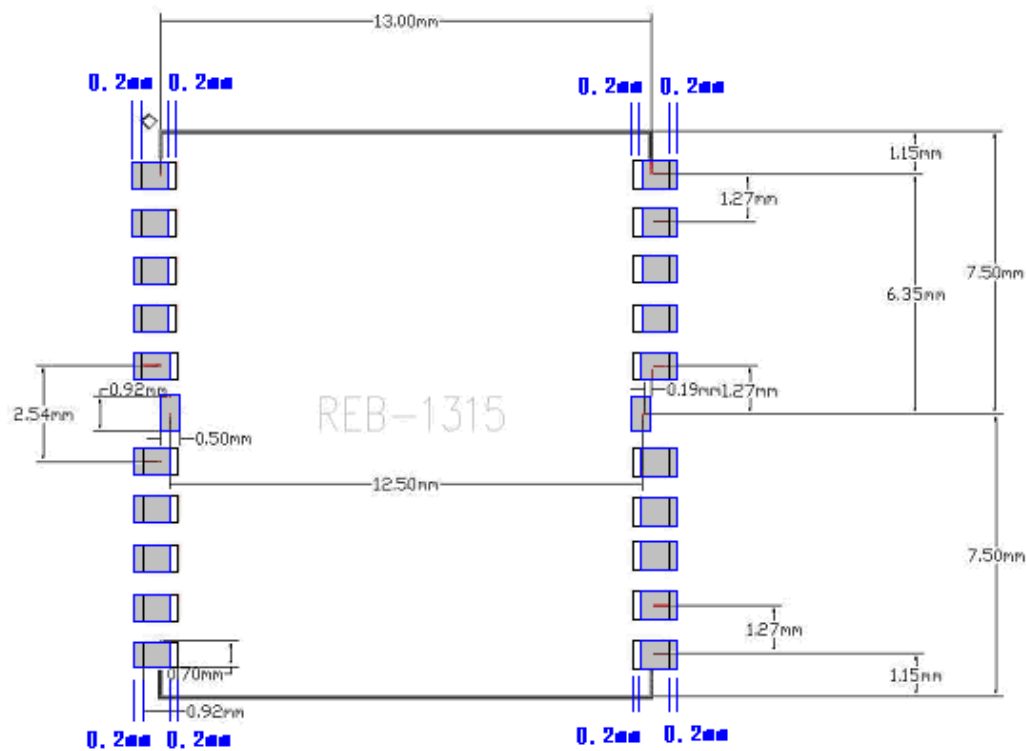


**TOP View**

### Recommend paste mask pad

Recommend paste mask pad is shift outside the layout pad 0.2mm(See under figure)

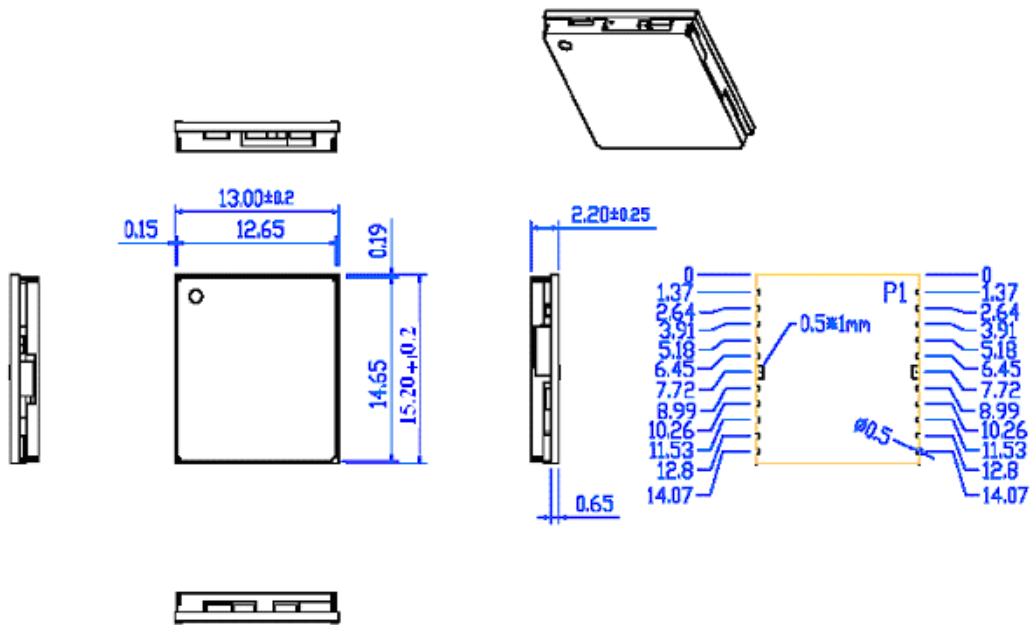
Black Block is layout PAD、Blue Block(Gray region is paste mask pad recommend)



