REB-3300 Operational Manual

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RoyalTek GPS Module: REB-3300 Operational Manual

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Introduction

RoyalTek REB-3300 low power and small form factor board is the newest generation of RoyalTek GPS Receiver. The GPS receiver is powered by SiRFStarIIe/LP technology with XTrac 2.0 firmware and RoyalTek proprietary navigation algorithm that providing you more stable navigation data. The smallest form factor and miniature design is the best choice to be embedded in a portable device like PDA, personal position and navigation like personal locator, speed camera detector and vehicle locator. The excellent sensitivity of REB-3300 gets the great performance when going though the urban canyon and foliage.

Product Features

✧ 12 parallel channels
✧ Operable from 3.3V/65mA continuous mode.
✧ SMT type with stamp holes
✧ Pin reserved for Backup battery and RF connector
✧ TCXO design
✧ 7 I/O lines(GPIO) available to connect
✧ 0.1 second reacquisition time
✧ Small form factor.
✧ NMEA-0183 compliant protocol/custom protocol.
✧ Enhanced algorithm for navigation stability.
✧ Excellent sensitive for urban canyon and foliage environments.
✧ SBAS (WAAS, EGNOS and MSAS) support
✧ Auto recovery while RTC crashes
✧ Trickle power supported
✧ ARM 7 CPU core accessible
✧ 4/8/16Mbits Flash Memory

Optional
✧ SiRFStarII normal version firmware
✧ SiRFStarII enhance(ES) version firmware
✧ XTrac 2.0 high sensitivity(HS) version firmware

Product applications

✧ Automotive navigation

♦ Personal positioning and navigation

♦ Marine navigation

♦ Timing application

Product Picture
REB-3300

REB-3300 Interface Board

RoyalTek Evaluation Kit REV-2000 for REB-3300

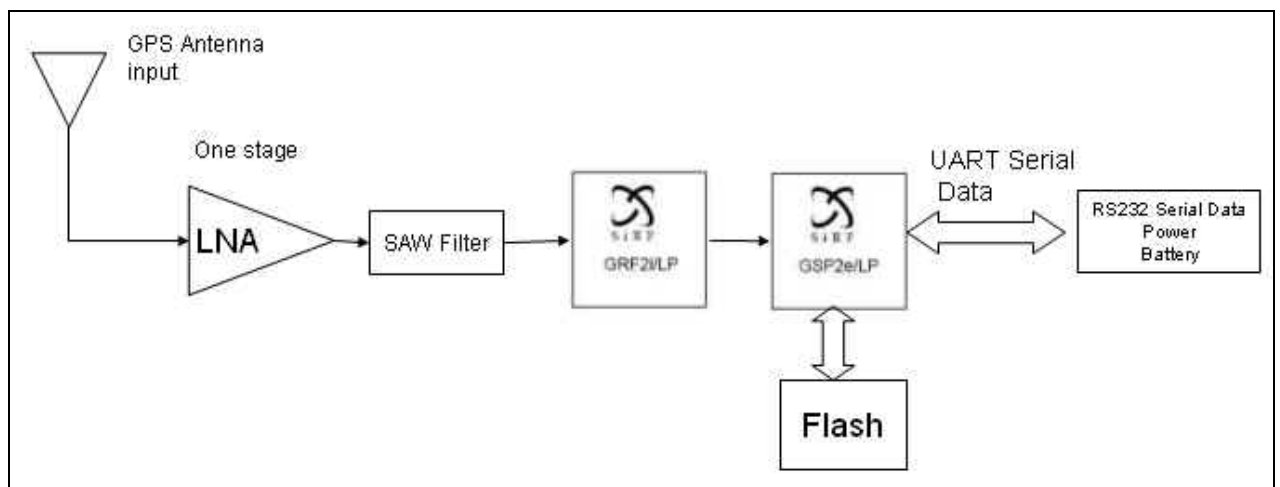(Please refer to RoyalTek Evaluation Kit REV-2000 for REB-3300 Operational Manual for more information)

REB-3300 Series System Block Diagram

REB-3300 engine board consists of SiRF star IIe/LP chipset technology, 4/8/16Mbits flash memory, and proprietary software. The system is described as follows.

