REB-4315 Operational Manual

Version 0.2
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Content

1   Introduction

RoyalTek REB-4315 is the newest generation of RoyalTek GPS module. The module is powered by latest SiRF Star IV chip and RoyalTek proprietary navigation technology that provides you with stable and accurate navigation data. SiRF Star IV is the high sensitivity navigation engine tracks as low as -163dBm. 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.
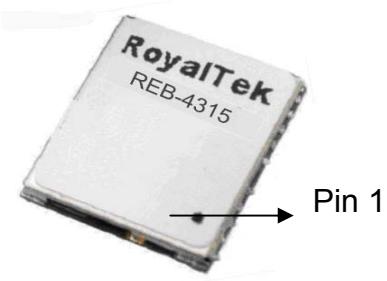
Product Features

- ✧   48 track verification channels
- ✧   Power supply 1.8 volts
- ✧   SMT type with stamp holes
- ✧   Small form factor with embedded SiRF Star IV technology.
- ✧   Removes in-band jammers up to 80 dB-Hz, track up to 8 CW jammers
- ✧   Embedded InstantFix CGEE and Reverse CGEE(3 days)
- ✧   Enhanced algorithm for navigation stability
- ✧   Excellent sensitivity for urban canyon and foliage environments.

1.1   Product Applications

- ✧   Automotive navigation
- ✧   Personal positioning and navigation
- ✧   Mobile gaming
- ✧   Cameras
- ✧   Asset Tracking
- ✧   Others location-aware consumer devices
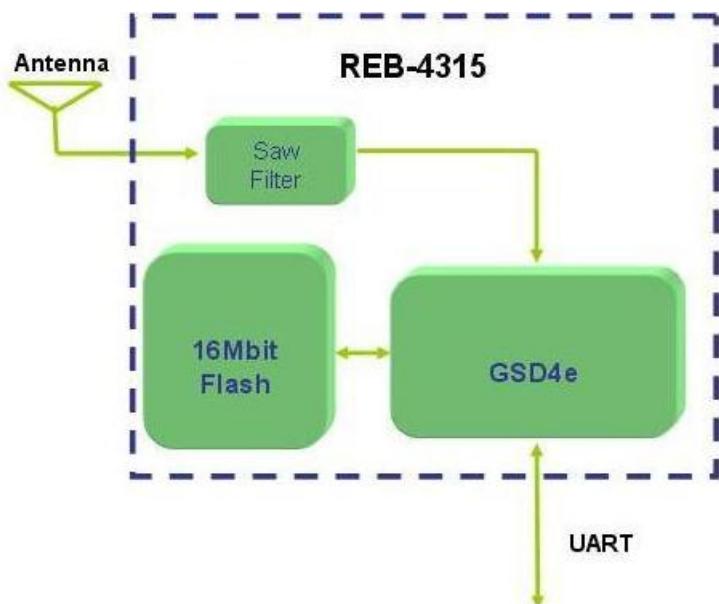
2 Product Pictures

→ Pin 1

3 REB-4315 Block Diagram

System block diagram description:

    a. External antenna.

    b. 16 Mega bits flash memory

    c. 22 pin I/O pins
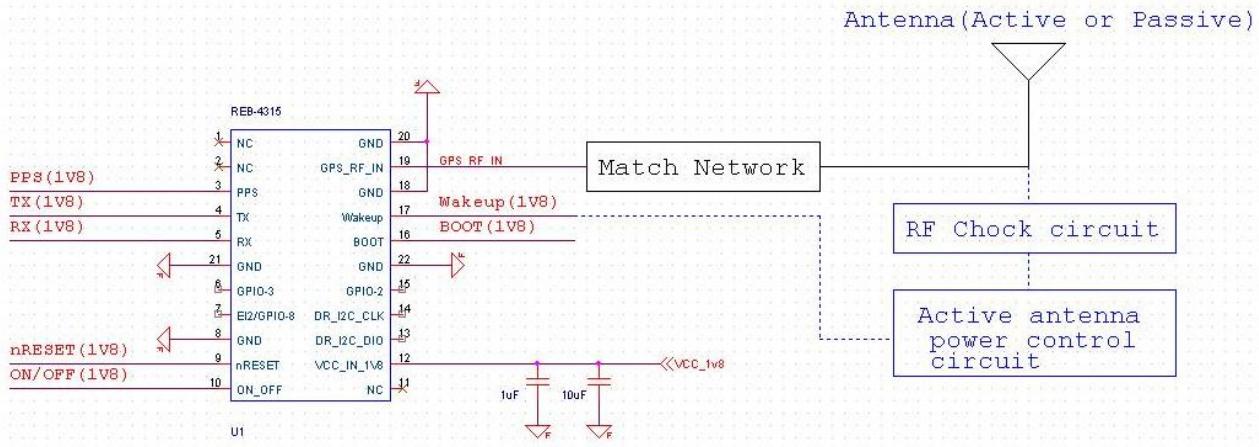
4 REB-4315 Technical Specification

