REB-3570LPX Operational Manual

Version 1.0
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文件編號：

1. Introduction

RoyalTek REB-3570LPX 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

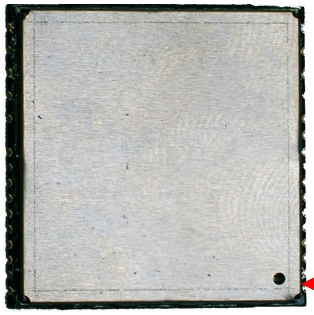
- ✧ 20 parallel channels
- ✧ SMT type with stamp holes
- ✧ High quality stereo audio output
- ✧ TCXO design
- ✧ 0.1 second reacquisition time
- ✧ Small form factor with embedded SiRF Star III single chip technology.
- ✧ NMEA-0183 compliant protocol/ customize protocol
- ✧ Enhanced algorithm for navigation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

1.1 Product Applications

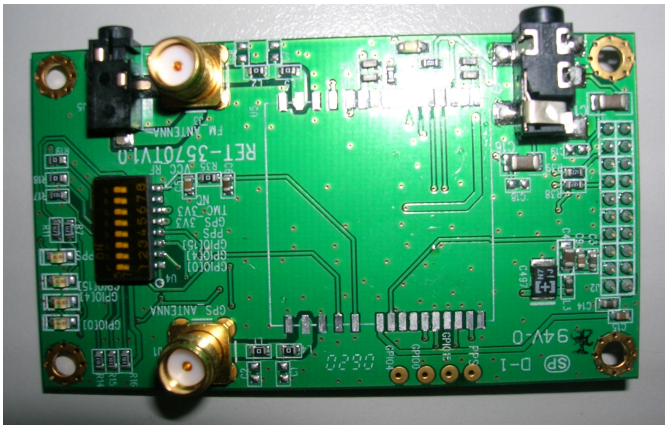
- ✧ Automotive navigation
- ✧ Personal positioning and navigation
- ✧ Marine navigation
- ✧ Timing application

1.2 Product Pictures

(1) REB-3570LPX



(2) REB-3570LPX Interface board



The interface board pin definition

J2 CONNECTOR

Pin #	Signal Name	I/O	Description	Characteristics
1	N.C			
2	N.C			
3	Battery	I	Backup voltage supply	DC + 2.5 ~ +3.6V Current ≤ 10uAq
4	VCC	I	DC Supply Voltage input	DC +3.3V±10%
5	RESET	I	Reset (Active low)	$V_{IH} > 2.3V$; $V_{IL} < 0.8V$
6-10	N.C			
11	TXA	O	Serial port A	$2.375V \le V_{OH} \le 2.85V$ $V_{OL} \le 0.715V$ CMOS TTL level
12	RXA	I	Serial port A	$1.995V \le V_{IH} \le 3.15V$ $-0.3V \le V_{IL} \le 0.855V$ CMOS TTL Level
13	N.C			
14	TXB	O	Serial port B	$2.375V \le V_{OH} \le 2.85V$ $V_{OL} \le 0.715V$ CMOS TTL level

15	RXB	I	Serial port B	$1.995V \le V_{IH} \le 3.15V$ $-0.3V \le V_{IL} \le 0.855V$ CMOS TTL Level
16	N.C			
17	BOOT	I	Boot mode	$1.995V \le V_{IH} \le 3.15V$ $-0.3V \le V_{IL} \le 0.855V$
18	GND	G	Ground	
19	N.C			
20	N.C			

Switch U4

Pin #	Signal Name	0/1	Description	Characteristics
1	GPIO-0		GPIO input/output	Switch: 0: Low 1:High CMOS TTL Level
2	GPIO-4		GPIO input/output	Switch: 0: Low 1:High CMOS TTL Level
3	N.C			
4	PPS		PPS output	Switch: 0: Low 1:PPS output
5	GPS_3V3		Power supply for GPS section	Switch: 0: Low 1: DC 3.3V output
6	N.C			
7	N.C			
8	RF_BIAS		RF_BIAS voltage switch	0: open. No voltage provide antenna. 1:Provide 2.85V to antenna.