   a.   Support external active patch antenna

   b.   Support 4/8/16 Mega bits flash memory

   c.   30 I/O pins

REB-3300 Technique Specification

Impedance   50

No	Function	Specification
GPS receiver		
1	Chipset	SiRF GSP 2e/LP, GRF 2i/LP
2	Frequency	L1 1575.42MHz.
3	Code	C.A. Code.
4	Channels	12.
5	Sensitivity (Tracking)	It shall show C/No 37 dB-Hz when external power = -130dBm. 28 dBHz (SSII normal version software) 28 dBHz (SSII ES version software) 16 dBHz (SSII XTrac version software)
6	Sensitivity (Cold Start)	36 dBHz (SSII normal version software) 33 dBHz (SSII ES version software) 32 dBHz (SSII XTrac version software)
7	Sensitivity (Warm Start)	36 dBHz (SSII normal version software) 33 dBHz (SSII ES version software) 28 dBHz (SSII XTrac version software)
8	Cold start	45sec typical (SSII normal version software, Open sky) 75sec typical (SSII ES version software, Open sky) 45sec typical (SSII XTrac version software, Open sky)
9	Warm start	38sec typical (SSII normal version software, Open sky) 40sec typical (SSII ES version software, Open sky) 35sec typical (SSII XTrac version software, Open sky)
10	Hot start	8 sec. typical (SSII normal version software, Open sky) 18 sec. typical (SSII ES version software, Open sky) 4 sec. typical (SSII XTrac version software, Open sky)
11	Reacquisition	0.1sec typical
12	Clock drift	200Hz in 60 sec
13	Clock offset	90000Hz Clock offset 100000Hz
14	Position accuracy	25m CEP.
15	Maximum altitude	18000 m
16	Maximum velocity	514 m/s
17	Trickle power mode	Duty cycle 34%. (Variable) Default: disable(option: enable)
18	Update rate	Continuous operation: 1Hz
19	Navigation filter	It shall freeze the navigation update when speed 2.5 km/hr
20	Testability	It shall be able to be tested by SiRF test II and single channel simulator.
22	Protocol setup	It shall store the protocol setup in the SRAM memory.
23	DGPS	1.WAAS, EGNOS 2.RTCM protocol
Interface		
24	LNA	On board LNA : a. Gain 14dB b. N.F. < 2dB
25	I/O Pin	30pin stamp holes

Mechanical requirements		
26	Weight	3.5g
Power consumption		
27	Vcc	DC 3.3 ±5%
28	Current	REB3300: Current 65mA@3.3V typical (w/o ext. antenna)
29	Trickle power mode	Average current 65mA. (IO float)
30	Power down mode current	1. It means that the GPS receiver is in power down mode. 2. Current 800μ A.
Environment		
31	Operating temperature	-40 ~ 85
32	Humidity	95%
33	Interface Protocol	1. NMEA 0183 ver 3.0, GGA, GSA, RMC and GSV once per 2. SiRF Protocol 3. 4800 bps, 8 data bits, no parity, 1 stop bits

Application Circuit
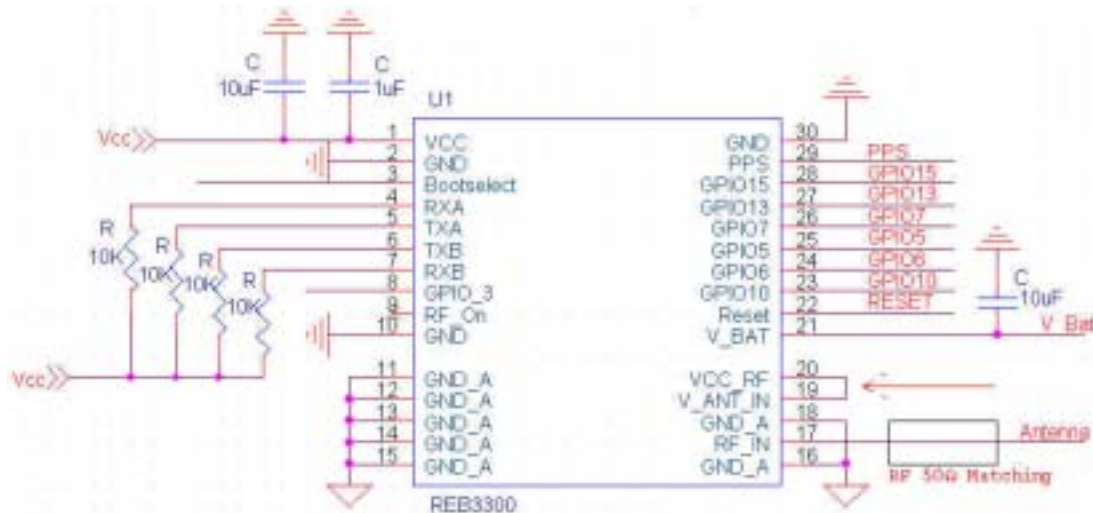
(1) Ground Planes:

REB-3300 GPS receiver needs two different ground planes. The GND_A pin(11

12 13 14 15 16 18)   shall be connect to analog ground.

The GND pin(2   10   30) connect to digital ground.

(2) Serial Interface:

The Serial interface pin(RXA TX1 TXB RXB) is recommended to pull up(10K   ).

It can increase the stability of serial data.

(3) Backup Battery:

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

In order to enable the warm 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, shall need to add a bypassing capacitor (10uF) at V_bat

trace. It can reduce noise and increase the stability.

(4) Antenna:

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.

(5) Active antenna bias voltage:

The Vcc_RF pin(pin 20) is provide voltage 3.0V. 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 through RF_IN pin to provide active antenna bias voltage from Vcc_RF pin.

If your bias voltage of active antenna isn't 3.0V, you can input bias voltage to V_ANT_IN pin(pin 19).And input bias voltage of you need. It can open if you use passive antenna. The input bias voltage will through RF_IN pin to provide active antenna bias voltage from V_ANT_IN pin.

The maximum power consumption of active antenna is about 100mW

(6) Power:

Connect Vcc 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.

Recommended layout PAD
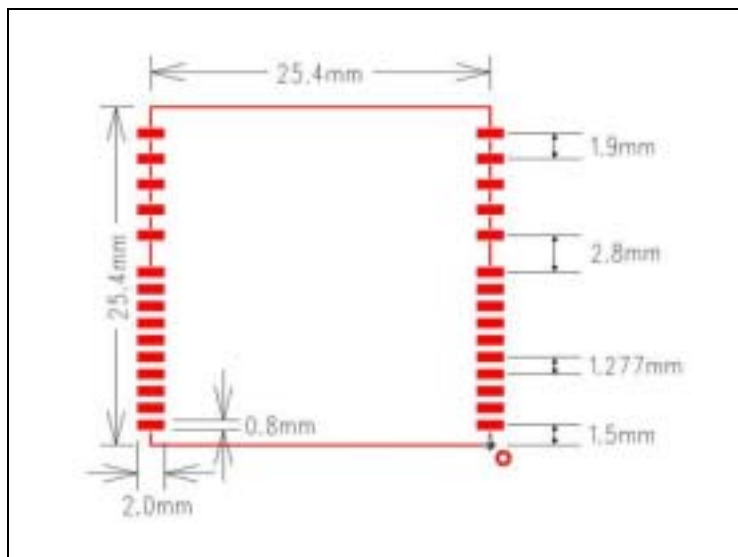
GPS Antenna Specification (Recommendation)