Impedance：50Ω

No	Function	Specification
GPS receiver		
1	Chipset	SiRF Star IV, GSD4e
2	Frequency	L1 1575.42MHz.
3	Code	C.A. Code.
4	Channels	48 track verification channels
5	Sensitivity (Acquisition)	It shall show C/No $\geq$ 40 dB-Hz when external power = -130dBm.
6	Cold start	35 sec　(50% -130dBm Fu 0.5 ppm Tu ±2s Pu 30km)
7	Warm start	35 sec　(50% -130dBm Fu 0.5 ppm Tu ±2s Pu 30km)
8	Hot start	1 sec　　(50% -130dBm Fu 0.5 ppm Tu ±2s Pu 30km)
9	Reacquisition	0.1sec typical
10	Position accuracy	2.5meters(50% 24hr static, -130dBm)
11	Maximum altitude	18288 m
12	Maximum velocity	514 m/s
13	Update rate	1Hz
14	Protocol setup	NMEA0183 standard V3.01 and backward compliance-Adjustable by firmware
Interface		
15	I/O Pin	22pins
Power consumption		
16	Vcc	DC 1.8v(Max. 1.89v)
17	Current	GPS : Typ.52mA@1.8V(Avg Acquisition w/o ext. Antenna) Typ.41mA@1.8V(Avg Tracking w/o ext. Antenna)
18	Hibernate Mode	Typ.20uA@1.8V(Average w/o ext. Antenna)
Mechanical requirements		
19	Dimension(mm)	13*15*2.2
20	Weight	$\leq$3g
Environment		
21	Operating temperature	-30 ~ 85℃
22	Humidity	$\leq$95%

5   Reference schematic:

For example:

Note:

    (1) Ground Planes:

        These　pin(8、18、20、21、22)　should be connect to ground.

    (2) Serial Interface:

        (Ⅰ)The TX pin is the serial output data.<UART data transmit (TX)>

        (Ⅲ)The RX pin is the serial input data.< UART data receive (RX)>

    (3) 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 50Ω)

        Recommend used Active antenna (Gain 27).

    (4) Power:

        Connect VCC_IN_1V8 pin to DC 1.8V. The power supply must add bypass capacitor(10uF and 1uF).It can reduce the Noise from power supply and increase power stability.

        Shutdown

        Shutdown the REB-4315 module, don't remove the Vcc_IN_1V8 Pin, must be use on/off pulse make it into Hibernate mode.(It's will keep the Warm start and Hot start function work well)

    (5) nRESET：

        External reset input with internal pull-up, active low.

    (6) ON/OFF：

Input pulse is required to start the system, and switch the operation mode to full-power mode or Hibernate mode.

(7) Wakeup：

Wakeup output indicate the chip states, when chip is working the output is high level.

Wakeup output can control or enable the external regulator.(Ex. To control external antenna power)

(8) Boot

Set this pin to high for programming flash.

Normal operation mode it is set to low voltage.

6 Power Design Consideration

Start the REB-4315(GSD4e)

After supply the 1.8v to the P12 VCC_IN_1V8,the REB-4315(GSD4e) awaits a pulse to the ON_OFF input to start.

Switching to Hibernate State

By ON_OFF:assert an ON_OFF pulse when receiver is in full-power mode

Awakening from hibernate state

When the system is in simple hibernate state, an ON_OFF input pulse is required to start the system.