Connector:

Pin #	Description	Characteristics
J1	GPS RF Connector	1575.42MHz
J5	N.C	
J4	N.C	

RoyalTek Evaluation Kit REV-2000 for REB-3570LPX

(Please refer to RoyalTek Evaluation Kit REV-2000 for REB-3570LPX Operational Manual for more information)

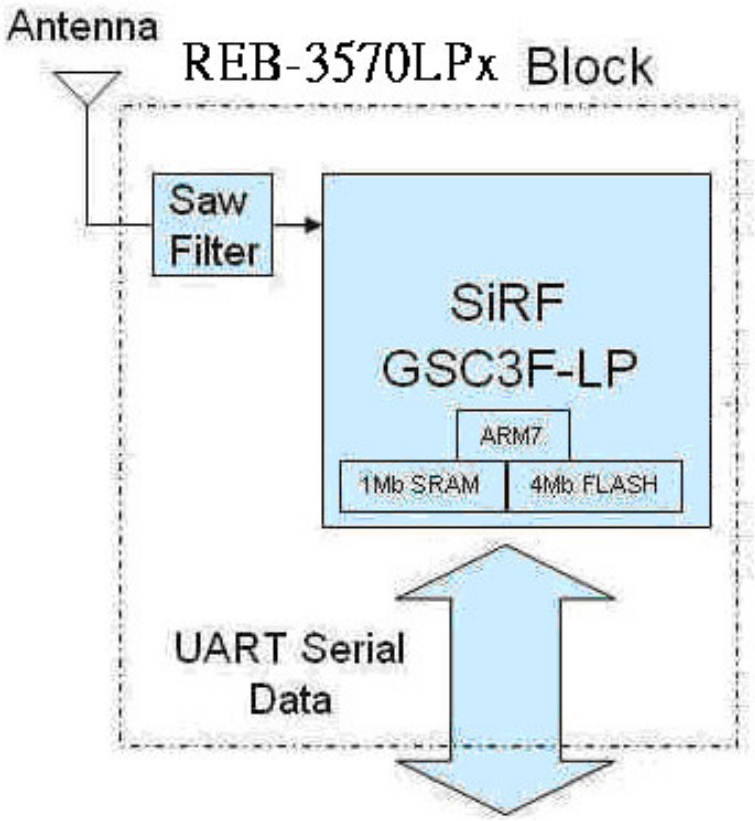
1.3 REB-3570LPX Series Block Diagram

System block diagram description:

(1) External antenna.

