

REB-22R User Manual

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0. Revision History

Rev	Release Date	Change Description	Editor
1.0	2007/3/20	Initial Draft	Amanda Lee
1.1	2008/2/27	Update Storage temperature/ Operating temperature/ Package material temperature	Amanda Lee
1.2	2008/7/15	Modify company address & NMEA table	Jerry.Weng

RoyalTek REB-22R Series User Manual

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1 Introduction

REB-22R is the heritage from REB-21R, and REB-22R Pinout compatibility as REB-21R. However, REB-22R has higher sensitivity than REB-21R, and much more power saving than REB-21R.

REB-22R also consists of SiRF Star II technology and RoyalTek proprietary navigation algorithm that providing you more stable navigation data.

1.1 Product Features.

- Pinout compatibility as REB-21R
- Much more power saving than REB-21R
- Higher sensitivity than REB-21R
- OEM product development is fully supported through applications engineering and WEB technique forum.
- 12 parallel channels
- Enhanced algorithm for navigation stability.
- NMEA-0183 compliant protocol/custom protocol.
- Excellent sensitive for urban canyon and foliage environments.
- Single satellite positioning.
- Dual multi path rejection.
- WAAS/EGNOS supported

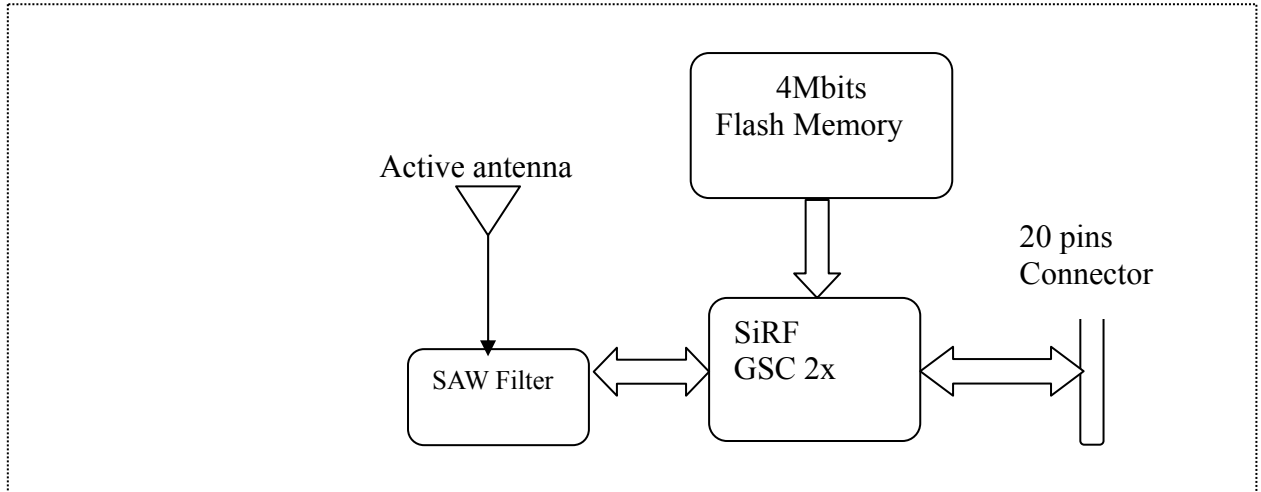
1.2 Product applications

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



1.3 REB-22R Series Block diagram

The block diagram is described as follows.



1.4 Technique specifications

The specification list of REB-22R

- Channels : 12 Channels
Frequency: L1, 1575.42MHz.
C / A code :1.023MHz chip rate.
- Hot start : 8sec., typical
- Warm start: 38sec. typical
- Cold start: 48sec., typical
- Reacquisition : 1 sec. typical
- Position accuracy: 25m CEP without SA
- Velocity accuracy : 0.1 meters/second without SA
- Dynamics:
 - Altitude : 18000 meters (60000 feet) Max.
 - Velocity : 515 meters / second Max.
 - Acceleration : 4 g. , Max.
- DGPS Accuracy :
Position:1 to 5 m, typical
Velocity: 0.05 meters/second, typical
- Datum: WGS-84.
- Navigation update rate : 1 Hz.
- RTC reset function,
- Battery<2.0V: cold start;
- TTL level 【3.3V 、5V(option)】
- GPIO (option)
- Clock offset: $90000\text{Hz} \leq \text{Clock offset} \leq 100000\text{Hz}$
- Clock drift: $\leq 200\text{Hz}$ in 60 sec.
- Software interface (Output Messages)
 - ◆ RS-232 interface(Data format): 9600bps, 8bit data, 1 stop bit and no

parity.