TOP View

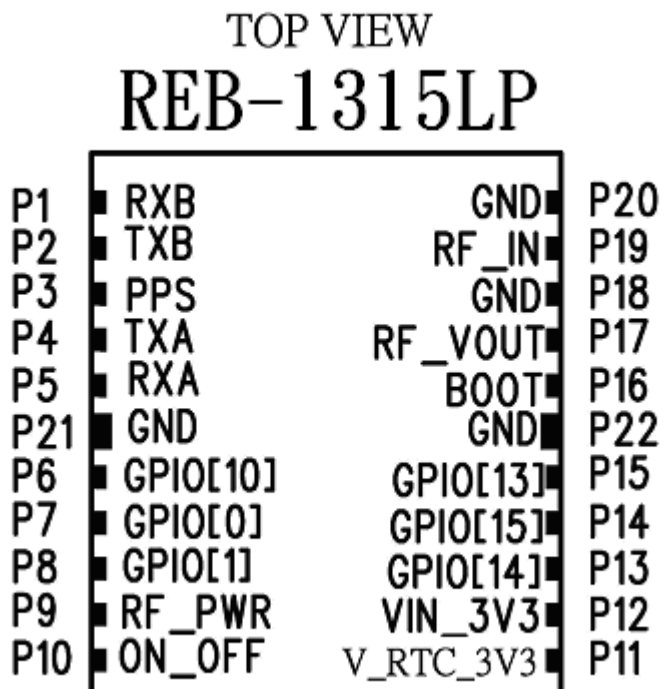
### 1.6 Mechanical Layout

REB-1315LP dimension



### 1.7 Hardware interface

Interface Pin Number:



### Pin defined:

Pin	Signal Name	I/O	Description	Characteristics
1	RXB	I	Serial port B	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$
2	TXB	O	Serial port B	$2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
3	PPS	O	One pulse per second	$2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
4	TXA	O	Serial port A	$2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
5	RXA	I	Serial port A	$3.15V \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$
6	GPIO[10]	I/O	General purpose I/O	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$ $2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
7	GPIO[0]	I/O	General purpose I/O	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$ $2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
8	GPIO[1]	I/O	General purpose I/O	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$ $2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
9	RF_PWR	O	Indicates power state of RF part	$V_{OH} = 2.85V$ $V_{OL} = 0V$
10	ON_OFF	I	Edge triggered soft on/off request.	<b>Reserve function</b> <b>PS: Let it N.C.</b>
11	V_RTC_3V3	I	Backup voltage supply	DC + 2.5 ~ +3.6V Current $\leq 10\mu A$
12	VIN_3V3	I	DC Supply Voltage input	DC +3.3V $\pm 5\%$
13	GPIO[14]	I/O	General purpose I/O	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$ $2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
14	GPIO[15]	I/O	General purpose I/O	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$ $2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
15	GPIO[13]	I/O	General purpose I/O	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$ $2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
16	Boot	I	Boot mode	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$
17	RF_VOUT	O	Supply Antenna Bias	$V_O = 2.85V \pm 5\%$ Current 30mA

			voltage	
18	GND	G	Ground	Reference Ground
19	RF_IN	I	GPS Signal input	50 $\Omega$ @1.57542GHz
20	GND	G	Ground	Reference Ground
21	GND	G	Ground	Reference Ground
22	GND	G	Ground	Reference Ground

### **VIN\_3V3(+3.3V DC power Input)**

This is the DC power supply input pin for GPS system. It provides voltage to module.

### **GND**

GND provides the reference ground .

### **Boot**

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. This pin via serial port output GPS NEMA data.

### **RXB**

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

### **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). (Default Null).

### **RF\_PWR**

This pin indicates state of RF voltage. (Output 2.85V for user)

### **RF\_IN**

This pin receives GPS analog signal. The line on the PCB between the antenna(or antenna connector) has to be a controlled impedance line (Microstrip at 50  $\Omega$ ).

### **RF\_VOUT**

This pin can provide maximum power 30mA@2.85V for active antenna.

### **PPS**

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.



**V\_RTC\_3V3 (Backup battery)**

This is the battery backup input that powers the SRAM and RTC (Real Time Clock) when main power is removed. Typical current draw is 10uA.

The supply voltage should be between 2.5V and 3.6V.

**ON\_OFF (GPS Sleep Mode)**

This pin is triggered soft on/off request. Please shall only used to wake up chip. Control for hibernate. **Please let it N.C.**

**GPIO Functions**

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

## 2. Software Interface

### NMEA V3.0 Protocol

Its output signal level is TTL: 4800 bps (default), 8 bit data, 1 stop bit and no parity. It supports the following NMEA-0183

Messages: GGA, GSA, GSV, RMC .