Requirements:
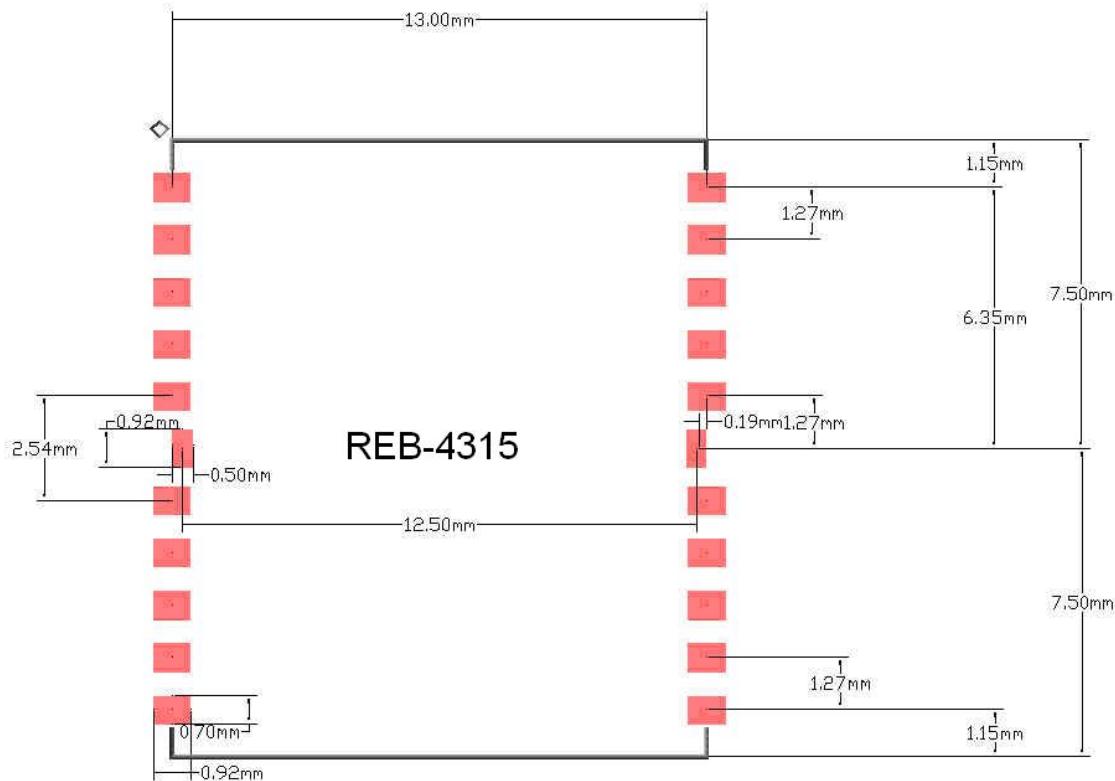
・ The REB-4315(GSD4e) is intended to be used with an always-ON, single voltage supply of 1.8V

・ The REB-4315(GSD4e)   requires an orderly shut-down process to properly stop internal operation and complete any writes of critical data to BBRAM, EEPROM, or Flash memory data area (if those functions are in use).

Cautions:

・ Abrupt removal or droop of main power while the system is running has risks ranging from fatal corruption of flash memory code area with BGA parts to minor impact on TTFF from lost data.

・ Complete removal of 1.8V even after orderly shutdown, will have performance consequences