- ◆ It supports the following NMEA-0183 messages: GGA, GGL, GSA, GSV, RMC and VTG (default).
- Differential Input: It shall provide external serial RTCM 104
- Storage temperature: $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$. (exception for backup battery -20 to $+60$ degree Celsius)
- Operating temperature: $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$. (exception for backup battery -25 to $+60$ degree Celsius)
- Package material temperature: $-20^{\circ}\text{C} \sim +60^{\circ}\text{C}$.

2 Hardware Interface

- Digital Interface connector type
- Connector Number : U402 (RF Interface connector type)
- Antenna connector is female MCX or others type.
- Connector Number : CON1 (20pin I/O interface connector)

2.1 For 5V TTL Output .

Pin NO	Signal Name	I/O	Description	Characteristics
1	ANT_PWR (*Note3)	I	Antenna DC Voltage	Depending on the user required.
2	VCC_5V (*Note1)	I	+5V DC Power Input	DC +5V \pm 10%.
3	VBAT (*Note11)	I	User Supply +2.6 ~ +3.6V DC Power Input	DC +2.6 ~ +3.6V. Current \leq 10uA w/o battery
4	NC	-	NC	
5	NC	-	NC	
6	NC	-	NC	
7	Boot / (*Note13)	I	HA:Boot HS:NC	TTL : $4.5V \leq V_{IH} \leq 5.5V$ $0V \leq V_{OL} < 1.35V$
8	NC			
9	NC			
10	GND (*Note4)	G	Ground	
11	TXA (*Note8)	O	NMEA Output 9600bps, 8 data bits, no parity, 1 stop bit	TTL : $4.5V \leq V_{OH} \leq 5.5V$ ($I_{OH} = -50uA$) $0V \leq V_{OL} \leq 0.1V$, ($I_{OL} = 50uA$)
12	RXA (*Note6)	I	Serial Data Input A	TTL : $4.5V \leq V_{IH} \leq 5.5V$ $0V \leq V_{IL} < 1.35V$
13	GND (*Note4)	G	Ground	
14	TXB (*Note9)	O	Serial Data Output B	TTL : $4.5V \leq V_{OH} \leq 5.5V$ ($I_{OH} = -50uA$) $0V \leq V_{OL} \leq 0.1V$, ($I_{OL} = 50uA$)
15	RXB (*Note7)	I	RTCM 104 differential GPS input.	TTL : $4.5V \leq V_{IH} \leq 5.5V$ $0V \leq V_{IL} \leq 1.35V$
16	GND (*Note4)	G	Ground	
17	BOOT/NC (*Note13)	I	HA : NC HS : BOOT	TTL : $4.5V \leq V_{IH} \leq 5.5V$ $0V \leq V_{IL} \leq 1.35V$
18	GND (*Note4)	G	Ground	
19	TIMEMARK (*Note10)	O	1PPS Time Mark Output.	TTL : $4.5V \leq V_{OH} \leq 5.5V$ ($I_{OH} = -50uA$) $0V \leq V_{OL} \leq 0.1V$, ($I_{OL} = 50uA$)
20	NC	-	NC	

Notes: HA boot pin: pin 7, HS Boot pin: pin 17

2.2 For 3.3V TTL Output .

Pin NO	Signal Name	I/O	Description	Characteristics
1	ANT_PWR (*Note3)	I	Antenna DC Voltage	Depending on the user required.
2	NC	-	NC	
3	VBAT (*Note11)	I	User Supply +2.6~3.6V DC Power Input w/o battery	DC +2.6 ~ +3.6V. Current $\leq 10\mu\text{A}$ (w/o battery)
4	VCC_3V (*Note2)		DC+3.3V $\pm 10\%$	DC +3.3V $\pm 10\%$
5	NC	-	NC	
6	NC/GPIO15 (*Note12)	I/O	HA:NC HS:GPIO15	TTL: $2 \leq V_{IH} \leq 3.15\text{V}$ $-0.3 \leq V_{IL} \leq 0.84$ $3.3 \geq V_{OH} \geq 2.2\text{V}$ $0 \leq V_{OL} \leq 0.7\text{V}$
7	Boot / GPIO3 (*Note13,12)	I/O	HA:Boot HS:GPIO3	TTL: $2 \leq V_{IH} \leq 3.15\text{V}$ $-0.3 \leq V_{IL} \leq 0.84$ $3.3 \geq V_{OH} \geq 2.2\text{V}$ $0 \leq V_{OL} \leq 0.7\text{V}$
8	NC/GPIO7 (*Note12)	I/O	HA:NC HS:GPIO7	TTL: $2 \leq V_{IH} \leq 3.15\text{V}$ $-0.3 \leq V_{IL} \leq 0.84$ $3.3 \geq V_{OH} \geq 2.2\text{V}$ $0 \leq V_{OL} \leq 0.7\text{V}$
9	NC/GPIO5 (*Note12)	I/O	HA:NC HS:GPIO5	TTL: $2 \leq V_{IH} \leq 3.15\text{V}$ $-0.3 \leq V_{IL} \leq 0.84$ $3.3 \geq V_{OH} \geq 2.2\text{V}$ $0 \leq V_{OL} \leq 0.7\text{V}$
10	GND (*Note4)	G	Ground	
11	TXA (*Note8)	O	NMEA Output 9600bps, 8 data bits, no parity, 1 stop bit	TTL: $3.6 \geq V_{OH} \geq 2.9\text{V}$ $0 \leq V_{OL} \leq 0.1\text{V}$
12	RXA (*Note6)	I	Serial Data Input A	TTL : $2.4\text{V} \leq V_{IH} \leq 3.6\text{V}$ $0 \leq V_{IL} \leq 0.9\text{V}$
13	GND/GPIO10 (*Note4,12)	G	HA:Ground HS:GPIO10	TTL: $2 \leq V_{IH} \leq 3.15\text{V}$ $-0.3 \leq V_{IL} \leq 0.84$ $3.3 \geq V_{OH} \geq 2.2\text{V}$ $0 \leq V_{OL} \leq 0.7\text{V}$
14	TXB (*Note9)	O	Serial Data Output B	TTL: $3.6 \geq V_{OH} \geq 2.9\text{V}$

