NMEA reference manual

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1. NMEA output messages

The table below lists each of the NMEA output messages specifically developed and defined by SiRF for use within SiRF products.

Option	Description
GGA	Time, position and fix type data
GLL	Latitude, longitude, UTC time of position fix and status
GSA	GPS receiver operating mode, satellites used in the position solution, and DOP values
GSV	The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values
MSS	Signal-to-noise ratio, signal strength, frequency, and bit rate from a radio-beacon receiver
RMC	Time, date, position, course and speed data
VTG	Course and speed information relative to the ground
ZDA	ZDAPPS timing message (synchronized to PPS)
150	OK to send message

Table 1-1: NMEA output messages

A full description of the listed NMEA messages are provided in the following sections. Table 1-2 provides a summary of SiRF NMEA output messages supported by the specific SiRF platforms.

Message ID	SiRF software options		
	GSW2	SiRFDRive	SiRFXTrac
GGA	✓	✓	✓
GLL	✓	✓	✓
GSA	✓	✓	✓
GSV	✓	✓	✓
MSS	✓	X	X
RMC	✓	✓	✓
VTG	✓	✓	✓
ZTA	✓	X	X
150	✓	X	X

Table 1-2: Supported NMEA output messages

All software options output NMEA version 2.20.

GGA —Global Positioning System Fixed Data

This message contains time, position and fix related data. GGA Data Format contains the values for the following example:

$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M,1.0,M,0.0,0000*18

Name	Field type	Example	Units	Description
Message ID	string	$GPGGA		GGA protocol header
UTC Time	hhmmss.sss	161229.487		current time
Latitude	dddmm.mmmm	3723.2475		degrees + minutes
N/S Indicator	character	N		N=north or S=south
Longitude	dddmm.mmmm	12158.3416		degrees + minutes
E/W Indicator	character	W		E=east or W=west
Position Fix Quality Indicator	digit	1		see Position Fix Quality Indicator (table 1-4)
Satellites Used	numeric	07		range 0 to 12
HDOP	numeric	1.0		Horizontal Dilution of Precision
MSL Altitude	numeric	9.0	metres	
Units	character	M		stands for 'metres'
Geoid Separation	numeric	1.0	metres	
Units	character	M		stands for 'metres'
Age of Differential Corrections	numeric	0.0	seconds	null fields when DGPS is not used
Differential Reference Station ID	numeric	0000		
Checksum	hexadecimal	*18		
<CR><LF>				end of message termination

Table 1-3: GGA data format

Name	Description
0	fix not available or invalid
1	GPS SPS mode, fix valid
2	Differential GPS, SPS mode, fix valid

Table 1-4: GGA position fix quality indicator

Note: A valid position fix quality indicator is derived from the SiRF Binary M.I.D. 2 position mode 1. Refer to the SiRF Binary Protocol Reference manual.

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GLL—Geographic Position - Latitude/Longitude

This message contains the latitude and longitude of the present position, the time of position, the fix and the status. GLL Data Format contains the values for the following example:

$GPGLL,3723.2475,N,12158.3416,W,161229.487,A,A*41

Name	Field type	Example	Description
Message ID	string	$GPGLL	GLL protocol header
Latitude	dddmm. mmmm	3723.2475	degrees + minutes
N/S indicator	character	N	N=north or S=south
Longitude	dddmm. mmmm	12158.3416	degrees + minutes
E/W indicator	character	W	E=east or W=west
UTC time	hhmmss.sss	161229.487	current time
Status†	character	A	A=data valid or V=data not valid
Checksum	hexadecimal	*41	
<CR><LF>			end of message termination

†A data valid status should not be confused with a valid position fix quality indicator.

Table 1-5: GLL data format

GSA—GNSS DOP and Active Satellites

This message contains the receiver's operating mode, satellites used for navigation,and DOP values. GSA Data Format contains the values for the following example:

$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33

Name	Field type	Example	Description
Message ID	string	$GPGSA	GSA protocol header
Mode 1	character	A	see Mode 1 (table 1-7)
Mode 2	digit	3	see Mode 2 (table 1-8)
Satellite Used†	numeric	07	Sv on Channel 1
Satellite Used†	numeric	02	Sv on Channel 2
....			....
Satellite Used†	numeric		Sv on Channel 12
PDOP	numeric	1.8	Position Dilution of Precision
HDOP	numeric	1.0	Horizontal Dilution of Precision
VDOP	numeric	1.5	Vertical Dilution of Precision
Checksum	hexadecimal	*33	
<CR> <LF>			end of message termination
†*Satellite used in solution*			

Table 1-6: GSA data format

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

Table 1-7: Mode 1 GSA data format

Value	Description
1	fix not available
2	2D (<4 SVs used)
3	3D (>3 SVs used)

Table 1-8: Mode 2 GSA data format

GSV—GNSS Satellites in View

This message contains the number of satellites in view, PRN numbers, elevation, azimuth and Signal-to-Noise Ratio (SNR) values. Each transmission identifies up to four satellites; additional satellite data is sent in a second or third message. The total number of messages being transmitted and the number of the message being transmitted is indicated in the first two fields.