(2) 4 Mega bits flash memory

(3) 31 pin I/O pin



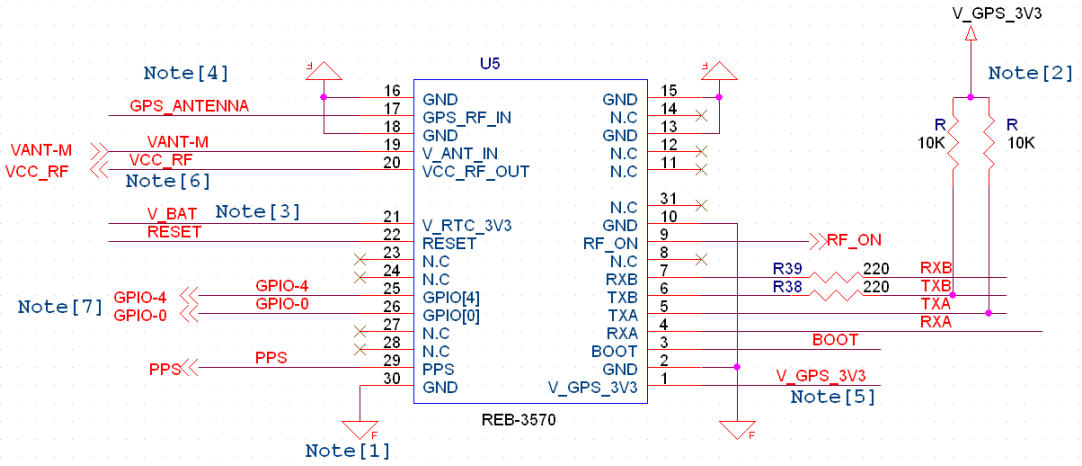
1.4 REB-3570LPX Technical Specification

Impedance：50Ω

No	Function	Specification
GPS receiver		
1	Chipset	SiRF Star III, GSC3f/LPx (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)
7	Chipset Warm start	35 sec (open sky)
8	Chipset Hot start	1 sec (open sky)
9	Reacquisition	0.1sec typical
10	Position accuracy	10meters at 2D RMS.
11	Maximum altitude	18000 m
12	Maximum velocity	514 m/s
13	Update rate	Continuous operation: 1Hz
14	Testability	It shall be able to be tested by SiRF test IV and single channel simulator.
15	Protocol setup	It shall store the protocol setup in the SRAM memory.
17	DGPS	WAAS, EGNOS
Interface		
18	LNA	No LNA
19	I/O Pin	31pin
Mechanical requirements		
20	Weight	≦3.5g
Power consumption		
21	Vcc	DC 3.3 ±5%
22	Current	Average ≦ 43mA
Environment		
23	Operating temperature	-40 ~ 85℃
24	Humidity	≦95%

1.5 Application Circuit

Reference:



Note:

(1) Ground Planes:

REB3570LPX GPS receiver needs two different ground planes. These pin(13、15、16、18) should be connect to analog ground.

These pin(2、10、30) should be connect to digital ground.

(2) Serial Interface:

(Ⅰ)The TXA pin is recommended to pull up(10KΩ). It can increase the stability of serial data.

(Ⅱ)The TXB pin is recommended to connect to serial resistance(220Ω) and pull up (10KΩ), if use the DGPS output.

If no use DGPS output, it don't connect anything.

(Ⅲ) The RXB pin is recommended to connect to serial resistance(220Ω) , if use the DGPS output.

If no use DGPS output, it don't connect anything.

(3) Backup Battery:

It's recommended to connect a backup battery to V_RTC_3V3.

In order to enable the warm start and hot start features of the GPS receiver. If you don't intend to use a backup battery, connect this pin to GND or open.

If you use backup battery, should be add a bypassing capacitor (10uF) at V_RTC_3V3 pin. It can reduce noise and increase the stability.

(4) GPS_RF_IN:

Connecting to the antenna has to be routed on the PCB. The transmission line must to controlled impedance to connect RF_IN to the antenna or antenna connector of your choice. (Impedance 50Ω)

(5) Power:

Connect V_GPS_3V3 pin to DC 3.3V. The power supply must add bypassing capacitor(10uF and 1uF).It can reduce the Noise from power supply and increase power stability.

(6) Active antenna bias voltage:

The Vcc_RF_OUT pin(pin 20) is provide voltage 2.85V. If you use active antenna, you can connect this pin to V_ANT_IN pin (pin 19) to provide bias voltage of active antenna. The bias voltage will be through GPS_RF_IN pin to provide active antenna bias voltage from Vcc_RF_OUT pin.

If your bias voltage of active antenna isn't 2.85V, you can input bias voltage to V_ANT_IN pin (pin 19).And input bias voltage of you need. The input bias voltage will through GPS_RF_IN pin to provide active antenna bias voltage from V_ANT_IN pin.

PS:

(1) The maximum power consumption of active antenna is about 85mW.

