

GPS Module

Datasheet

Name: Ultra High Sensitivity and Low Power GPS Receiver Module

Model No.: SKG16B

Revision: V2.02

Revision History:

Revision	Description	Approved	Date
V1.01	Initial Release	George	20120728
V2.01	Update office's address	George	20131120
V2.02	Update certification information	George	20170831

General Description

The SKG16B is a complete GPS engine module that features super sensitivity, ultra low power and small form factor. The GPS signal is applied to the antenna input of module, and a complete serial data message with position, velocity and time information is presented at the serial interface with NMEA protocol or custom protocol.

It is based on the high performance features of the MediaTek MT3337 single-chip architecture, Its -162Bm tracking sensitivity extends positioning coverage into place like urban canyons and dense foliage environment where the GPS was not possible before. The small form factor and low power consumption make the module easy to integrate into portable device like PNDs, mobile phones, cameras and vehicle navigation systems.

Applications

- LBS (Location Based Service)
- PND (Portable Navigation Device)
- Vehicle navigation system
- Mobile phone



Figure 1: SKG16B Top View

Features

- Ultra high sensitivity: -162dBm
- Extremely fast TTFF at low signal level
- Built-in 12 multi-tone active interference canceller
- Ultra low power consumption
- NMEA Output: GGA,GSA,GSV,RMC
- $\pm 10\text{ns}$ high accuracy time pulse (1PPS)
- Advanced Features: AlwaysLocate; AIC
- QZSS、SBAS (WAAS, EGNOS, MSAS, GAGAN)
- UART interface: 4800/9600/38400/115200 bps
- Small form factor: $15.9 \times 13.1 \times 2.2\text{mm}$
- RoHS compliance (Lead-free)
- FCC,CE compliance

Pin Assignment

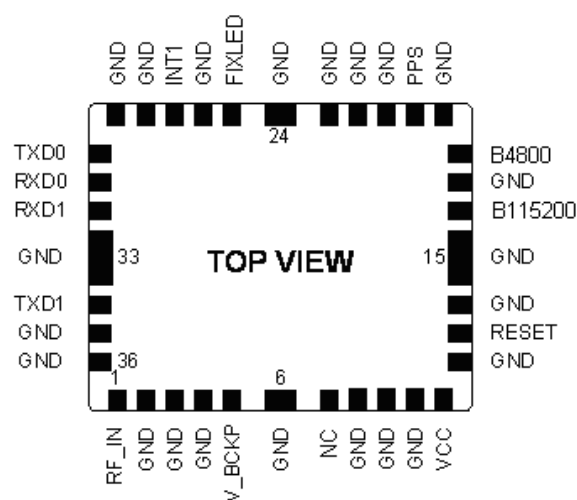


Figure 2: SKG16B Pin Package

Pin Description

Pin No.	Pin name	I/O	Description	Remark
1	RF_IN	I	Antenna Input	50 Ω @1575.42MHz
2	GND	G	Ground	
3	GND	G	Ground	
4	GND	G	Ground	
5	V_BCKP	I	RTC and backup SRAM power (2.0-4.2V)	May be connect to Battery
6	GND	G	Ground	
7	NC			
8	GND	G	Ground	
9	GND	G	Ground	
10	GND	G	Ground	
11	VCC	P	Module Power Supply	Operating range: 3.0V to 4.2V
12	GND	G	Ground	
13	RESET	I	Module Reset (Active Low Status)	Leave open if not used
14	GND	G	Ground	
15	GND	G	Ground	
16	B115200	I/O	Baudrate set to 115200	Leave Open in not used
17	GND	G	Ground	
18	B4800	I/O	Baudrate set to 4800	Leave Open in not used
19	GND	G	Ground	
20	PPS	O	Time pulse Signal (100ms)	Leave Open in not used
21	GND	G	Ground	
22	GND	G	Ground	
23	GND	G	Ground	
24	GND	G	Ground	
25	FIXLED	I/O	Fixed LED Output	Leave Open in not used
26	GND	G	Ground	
27	INT1	I	Wakeup signal input from such a G sensor	Leave Open in not used
28	GND	G	Ground	
29	GND	G	Ground	
30	TXD0	O	UART Serial Data Output 0	Leave Open in not used
31	RXD0	I	UART Serial Data Input 0	Leave Open in not used
32	RXD1	O	UART Serial Data Output 1	Not Open
33	GND	G	Ground	
34	TXD1	I	UART Serial Data Input 1	Not Open
35	GND	G	Ground	
36	GND	G	Ground	

Interfaces Configuration

Power Supply

Regulated power for the SKG16B is required. The input voltage Vcc should be 3.0V to 4.2V range, current is no less than 100mA. Suitable decoupling must be provided by external decoupling circuitry (10uF and 1uF). It can reduce the Noise from power supply and increase power stability.