✧   Active patch antenna

✧   Receiving freq. 1575.42 +/-1.032MHz

✧   Polarization RHCP

✧   Output impedance 50 Ohm

✧   2 stage LNA

✧   Connection: surface mounted on main PCB

Mechanical Layout
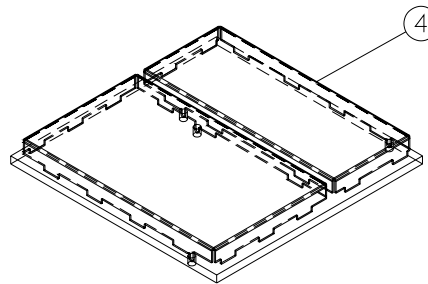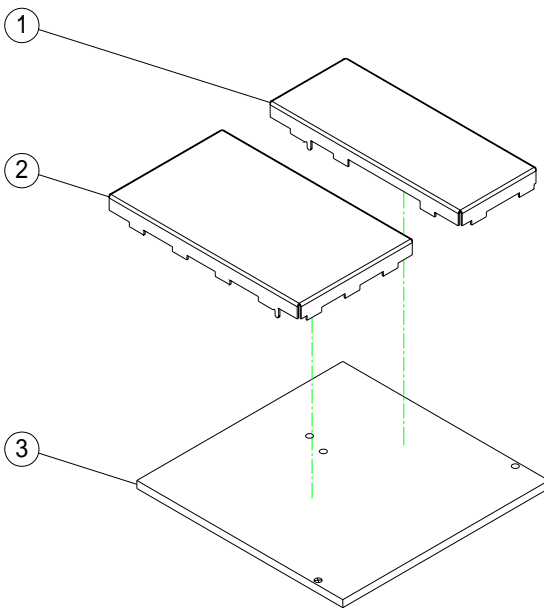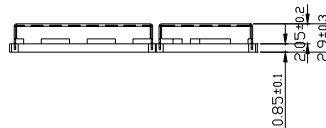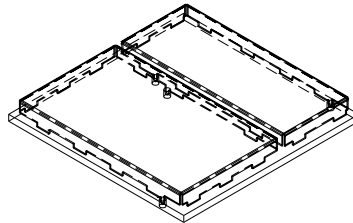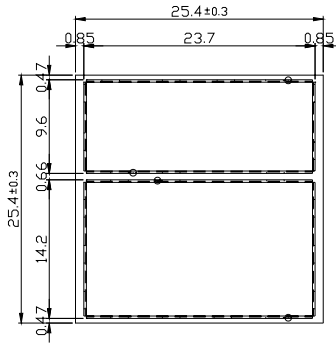
1	1TOSBN25**	SHIELD-RF	
2	1TOSBN26**	SHIELD-LNA	
3	PSB*01****	M-PCB REB-3300 V*.*	
4	NSB0000A**	REB-3300 M-PCB (SMD)	

Mechanical requirements		
1	REB-3300	Length= 25.4 mm
		Width= 25.4 mm
		Thickness= 3mm
2	Weight	3.5g

Hardware interface
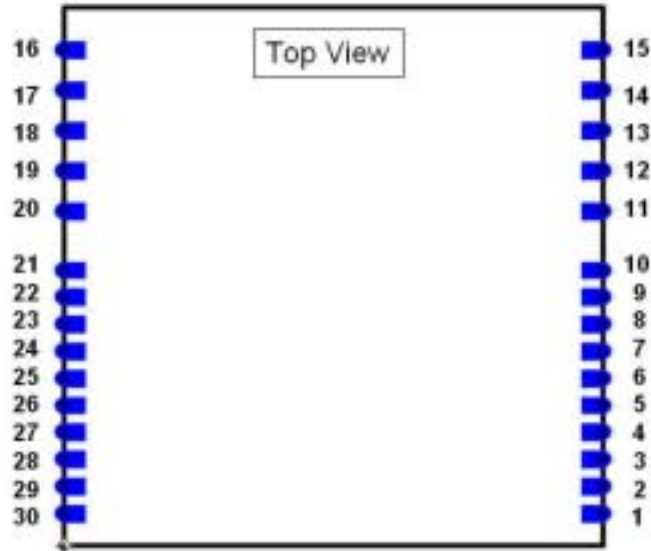
Definition of Pin assignment