				$0V \leq V_{OL} \leq 0.1V$
15	RXB (*Note7)	I	RTCM 104 differential GPS input.	TTL : $2.4V \leq V_{IH} \leq 3.6V$ $0V \leq V_{IL} \leq 0.9V$
16	GND/GPIO6 (*Note4,12)	I/O	HA:GROUND HS:GPIO6	TTL: $2 \leq V_{IH} \leq 3.15V$ $-0.3 \leq V_{IL} \leq 0.84$ $3.3 \geq V_{OH} \geq 2.2V$ $0 \leq V_{OL} \leq 0.7V$
17	BOOT/NC (*Note13)	I	HA : NC HS : BOOT	TTL: $2 \leq V_{IH} \leq 3.15V$ $-0.3 \leq V_{IL} \leq 0.84$ $3.3 \geq V_{OH} \geq 2.2V$ $0 \leq V_{OL} \leq 0.7V$
18	GND (*Note4)	G	Ground	
19	TIMEMARK (*Note10)	O	1PPS Time Mark Output.	TTL: $3.6 \geq V_{OH} \geq 2.9V$ $0V \leq V_{OL} \leq 0.1V$
20	NC	-	NC	

Notes: HA version: non GPIO, HS version: with GPIO

2.3 Connector number : U203 (JTAG Connector)

Pin NO	Signal Name	I/O	Description	Characteristics
1	VDD	O	DC+2.85V \pm 5%	DC+2.85V \pm 5%
2	GND	G	Ground	
3	NICERST	O	Low level sensitive reset to initialize the system and ARM7TDMI to known states	$V_{OH} \geq 2.4V$ $V_{OL} \leq 0.4V$
4	GND	G	Ground	
5	JTDI	I/O	JTAG Interface	$VDD+0.3V \geq V_{IH} \geq 0.7V \cdot VDD$, $-0.3 \leq V_{IL} \leq 0.3V \cdot VDD$ $V_{OH} \geq 0.75 \cdot VDD$ $V_{OL} \leq 0.25 \cdot VDD$
6	GND	G	Ground	
7	JTMS	I/O	JTAG interface	$VDD+0.3V \geq V_{IH} \geq 0.7V \cdot VDD$, $-0.3 \leq V_{IL} \leq 0.3V \cdot VDD$ $V_{OH} \geq 0.75 \cdot VDD$ $V_{OL} \leq 0.25 \cdot VDD$
8	GND	G	Ground	
9	JTCK	I/O	JTAG interface	$VDD+0.3V \geq V_{IH} \geq 0.7V \cdot VDD$, $-0.3 \leq V_{IL} \leq 0.3V \cdot VDD$ $V_{OH} \geq 0.75 \cdot VDD$ $V_{OL} \leq 0.25 \cdot VDD$
10	GND	G	Ground	
11	JTDO	I/O	JTAG interface	$VDD+0.3V \geq V_{IH} \geq 0.7V \cdot VDD$, $-0.3 \leq V_{IL} \leq 0.3V \cdot VDD$ $V_{OH} \geq 0.75 \cdot VDD$ $V_{OL} \leq 0.25 \cdot VDD$
12	NC	-	NC	
13	VCC3	O	DC+2.85V \pm 5%	DC+2.85V \pm 5%
14	GND	G	Ground	

VCC_5V (+5V DC Power Input)

This is the main DC power supply for a +5V powered.

VCC_3V (+3.3V DC Power Input)

This is the main DC supply for a +3.3V powered.