Main power supply Vcc current varies according to the processor load and satellite acquisition. Maximum Vcc peak current is about 30 mA during acquisition.

Backup Battery Power

In case of a power failure on pin Vcc, real-time clock and backup RAM are supplied through pin V_BCKP. This enables the SKG16B GPS Receiver to recover from power failure with either a hot start or a warm start (depending on the duration of Vcc outage). If no Backup Battery is connected, the receiver performs a cold start upon powered up.

Backup Battery Power V_BCKP draws typically 7 uA current in backup state.

RESET

The SKG16B modules include a RESET pin. Driving RESET low activates a hardware reset of the system. RESET is only an input and will not reset external circuitry. At power down the reset is forced when the Vcc drops below 2.7V.

NOTE

If not used, leave RESET not connected (floating).

Antenna

The SKG16B GPS receiver is designed for supporting the active antenna or passive antenna connected with pin RF_IN. The gain of active antenna should be no more than 25dB (18~20dB Typical). The maximum noise figure should be no more than 1.5dB and output impedance is at 50 Ohm.

NOTE

With passive antenna keep the cable loss at minimum(<1dB).

FIXLED

The default FIXLED function is valid fix indicator output. Without a valid fix the signal is at low state; during valid fix condition the signal outputs 50ms pulses every seconds

UART Ports

There are several function in SKG16B related to UATR communication, such as UART data transmission/receive and NMEA sentences input/output. In general, UART0 is as NMEA output and PMTK command input, UAR1 as RTCM input. The bit rates are selectable from 4800,9600,38400,115200 bps (see table).

Baud rate	Pin18:B4800	Pin16:B115200
9600bps	NC	NC
4800bps	10K pull-down	NC
115200bps	NC	10K pull-down
38400bps	10K pull-down	10K pull-down

RF_IN

The transmission line must to be control impedance from RF_IN pin to the antenna or antenna connector of your

choice. (Impedance 50Ω)

PPS

A pulse per second (1 PPS) is an electrical signal that very precisely indicates the start of a second. Depending on the source, properly operating PPS signals have an accuracy ranging 10ns. The PPS signals are used for precise timekeeping and time measurement.

EINT1

The default EINT1 function is Standby mode control but the function is not supported; leave signal floating (not connected).

Advanced Software Features

AlwaysLocate™

AlwaysLocate™ is an intelligent controller of periodic mode. Depending on the environment and motion conditions, GPS module can adaptively adjust working/standby time to achieve balance of positioning accuracy and power consumption. In this mode, the host CPU does not need to control GPS module until the host CPU needs the GPS position data. The following flow chart is an example to make GPS module go into AlwaysLocate™ mode and then back to normal operation mode.

Embedded Logger function

The Embedded Logger function don't need host CPU (MCU) and external flash to handle the operation , GPS Engine will use internal flash (embedded in GPS chipset) to log the GPS data (Data format : UTC, Latitude , longitude, Valid ,Checksum), the max log days can up to 2 days under AlwaysLocate™ condition .

AIC_Multi-tone active interference canceller

Because different application (Wi-Fi , GSM/GPRS,3G/4G,Bluetooth)are integrated into navigation system , the harmonic of RF signal will influence the GPS reception , The multi- tone active-interference canceller can reject external RF interference which come from other active components on the main board , to improve the capacity of GPS reception without any needed HW change in the design .SKG16B can cancel up to 12 independent channel interference continuous wave.