Pin #	Signal Name	I/O	Description	Characteristics
1	VCC	I	DC Supply Voltage input	DC +3.3V±10%
2	GND	G	Ground	Digital Reference Ground
3	Bootselect	I	Boot mode	$V_{IH} \geq 0.7V * VCC$ $V_{IL} \leq 0.3V * VCC$
4	RXA	I	Serial port A	$V_{IH} \geq 0.7V * VCC$ $V_{IL} \leq 0.3V * VCC$
5	TXA	O	Serial port A	$V_{OH} \geq 2.4V$ $V_{OL} \leq 0.4V$
6	TXB	O	Serial port B	$V_{OH} \geq 2.4V$ $V_{OL} \leq 0.4V$
7	RXB	I	Serial port B	$V_{IH} \geq 0.7V * VCC$ $V_{IL} \leq 0.3V * VCC$
8	GPIO3	I/O	General –purpose I/O	$V_{IH} \geq 0.7V * VCC$ $V_{IL} \leq 0.3V * VCC$ $V_{OH} \geq 2.4V$ $V_{OL} \leq 0.4V$
9	RF_ON	O	Indicates power state of RF part	$V_{OH} = 2.85V$ $V_{OL} = 0V$
10	GND	G	Digital Ground	Digital Reference Ground
11 | 16	GND_A	G	Analog Ground	Analog Reference Ground
17	RF_IN	I	GPS Signal input	50 Ω @1.57542GHz
18	GND_A	G	Analog Ground	Analog Reference Ground
19	V_ANT_IN	I	Active Antenna Bias voltage	Receiving DC power supply for active antenna bias.
20	VCC_RF	O	Supply Antenna Bias voltage	$V_O = 3.0V$ ±0.3
21	V_BAT	I	Backup voltage supply	DC + 2.6 ~ +3.6V Current $\leq$ 10uA (w/o battery)
22	Reset	I	Reset (Active low)	$V_{IH} > 2.3V$ $V_{IL} < 0.8V$
23	GPIO10	I/O	General purpose I/O	$V_{IH} \geq 0.7V * VCC$ $V_{IL} \leq 0.3V * VCC$ $V_{OH} \geq 2.4V$ $V_{OL} \leq 0.4V$

24	GPIO6	I/O	General purpose I/O	$V_{IH} \geq 0.7V * VCC$ $V_{OH} \geq 2.4V$	$V_{IL} \leq 0.3V * VCC$ $V_{OL} \leq 0.4V$
25	GPIO5	I/O	General purpose I/O	$V_{IH} \geq 0.7V * VCC$ $V_{OH} \geq 2.4V$	$V_{IL} \leq 0.3V * VCC$ $V_{OL} \leq 0.4V$
26	GPIO7	I/O	General purpose I/O	$V_{IH} \geq 0.7V * VCC$ $V_{OH} \geq 2.4V$	$V_{IL} \leq 0.3V * VCC$ $V_{OL} \leq 0.4V$
27	GPIO13	I/O	General purpose I/O	$V_{IH} \geq 0.7V * VCC$ $V_{OH} \geq 2.4V$	$V_{IL} \leq 0.3V * VCC$ $V_{OL} \leq 0.4V$
28	GPIO15	I/O	General purpose I/O	$V_{IH} \geq 0.7V * VCC$ $V_{OH} \geq 2.4V$	$V_{IL} \leq 0.3V * VCC$ $V_{OL} \leq 0.4V$
29	PPS	O	One pulse per second	$V_{OH} \geq 2.4V$	$V_{OL} \leq 0.4V$
30	GND	G	Digital Ground	Digital Reference Ground	

Definition of Pin assignment

VCC(+3.3V DC power Input)

This is the main DC power supply input pin. It provides voltage to module.

GND

GND provides the ground for digital part.

Bootselect

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_ON

This pin indicates state of RF voltage.

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 impedance line (Microstrip at 50).

V_ANT_IN

This pin is reserved an external DC power supply for active antenna.

If using 3.0V active antenna, pin 19 has to be connected to pin 20.

If using 3.3V or 12V active antenna ,this pin has to be connected to 3.3V or 5V power supply.

VCC_RF

This pin provides DC voltage 3.0 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.

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 10uA.

Without an external backup battery or super cap, the TMP will execute a cold start after every power on. To achieve the faster start-up offered by a hot or warm start, either a battery backup must be connected or a super cap installed. To maximize battery lifetime, the battery voltage should not exceed the supply voltage and should be between 2.5V and 3.6V.