ANT_PWR

DC voltage for an active antenna is not required for operation with a passive antenna. The antenna power may be supplied through the interface connector (CON1).

GND provides the ground for the Engine board. Connect all grounds.

The Engine supports two full duplex serial channels. All four connections are at TTL levels or RS-232 levels supporting variable baud rates, and can

be controlled from the appropriate screens in SIRFdemo

RXA

This is the main receiver channel and is used to receive software commands to the Engine board from SIRFdemo software or from user written software.

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

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

For user's application (not currently used).

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

Backup battery (VBAT)

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 Engine 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 2.6 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.

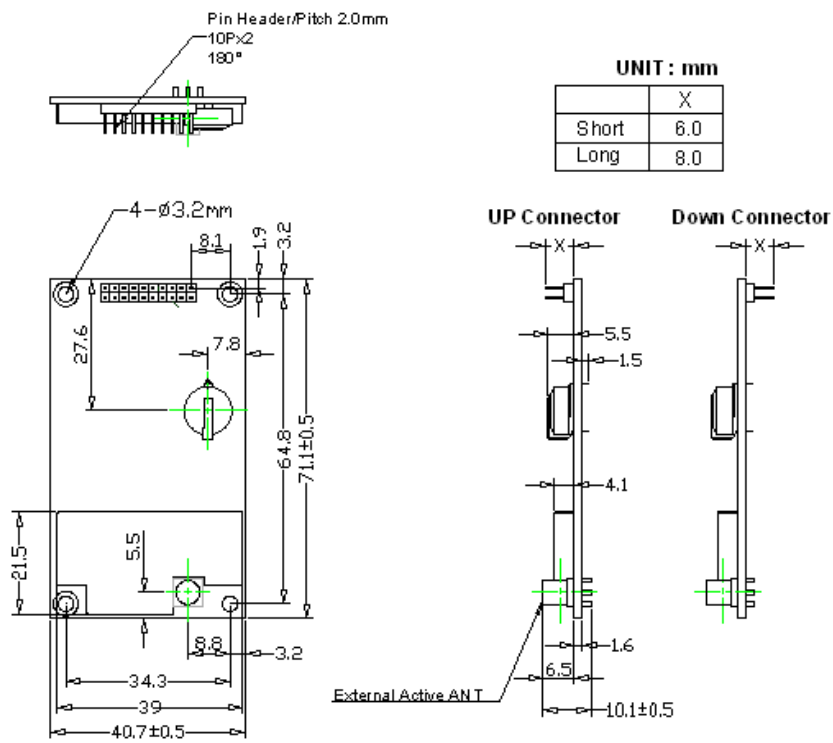
Note that even though all other components are rated at -40 to +85 deg C, a typical super cap is specified over a temperature range of -25 to +70 deg C and a typical rechargeable Lithium battery is over -20 to +60 deg C.

Several I/Os of STAR-II are connected to the digital interface connector for custom applications.

Notes:

- For 3.3V design, +3.3V at pin 4 is required and pin2 (5V) is unused.
- For 5V design, +4.5 to 5.5V at pin 2 is required and pin 4 (3.3V) is unused.
- Used this pin to start the execution of the resident Boot Loader code. To upload new firmware, tie this pin high and cycle the power.

3 Mechanical Layout.



4 Active antenna

4.1 GSP Antenna

Characteristics	Specification
Center frequency	1575.42 ± 1.023MHz
Bandwidth	2MHz Min
Gain at Zenith	2.0 dBi Min.
Gain at 10° elevation	4.0 dBi Min
Polarization	R.H.C.P
Axial Ratio	4.0dB Max

4.2 5V Filter/LNA

Characteristics	Specification
Center frequency (fo)	1575.42 ± 1.023MHz
Gain	28dB Min.
Noise Figure	2.0dB Max.
Out band attenuation	2dB Min. fo ± 20MHz 12dB Min. fo ± 50MHz 22dB Min. fo ± 100MHz
Output V.S.W.R.	2.0 dB max.
Voltage	5.0 ± 0.5V
Current	12mA Max.

4.3 3.3V Filter/LNA

Characteristics	Specification
Center frequency (fo)	1575.42 ± 1.023MHz
Gain	26dB Min.
Noise Figure	2.0dB Max.
Out band attenuation	2dB Min. fo ± 20MHz 12dB Min. fo ± 50MHz 22dB Min. fo ± 100MHz
Output V.S.W.R.	2.0 dB max.
Voltage	3.3 ± 0.3V
Current	12mA Max.

4.4 Absolute maximum ratings

Parameter	Symbol	Unit	Min. Value	Max. Value
Supply voltage	VCC_5	V	-0.3	6
RTC power	VBAT	V	-0.3	3.6

5 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 Messages¹	2		Range 1 to 3
Messages Number¹	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

¹Depending 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 ground	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

6 Contact Information Section

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