Performance Specification

Parameter	Specification	
Receiver Type	L1 frequency band, C/A code, 22 Tracking / 66 Acquisition-Channel	
Sensitivity	Tracking	-162dBm Typical
	Acquisition	-145dBm Typical
Accuracy	Position	3.0m CEP50 without SA(Typical Open Sky)
	Velocity	0.1m/s without SA
	Timing (PPS)	10ns RMS
Acquisition Time	Cold Start	23s(Typical Open Sky)

	Warm Start	23s
	Hot Start	1s
	Re-Acquisition	<1s
Power Consumption	Tracking	16mA @3.3V Typical
	Acquisition	21mA @3.3V
Navigation Data Update Rate	Max 10Hz	Default 1Hz
Operational Limits	Altitude	Max 18,000m
	Velocity	Max 515m/s
	Acceleration	Less than 4g

Electrical Characteristics

Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	VCC	-0.3	4.3	V
Input Pins				
Input voltage on any input connection	VIO	-0.3	3.6	V
Backup Battery	V_BCKP	-0.3	4.3	V
RF input power	RF_IN		10	dBm
Human Body Model ESD capability	RF_IN		2000	V
Machine Model ESD capability	RF_IN		100	V
Environment				
Storage Temperature	Tstg	-40	125	°C
Peak Reflow Soldering Temperature <10s	Tpeak		260	°C
Humidity			95	%

Note: Absolute maximum ratings are stress ratings only, and functional operation at the maxims is not guaranteed. Stress beyond the limits specified in this table may affect device reliability or cause permanent damage to the device. For functional operating conditions, refer to the operating conditions tables as follow.

The SKG16B module is Electrostatic Sensitive Device (ESD) and may be damaged with ESD or spike voltage. Although it has built-in ESD protection circuitry at digital I/O, please handle with care to avoid permanent malfunction or performance degradation. Note that RFIN has no ESD protection circuits.

Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		3	3.3	4.2	V
Backup Battery	V_BCKP		2	3.3	4.2	V
Power supply voltage ripple	Vcc_PP	Vcc=3.3V			30	mV

Supply current, navigation	I _{cc}	V _{cc} =3.3V		16	21	mA
Supply current, backup state	I _{bkp}	V _{cc} =3.3V		7		uA
VCC_OUT Antenna bias supply	VCC_OUT	I _{ANT} = 18 mA		3		V
Input high voltage	V _{IH}		2		3.6	V
Input low voltage	V _{IL}		-0.3		0.8	V
Output high voltage	V _{OH}		2.4		3.1	V
Output low voltage	V _{OL}		-0.3		0.4	V
Operating temperature	T _{opr}		-40		85	°C