With the super cap (B1) installed, and after at least ten minutes of continuous operation, the data retention is about seven hours.

Note that even though all other components are rated at –40 to +85 deg C , a typical super cap is specified over a temperature range of –25 to +70 deg C and a typical rechargeable Lithium battery is over –20 to +70 deg C.

GPIO Functions

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

Test Software Specification

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

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, GLL, GSA, GSV, RMC and VTG.

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
GLL	Geographic position – latitude / longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
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 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 3 contains the values of the following

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

Table 3 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.ss
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 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 4-1   Mode 1

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

Table 4-2   Mode 2

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

GSV-GNSS Satellites in View

Table 5 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 5 GGA Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
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(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

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

RMC-Recommended Minimum Specific GNSS Data

Table 6 contains the values of the following example:

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

Table 6 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
Checksum	*10		
CR LF			End of message termination

VTG-Course Over Ground and Ground Speed

Table 7 contains the values of the following example:

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

Table 7   VTG Data Format

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		Kilometer per hour
Checksum	*6E		
CR LF			End of message termination

GPS Receiver User's Tip

1. GPS signal will be affected by weather and environment conditions, thus suggest to use the GPS receiver under less shielding environments to ensure GPS receiver has better receiving performance.

2. When GPS receiver is moving, it will prolong the time to fix the position, so suggest to wait for the satellite signals to be locked at a fixed point when first power-on the GPS receiver to ensure to lock the GPS signal at the shortest time.

3. The following situation will affect the GPS receiving performance:
   a. Solar control filmed windows.
   b. Metal shielded, such as umbrella, or in vehicle.
   c. Among high buildings.
   d. Under bridges or tunnels.
   e. Under high voltage cables or near by radio wave sources, such as mobile phone base stations.
   f. Bad or heavy cloudy weather.

4. If the satellite signals can not be locked or encounter receiving problem (while in the urban area), the following steps are suggested:
   a. 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.
   b. Move to another open space or reposition GPS receiver toward the direction with less blockage.
   c. Move the GPS receiver away from the interferences resources.
   d. Wait until the weather condition is improved.

5. 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.
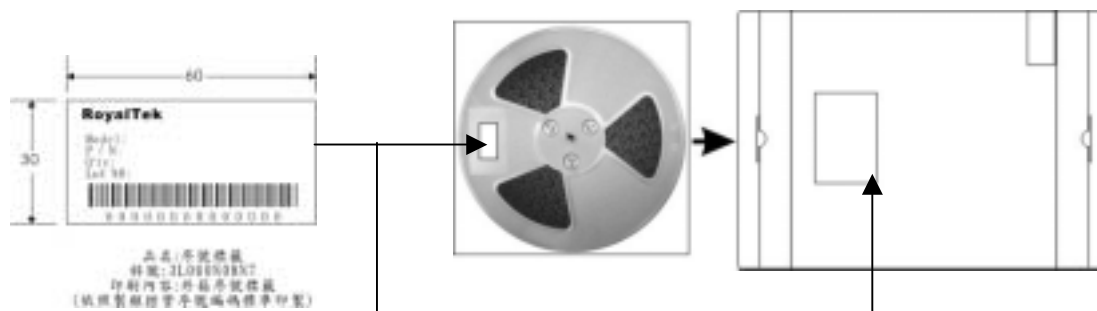
鼎天國際股份有限公司

MTBP Estimation

MTBF > 10000 hours

Package Specification and Order Information

Shipment Method: Tape and reel

	S/W Version	Protocol		Package
	1	2	label	3
REB-3300	0. Standard	0. Customize		0. Standard
	1.ES	1. GGA,GSA,GSV(5),RMC,4800		
	2.XTRAC	3. GGA,GSA,GSV(5),RMC,57600		
		4. RMC,9600		

Contact Information Section

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Revision History

鼎天國際股份有限公司

Title	REB-3300 GPS Receiver Module		
Doc Type	User Manual		
Revision Number	Date	Author	Change notice
0.1	7.Sep 2004	Ben	Initial version
0.5	15 Oct 2004	Ben	First release
1.0	24 Nov 2004	Ben	Application circuit, package antenna specification