NMEA Output Messages: the Engine board outputs the following messages as shown in Table 1:

**Table 2 NMEA-0183 Output Messages**

NMEA Record	Description
GGA	Global positioning system fixed data
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data

### GGA-Global Positioning System Fixed Data

Table 2 contains the values of the following example:

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

**Table 3 GGA Data Format**

Name	Example	Units	Description
Message ID	\$GPGGA		GGA protocol header
UTC Position	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 2-1
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 3 Position Fix Indicators**

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3-5	Not Supported GPS PPS Mode, fix valid
6	Dead Reckoning Mode, fix valid

**GSA-GNSS DOP and Active Satellites**

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

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

**Table 4 GSA Data Format**

Name	Example	Units	Description
Message ID	\$GPGSA		GSA protocol header
Mode 1	A		See Table 4-2
Mode 2	3		See Table 4-1
Satellite Used	07		Sv on Channel 1
Satellite Used	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

**Table 5 Mode 1**

Value	Description
1	Fix not available
2	2D
3	3D

**Table 6 Mode 2**

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

Table 7 contains the values of 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 7 GGA Data Format**

Name	Example	Units	Description
Message ID	\$GPGSV		GSV protocol header
Number of Messages <sup>1</sup>	2		Range 1 to 3
Messages Number <sup>1</sup>	1		Range 1 to 3
Satellites in View	07		
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

<sup>1</sup>Depending on the number of satellites tracked multiple messages of GSV data may be required.

### RMC-Recommended Minimum Specific GNSS Data

Table 8 contains the values of the following example:

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

**Table 8 GGA Data Format**

Name	Example	Units	Description
Message ID	\$GPRMC		RMC protocol header
UTC Position	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		degrees	E=east or W=west
Mode	A		A=Autonomous, D=DGPS, E=DR
Checksum	*10		

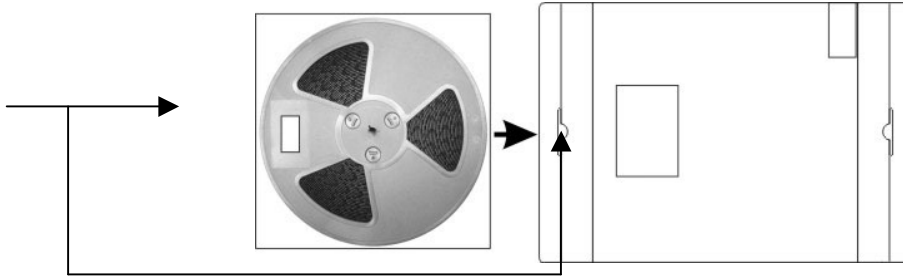
### 3. GPS Receiver User's Tip

- A. GPS signal will be affected by weather and environment conditions, so it is recommended to use the GPS receiver under less shielding environments to ensure GPS receiver has better receiving performance.
- B. When GPS receiver is moving, it will prolong the time to fix the position, so it is recommended to wait for the satellite signals locked at a fixed point when first power-on the GPS receiver to ensure to lock the GPS signal at the shortest time.
- C. The following situation will affect the GPS receiving performance:
  - i. Solar control filmed windows.
  - ii. Metal shielded, such as umbrella, or in vehicle.
  - iii. Among high buildings.
  - iv. Under bridges or tunnels.
  - v. Under high voltage cables or near by radio wave sources, such as mobile phone base stations.
  - vi. Bad or heavy cloudy weather.
- D. If the satellite signals can not be locked or encounter receiving problem (while in the urban area), the following steps are suggested:
  - i. Please plug the external active antenna into GPS receiver and put the antenna on outdoor or the roof of the vehicle for better receiving performance.
  - ii. Move to another open space or reposition GPS receiver toward the direction with less blockage.
  - iii. Move the GPS receiver away from the interferences resources.
  - iv. Wait until the weather condition is improved.
- E. While a GPS with a backup battery, the GPS receiver can fix a position immediately at next power-on if the build-in backup battery is full-recharged.





### 4. Package Specification and Order Information

Shipment Method: Tape and reel

SMT type with stamp holes (22 holes)



### 5. Matching active antenna

Model	RTK P/N	Picture
REB-1315LPN	ZANTEN1257G	
REB-1315LP	ZANTEN1241G	
	ZANTEN1229G	
	ZANTEN1263G	

## 6. Contact Royaltek

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Web Site Customer Service: <http://www.royaltek.com/contact>

## 7. Revision History

Title	REB-1315LP GPS Receiver Module		
Doc Type	User Manual		
Revision Number	Date	Author	Change notice
0.1	2006/09/07	Amy Liu	Initial Release
0.2	2006/11/08	Amy Liu	Add recommend layout PAD and modify mechanical layout
0.3	2006/11/13	Amy Liu	Modify 1.6 Mechanical Layout
1.0	2006/11/28	Amy Liu	Modify 1.6 Mechanical Layout, 1.7 Hardware interface
1.1	2007/02/06	Amy Liu	Modify 1.4 REB-1315LP Technical Specification – LNA, 1.5 Reference schematic; add 5. RGA-1201 Antenna
1.2	2007/05/11	Amy Liu	Modify 1.4 REB-1315LP Technical Specification - Chipset Sensitivity 、 cold start 、 warm start 、 hot start 、 DGPS 、 Operating temperature
1.3	2007/06/21	Amy Liu	Add recommend paste mask pad
1.4	2007/08/02	Amy Liu	Modify 1.5 Active antenna bias voltage: The input gain ranges
1.5	2007/09/07	Amy Liu	Add 5. Matching antenna board
1.6	2007/09/13	Amy Liu	Modify 1.5 reference schematic

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