Mechanical Specification

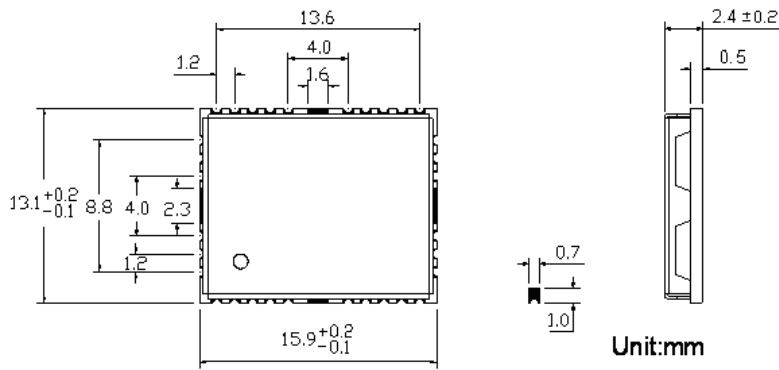


Figure 3: SKG16B Dimensions

Recommend Layout

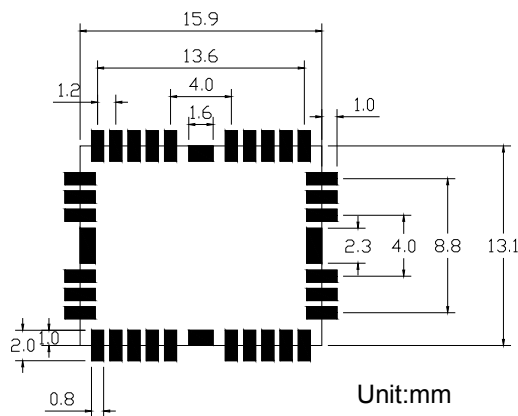


Figure 4: SKG16B Footprint

Reference design schematic

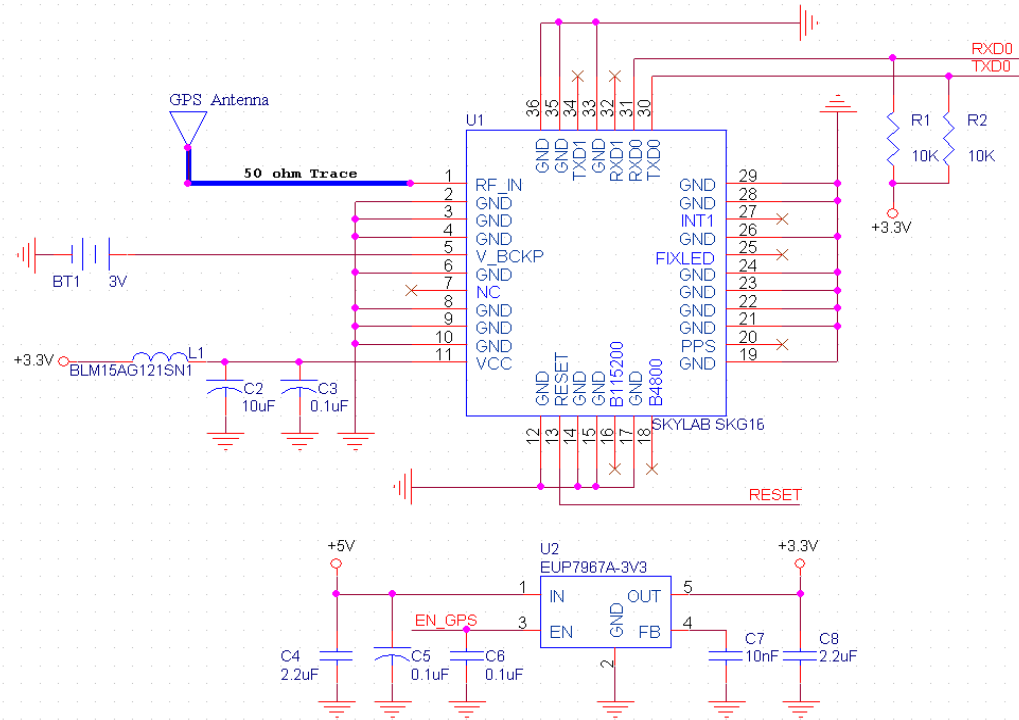


Figure 5: SKG16B application circuit

Packaging Specification

SKG16B modules are shipped in reel and with 1000 units per reel. Each tray is 'dry' package.