7   Recommend layout PAD:

Dimension：13mm*15mm*2.2mm(Tolerance：±0.2mm)
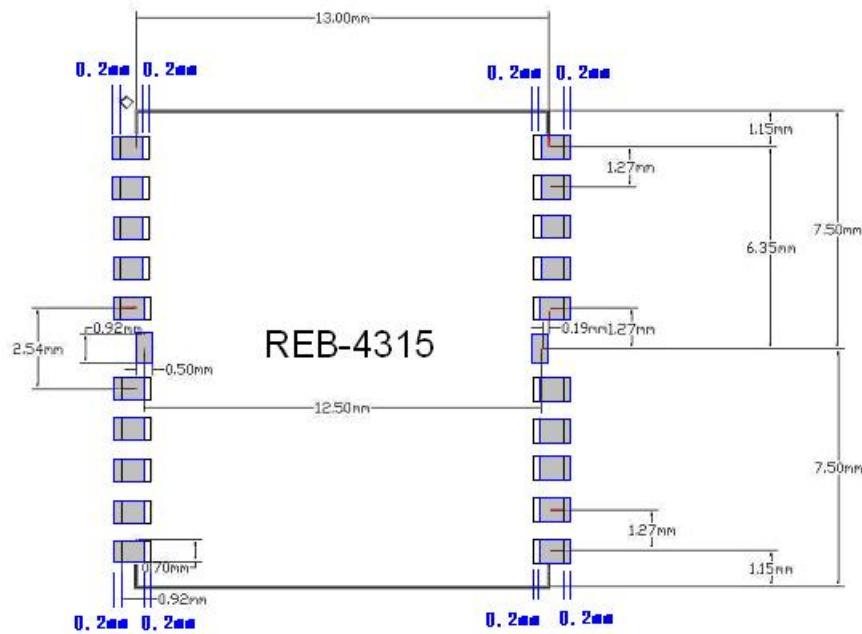
TOP View

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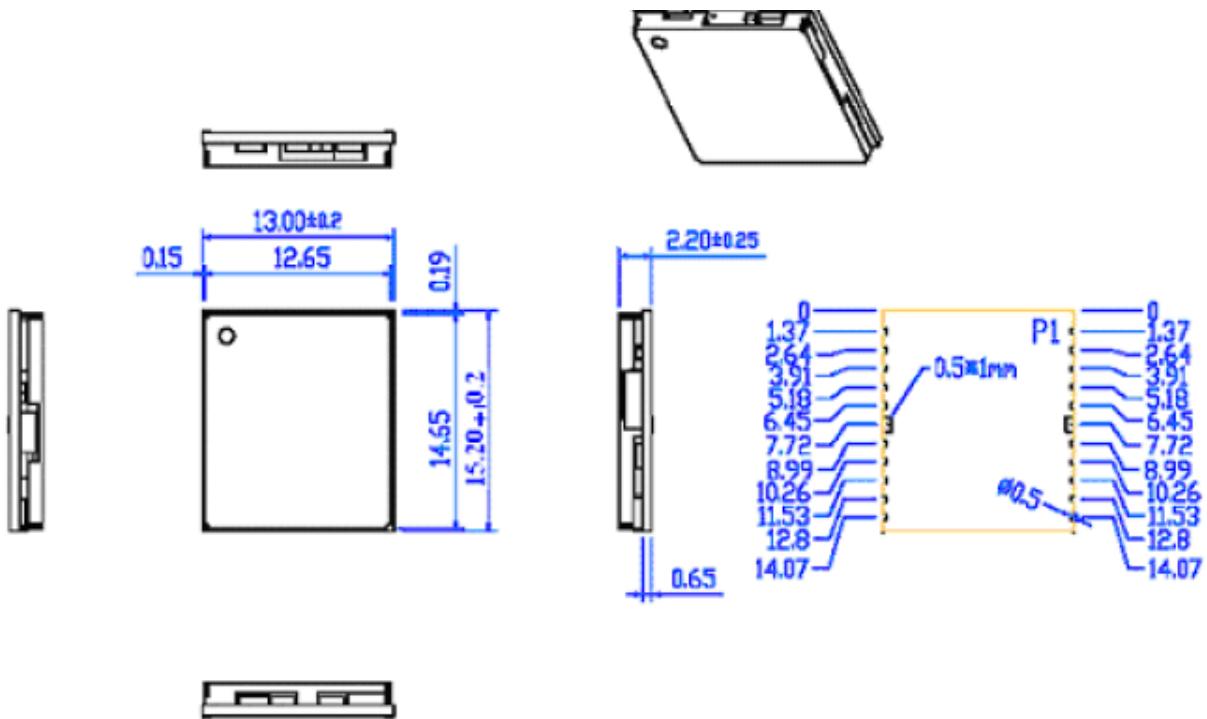
Recommend paste mask pad is shift outside the layout pad 0.2mm (See under figure)

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

TOP View

8 Mechanical diagram

9 Interface document

Top View

Pin defined:

Pin No.	Name	Input/ Output	Description	Characteristics
1	NC		Non connect	
2	NC		Non connect	
3	PPS	Output	TM Time mark output. Output pulse timing.	**Vol Max：0.4v** **Voh Min：1.35v** **(CMOS I/O run from 1.8v)**
4	TX	Output	UART data transmit.	**Vol Max：0.4v** **Voh Min：1.35v** **(CMOS I/O run from 1.8v)**
5	RX	Input	UART data receive.	**Vil ：-0.4v~0.45v** **Vih ：1.26v~3.6v** **(CMOS I/O run from 1.8v)**
6	GPIO-3	Reserved	Reserved.	
7	EI2/GPIO-8	Reserved	Reserved.	
8	GND		Ground	

9	nRESET	Input	External reset input with internal pull-up, active low.	**Vil ：-0.4v~0.45v** **Vih ：1.26v~1.8v** **(CMOS I/O run from 1.8v)**
10	ON/OFF	Input	Power control pin. Need a pulse to ON or OFF the Chip set.	**Vil ：-0.4v~0.45v** **Vih ：1.26v~3.6v** **(CMOS I/O run from 1.8v)**
11	NC		Non connect	
12	VCC_IN_1V8	Input	Single voltage supply of 1.8v.	**Max. 1.89v**
13	DR_I2C_DIO	Reserved	Reserved.	
14	DR_I2C_SCK	Reserved	Reserved.	
15	GPIO-2	Reserved	Reserved.	
16	BOOT	Input	Boot select.	**Vil ：-0.4v~0.45v** **Vih ：1.26v~1.8v** **(CMOS I/O run from 1.8v)**
17	Wakeup	Output	Indicate the state of the chip set.	**Vol Max：0.4v** **Voh Min：1.35v** **(CMOS I/O run from 1.8v)**
18	GND		Ground	
19	GPS_RF_IN	Input	GPS Signal input.	
20	GND		Ground	
21	GND		Ground	
22	GND		Ground	

VCC_IN_1V8 (Power Input)

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

Shutdown

Shutdown the REB-4315 module, don't remove the Vcc_IN_1V8 Pin, You should use on/off pulse make the chip into Hibernate mode.(It's will keep the receiver's SRAM data integrity)

GND provides the reference ground.

Boot(CMOS I/O run from 1.8v)

Set this pin to high for programming flash.

Normal operation mode it is set to low voltage.

RX(CMOS I/O run from 1.8v)

UART data receive (RX)

TX (CMOS I/O run from 1.8v)

UART data transmit (TX)

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).

ON_OFF (CMOS I/O run from 1.8v)

Input pulse is required to start the system, and switch the operation mode to full-power mode or Hibernate mode.

Wakeup(CMOS I/O run from 1.8v)

Wakeup output indicate the chip states, when chip is working the output is high level.

Wakeup output can control or enable the external regulator.(Ex. To control external antenna power)

PPS(CMOS I/O run from 1.8v)

This pin provides one pulse-per-second output from the board, which is synchronized to GPS time.

10. 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**
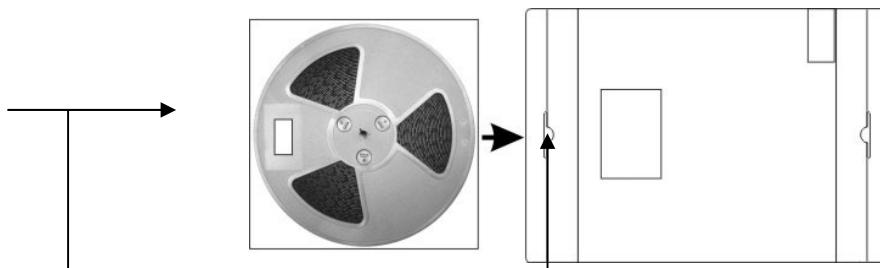
Table 10 GLL Data Format

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

11. Package Specification and Order Information

Shipment Method: Tape and reel

SMT type with stamp holes (22 holes)

12 Contact Royaltek

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Revision History

Title	REB-4315 GPS Module		
Doc Type	User Manual		
Revision Number	Date	Author	Change notice
0.1	2010/08/20	May Chen	Initial Release
0.2	2010/9/23	May Chen	Modified Power

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