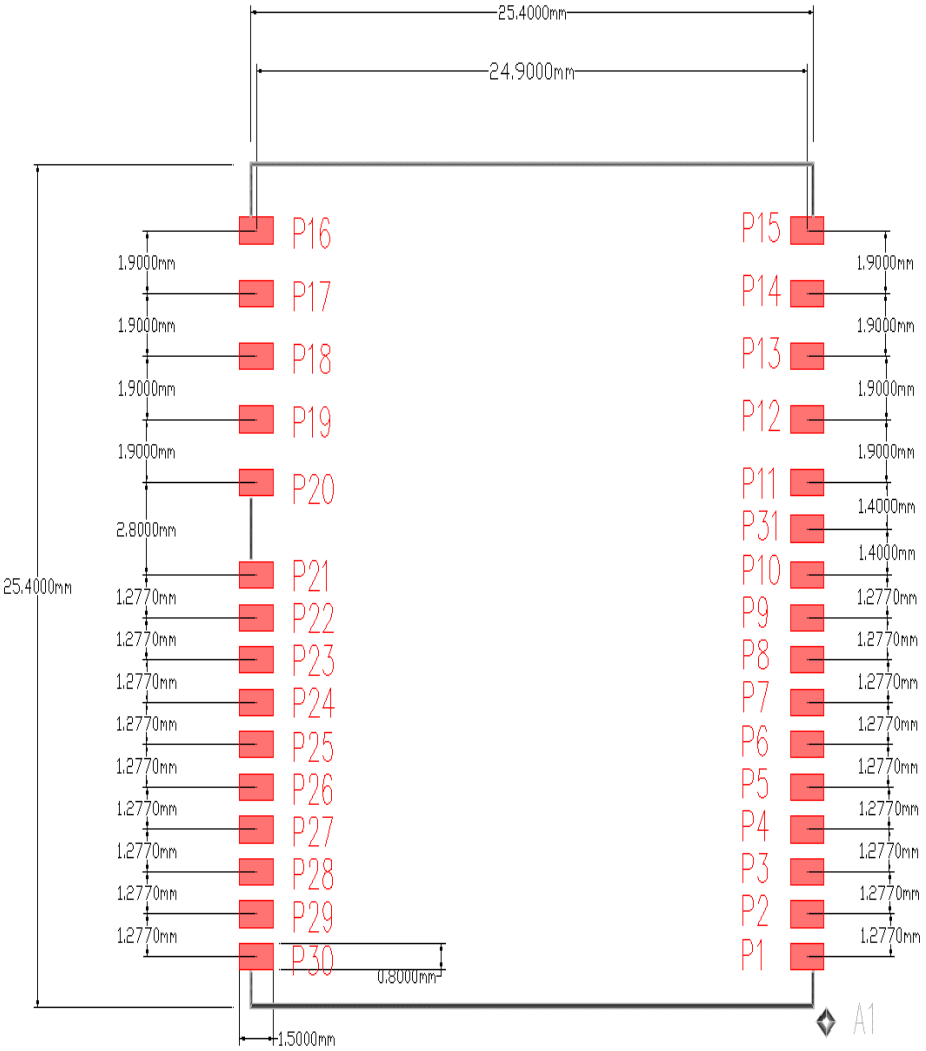
(2) The input gain ranges are 12~ 26dB.

(7) GPIO:

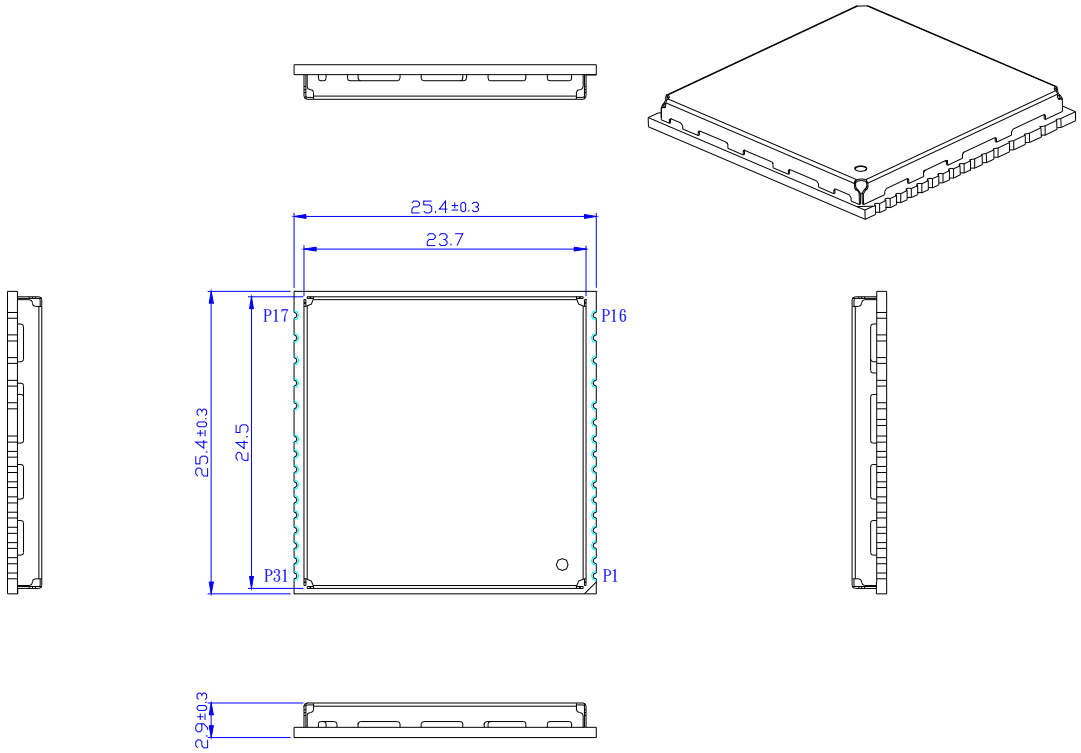
The GPIO pin is recommended to connect to serial resistance(220Ω),if use the GPIO function.