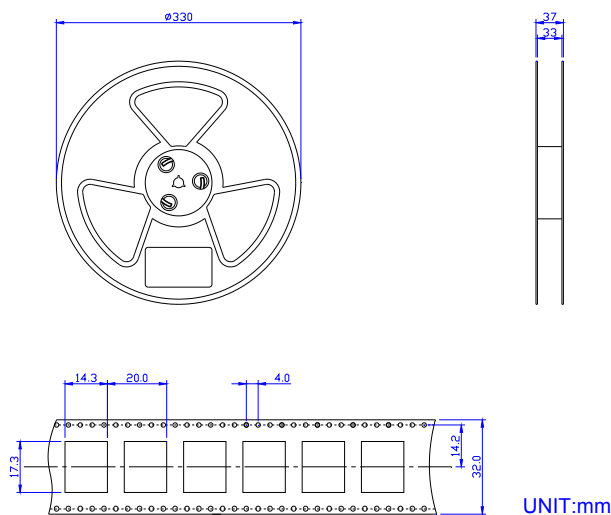


Figure 6: SKG16B Packaging

Manufacturing Process Recommendations

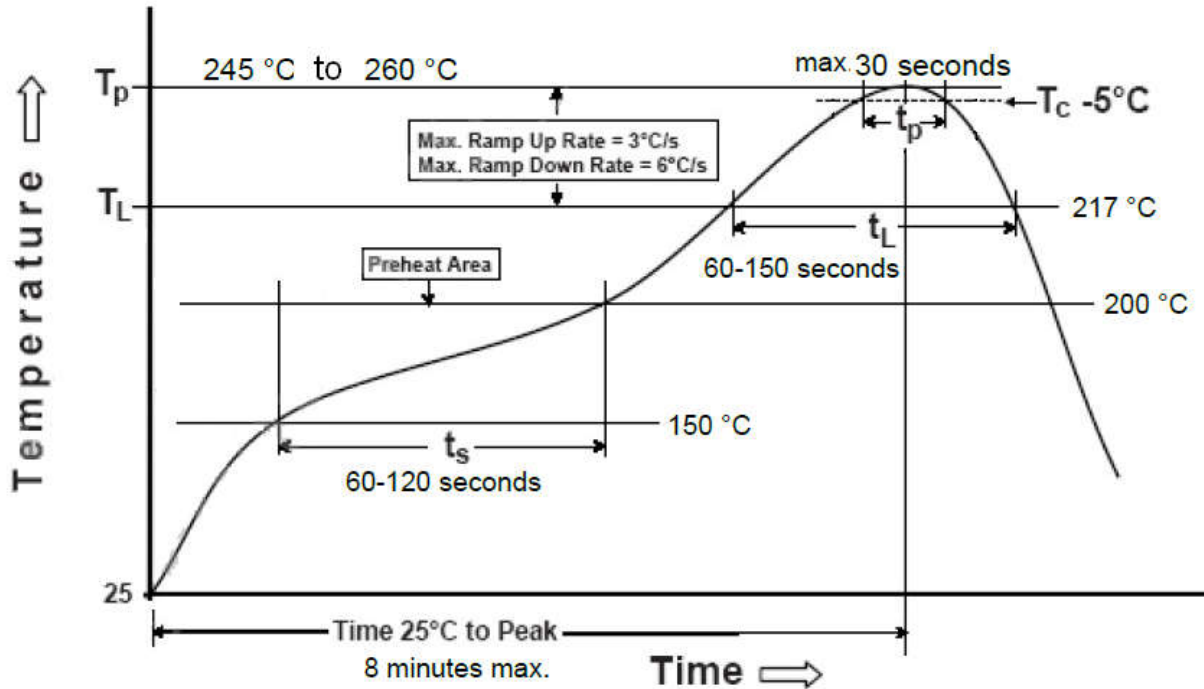


Figure 7: SKG16B Typical Leadfree Soldering Profile

Note: The final soldering temperature chosen at the factory depends on additional external factors like choice of soldering paste, size, thickness and properties of the baseboard, etc. Exceeding the maximum soldering temperature in the recommended soldering profile may permanently damage the module.

Software Protocol

NMEA 0183 Protocol

The NMEA protocol is an ASCII-based protocol, Records start with a \$ and with carriage return/line feed. GPS specific messages all start with \$GPxxx where xxx is a three-letter identifier of the message data that follows. NMEA messages have a checksum, which allows detection of corrupted data transfers.

The Skylab SKG16B supports the following NMEA-0183 messages: GGA, GSA, GSV, RMC. The module default NMEA-0183 output is set up GGA, GSA, RMC, GSV, and default baud rate is set up 9600bps.

Table 1: NMEA-0183 Output Messages

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

GGA-Global Positioning System Fixed Data

This sentence contains the position, time and quality of the navigation fix.

See RMC for Fix Status, Fix Mode, Fix Date, Speed, and True Course.

See GSA for Fix Type, PDOP, and VDOP.

\$GPGGA,021514.000,2232.1799,N,11401.1823,E,1,6,1.25,84.0,M,-2.2,M,,*74

Table 2: GGA Data Format

Name	Example	Units	Description
Message ID	\$GPGGA		GGA protocol header
UTC Position	021514.000		hhmmss.sss
Latitude	2232.1799		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	11401.1823		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 2-1
Satellites Used	6		Range 0 to 12
HDOP	1.25		Horizontal Dilution of Precision
MSL Altitude	84.0	meters	Altitude (referenced to the Ellipsoid)
AltUnit	M	meters	Altitude Unit
GeoSep	-2.2	meters	Geoidal Separation
GeoSepUnit	M	meters	Geoidal Separation Unit
Age of Diff.Corr.	<Null>	second	Null fields when it is not Used
Diff.Ref.Station ID	<Null>		Null fields when it is not Used
Checksum	*74		
EOL	<CR> <LF>		End of message termination

Table 2-1: 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	GPS PPS Mode, fix valid

GSA-GNSS DOP and Active Satellites

This sentence contains the mode of operation, type of fix, PRNs of the satellites used in the solution as well as PDOP, HDOP and VDOP.

\$GPGSA,A,3,26,05,18,15,27,29,,,,,,,,,1.52,1.25,0.87*0F

Table 3: GSA Data Format

Name	Example	Units	Description
Message	\$GPGSA		GSA protocol header

Mode 1	A		See Table 3-2
Mode 2	3		See Table 3-1
ID of satellite used	26		Sv on Channel 1
ID of satellite used	05		Sv on Channel 2
...
ID of satellite used	<Null>		Sv on Channel 12 (Null fields when it is not Used)
PDOP	1.52		Position Dilution of Precision
HDOP	1.25		Horizontal Dilution of Precision
VDOP	0.87		Vertical Dilution of Precision
Checksum	*0F		
EOL	<CR> <LF>		End of message termination

Table 3-1: Mode 2

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

Table 3-2: Mode 1

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

This sentence contains the PRNs, azimuth, elevation, and signal strength of all satellites in view.

\$GPGSV,3,1,12,15,79,333,42,42,50,127,,29,45,263,44,02,36,124,30*7E

\$GPGSV,3,2,12,26,36,226,34,05,35,046,22,27,33,161,29,21,16,319,*7D

\$GPGSV,3,3,12,10,15,066,31,18,14,285,45,24,12,319,15,08,09,047,18*7E

Table 4: GSV Data Format

Name	Example	Units	Description
Message ID	\$GPGSV		GSV protocol header
Number of Message	3		Total number of GSV sentences (Range 1 to 3)
Message Number	1		Sentence number of the total (Range 1 to 3)
Satellites in View	12		Number of satellites in view
Satellite ID	15		Channel 1(Range 01 to 32)
Elevation	79	degrees	Channel 1(Range 00 to 90)
Azinmuth	333	degrees	Channel 1(Range 000 to 359)
SNR(C/NO)	42	dB-Hz	Channel 1(Range 00 to 99, null when not tracking)
...			...
Satellite ID	02		Channel 4(Range 01 to 32)
Elevation	36	degrees	Channel 4(Range 00 to 90)

Azimuth	124	degrees	Channel 4(Range 000 to 359)
SNR(C/NO)	30	dB-Hz	Channel 4(Range 00 to 99, null when not tracking)
Checksum	*7E		
EOL	<CR> <LF>		End of message termination

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

RMC-Recommended Minimum Specific GNSS Data

This sentence contains the recommended minimum fix information.

See GGA for Fix Quality, Sats Used, HDOP, Altitude, Geoidal Separation, and DGPS data.

See GSA for Fix Type, PDOP and VDOP.

\$GPRMC,023345.000,A,2232.1767,N,11401.1953,E,0.18,151.55,100410,,,A*6B

Table 5: RMC Data Format

Name	Example	Units	Description
Message ID	\$GPRMC		RMC protocol header
UTS Position	023345.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2232.1767		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11401.1953		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.18	Knots	
Course Over Ground	151.55	Degrees	True Course
Date(UTC)	100410		ddmmyy
Magnetic variation	<Null>	Degrees	Null fields when it is not Used
Magnetic Variation Direction	<Null>		E=east or W=west (Null fields when it is not Used)
Fix Mode	A		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*6B		
EOL	<CR> <LF>		End of message termination

NMEA CMD List

Table 6: NMEA CMD List

NMEA CMD TYPE	NMEA CMD Example:
Hot Restart	\$PMTK101*32<CR><LF>
Warm Restart	\$PMTK102*31<CR><LF>
Cold Restart	\$PMTK103*30<CR><LF>
Full Cold Restart	\$PMTK104*37<CR><LF>
port baudrate	\$PMTK251,38400*27<CR><LF>

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