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

1.6 Recommended layout PAD



1.7 Mechanical Layout

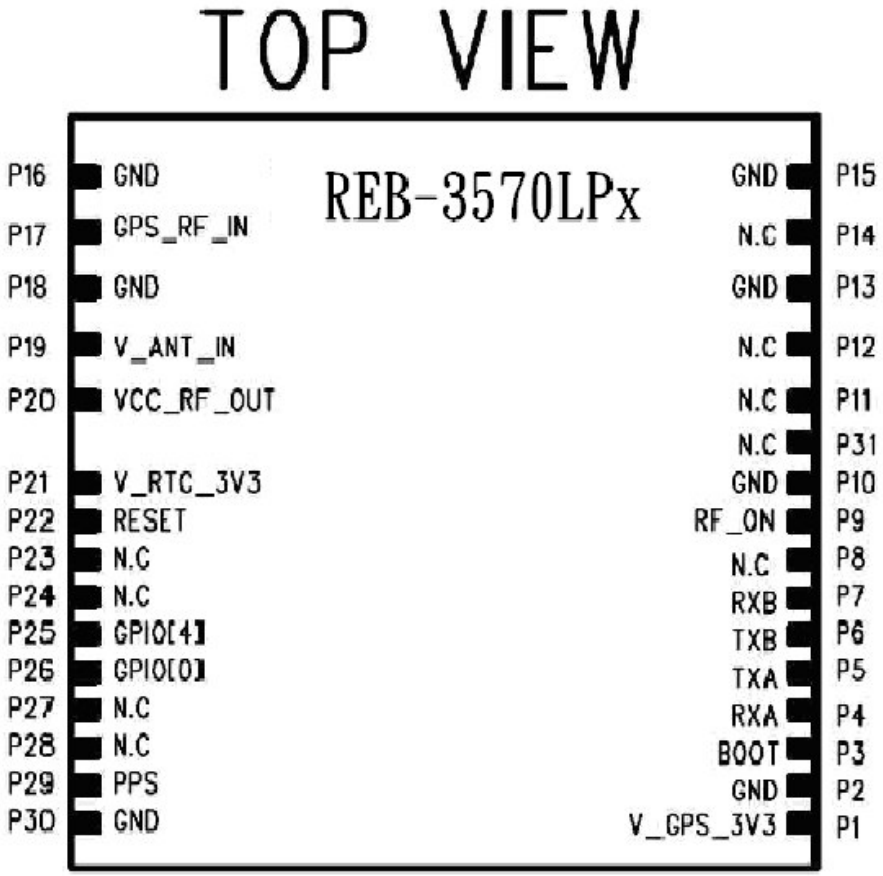


1.8 REB-3570LPX-Test Software Specification

No	Function	Specification
1	Clock offset	88000Hz≦量測值≦104000Hz
2	Clock Drift	量測值≦200Hz
3	C/No Hi Power Mean	量測值≧38dB
4	C/No Hi Power Sigma	量測值≦2dB
5	Bit Sync	量測值≦5 Sec
6	Frame Sync	量測值≦28 Sec
7	Phase Error	量測值≦0.22°

1.9 Hardware interface

Interface Pin Number:



Pin defined:

Pin #	Signal Name	I/O	Description	Characteristics
1	V_GPS_3V3	I	DC Supply Voltage input	DC +3.3V±5%
2	GND	G	Ground	Reference Ground
3	Boot	I	Boot mode	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$
4	RXA	I	Serial port A	$3.15V \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$
5	TXA	O	Serial port A	$2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
6	TXB	O	Serial port B	$2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
7	RXB	I	Serial port B	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$
8	N.C			
9	RF_ON	O	Indicates power state	$V_{OH} = 2.85V$ $V_{OL} = 0V$

			of RF part	
10	GND	G	Ground	Reference Ground
11	N.C			
12	N.C			
13	GND	G	Ground	Reference Ground
14	N.C			
15	GND	G	Ground	Reference Ground
16	GND	G	Ground	Reference Ground
17	GPS_RF_IN	I	GPS Signal input	50 Ω @1.57542GHz
18	GND	G	Ground	Reference Ground
19	V_ANT_IN	I	Active Antenna Bias voltage	Receiving DC power supply for active antenna bias.
20	VCC_RF_OUT	O	Supply Antenna Bias voltage	$V_O = 2.85V \pm 5\%$ Current<30mA
21	V_RTC_3V3	I	Backup voltage supply	DC + 2.5 ~ +3.6V Current ≤ 10uA
22	Reset	I	Reset (Active low)	$V_{IH} > 2.3V$ $V_{IL} < 0.8V$
23	N.C			
24	N.C			
25	GPIO4	I/O	General purpose I/O	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$ $2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
26	GPIO0	I/O	General purpose I/O	$3.15 \geq V_{IH} \geq 1.995V$ $-0.3V \leq V_{IL} \leq 0.855V$ $2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
27	N.C			
28	N.C			
29	PPS	O	One pulse per second	$2.85V \geq V_{OH} \geq 2.375V$ $V_{OL} \leq 0.715V$
30	GND	G	Ground	Reference Ground
31	N.C			

V_GPS_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 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.

RXB

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

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_ON

This pin indicates state of RF voltage.

GPS_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 50Ω).

V_ANT_IN

This pin is reserved as external DC power supply input for active antenna.
If using 2.85V active antenna, pin 20 has to be connected to pin 19.
If using 3.3V or 5V active antenna ,this pin has to be connected to 3.3V or 5V power supply.
PS: The current must be ≦100mA and voltage ≦12V,if using external power supply.

VCC_RF_OUT

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

Reset

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

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 when main power is removed. Typical current draw is 10uA.

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

GPIO Functions

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

2. Software Interface

NMEA Protocol

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

Table 1 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
GLL	Geographic position – latitude/longitude
VTG	Course over ground and ground speed

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 2 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
6	Dead Reckoning Mode, fix valid

GSA-GNSS DOP and Active Satellites

Table 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 5
Mode 2	3		See Table 6
ID of Satellite Used	07		Sv on Channel 1
ID of Satellite Used	02		Sv on Channel 2
….			….
ID of 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
M	Manual-forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

Table 6 Mode 2

Value	Description
1	Fix not available
2	2D

3	3D

GSV-GNSS Satellites in View

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 GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Total Number of Messages[1]	2		Range 1 to 3
Messages 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(Range 00 to 90)
Azimuth	048	degrees	Channel 1(True, Range 000 to 359)
SNR (C/No)	42	dBHz	Channel 1(Range 0 to 99, null when not tracking)
Satellite ID	27		Channel 4(Range 01 to 32)
Elevation	27	degrees	Channel 4(Range 00 to 90)
Azimuth	138	degrees	Channel 4(True, Range 000 to 359)
SNR (C/No)	42	dB-Hz	Channel 4(Range 00 to 99, null when not tracking)
Checksum	*71		
＜CR＞＜LF＞			End of message termination

[1]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 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	True
Course Over Ground	309.62	degrees	
Date	120598		ddmmyy
Magnetic Variation		degrees	
Variation sense			E=east or W=west (Not shown)
Mode	A		A=Autonomous, D=DGPS, E=DR
Checksum	*10		
<CR><LF>			End of message termination

VTG-Course Over Ground and Ground Speed

Table 9 contains the values of the following example:

$GPVTG,79.65,T,,M,2.69,N,5.0,K,A*38

Table 9 VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course over rgound	79.65	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	2.69	Knots	Measured speed
Units	N		Knots
Speed over ground	5.0	Km/hr	Measured speed
Units	K		Kilometer per hour
Mode	A		A-autonomous, D=DGPS, E=DR
Checksum	*38		
<CR><LF>			End of message termination

GLL-Geographic Position – Latitude/Longitude

Table 10 contains the values of the following example:

$GPGLL,2503.6319,N,12136.0099,E,053740.000,A,A*52

Table 10 GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	2503.6319		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12136.0099		Dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	053740.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=autonomous, D=DGPS, E=DR
Checksum	*52		
<CR><LF>			End of message termination

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.

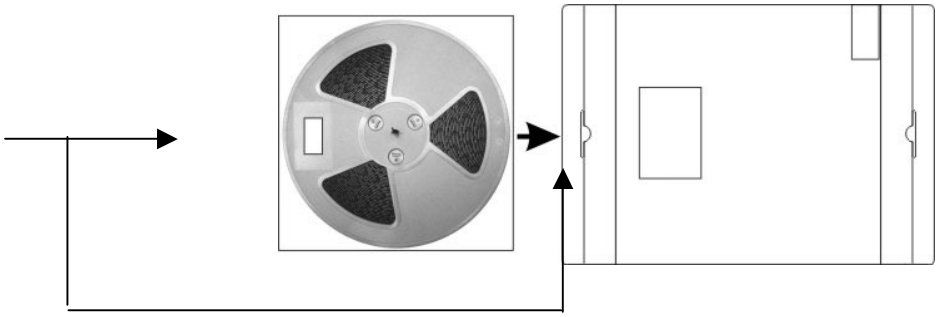
D. If the satellite signals can not be locked or encounter receiving problem (while in the urban area), the following steps are suggested:

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



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6. Revision History

Title	REB-3570LPX GPS Receiver Module		
Doc Type	User Manual		
Revision Number	Date	Author	Change notice
1.0	2008/08/05	Amy Liu	Initial Release