GSV Data Format contains the values for 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

Name	Field type	Example	Units	Description
Message ID	string	$GPGSV		GSV protocol header
Number of Messages†	digit	2		range 1 to 3
Message Number	digit	1		range 1 to 3
Satellites in View	numeric	07		
Satellite ID	numeric	07		Channel 1 (Range 1 to 32)
Elevation	numeric	79	degrees	Channel 1 (Maximum 90)
Azimuth	numeric	048	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	numeric	42	dBHz	Range 0 to 99, null when not tracking
....				....
Satellite ID	numeric	27		Channel 4 (Range 1 to 32)
Elevation	numeric	27	degrees	Channel 4 (Maximum 90)
Azimuth	numeric	138	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	numeric	42	dBHz	Range 0 to 99, null when not tracking
Checksum	hexadecimal	*71		
<CR> <LF>				end of message termination
†Depending on the number of satellites tracked, multiple messages of GSV data may be required				

Table 1-9: GSV data format

MSS—MSK Receiver Signal

MSS Data Format contains the values for the following example:

$GPMSS,55,27,318.0,100,1,*57

Name	Field type	Example	Units	Description
Message ID	string	$GPMSS		MSS protocol header
Signal Strength	numeric	55		SS of tracked frequency
Signal-to-Noise Ratio	numeric	27	dB	SNR of tracked frequency
Beacon Frequency	numeric	318.0	dB	currently tracked frequency
Beacon Bit Rate	numeric	100	kHz	bits per second
Checksum	hexadecimal	*57		
<CR> <LF>				end of message termination

Table 1-10: MSS data format

The MSS NMEA message can only be polled or scheduled using the MSK NMEA input message. See MSK—MSK Receiver Interface.

RMC—Recommended Minimum Specific GNSS Data

This message contains time, date, position, course, and speed data. The fields in this message always contain data even when the receiver is not navigating. This allows user-initialised, stored or default values to be displayed before a solution is obtained.

RMC Data Format contains the values for the following example:

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.130,309.62,120598,23.1,E*10

Name	Field type	Example	Units	Description
Message ID	string	$GPRMC		RMC protocol header
UTC Time	hhmmss.sss	161229.487		current time
Status[†]	character	A		A=data valid or V=data not valid
Latitude	ddmm.mmmm	3723.2475		degrees + minutes
N/S indicator	character	N		N=north or S=south
Longitude	ddmm.mmmm	12158.3416		degrees + minutes
E/W indicator	character	W		E=east or W=west
Speed over ground	numeric	0.130		
Course over ground	numeric	309.62		true
Date	ddmmyy	120598		current date
Magnetic variation	numeric	23.1	degrees	
E/W indicator	character	E		E=east or W=west
Checksum	hexadecimal	*10		
<CR> <LF>				end of message termination

[†]*A data valid status should not be confused with a valid position fix quality indicator.*

Table 1-11: RMC data format

VTG—Course Over Ground and Ground Speed

This message contains the course over ground (true and magnetic) and speed relative to the ground. VTG Data Format contains the values for the following example:

$GPVTG,309.62,T,286.52,M,0.13,N,0.20,K,A*23

Name	Field type	Example	Units	Description
Message ID	string	$GPVTG		RMC protocol header
Course	numeric	309.62	degrees	measured heading
Reference	character	T		true
Course	numeric	286.52	degrees	measured heading
Reference	character	M		magnetic
Speed	numeric	0.13	knots	measured horizontal speed
Units	character	N		knots
Speed	numeric	0.20	km/h	measured horizontal speed
Units	character	K		kilometres per hour
Checksum	hexadecimal	*23		
<CR> <LF>				end of message termination

Table 1-12: VTG data format

The precision of the speed and heading fields are always consistent, having a 2 decimal place precision. Please note that the NMEA standard allows these fields to be given out without digits after the decimal point.

ZDA—SiRF Timing Message

Outputs the time associated with the current 1 PPS pulse. Each message is output within a few hundred ms after the 1PPS pulse is output and tells the time of the pulse that just occurred.

ZDA Data Format contains the values for the following example:

$GPZDA,181813,14,10,2003,00,00*4F

Name	Field type	Example	Units	Description
Message ID	string	$GPZDA		ZDA protocol header
UTC time	hhmmss	181813		either using valid IONO/UTC or estimated from default leap seconds
Day	dd	14		01 TO 31
Month	mm	10		01 TO 12
Year	yy	2003		1980 to 2079
Local zone hour	numeric	00		Offset from UTC (set to 00)
Local zone minutes	numeric	00		Offset from UTC (set to 00)
Checksum	hexadecimal	*4F		
<CR> <LF>				end of message termination

Table 1-13: ZDA data format

150—OkToSend

This message is being sent out during the trickle power mode to communicate with an outside program such as SiRFDemo to indicate whether the receiver is awake or not.

OkToSend Message Data Format contains the values for the following example:

OkToSend – $PSRF150,1*3F

Name	Field type	Example	Units	Description
Message ID	string	$PSRF150		PSRF150 protocol header
OkToSend	numeric	1		1=OK to send, 0=not OK to send
ChecksumDay	hexadecimal	*3F		
<CR> <LF>		10		end of message termination

Table 1-14: OkToSend message data format

The not OkToSend message reads:

not OkToSend – $PSRF150,0*3E

2. NMEA input messages

NMEA input messages enable you to control the Evaluation Receiver while in NMEA protocol mode. The Evaluation Receiver may be put into NMEA mode by sending the SiRF binary protocol message ‘Switch to NMEA Protocol – Message I.D. 129’ (refer to the SiRF Binary Protocol Reference Manual). This can be done by using a user program or by using the SiRFDemo software and selecting ‘Switch to NMEA Protocol’ from the Action menu (refer to the Navman SiRFDemo and SiRFflash user guide). If the receiver is in SiRF binary mode, all NMEA input messages are ignored. Once the receiver is put into NMEA mode, the following messages may be used to command the module.

Transport Message

Start sequence	Payload	Checksum	End sequence
$PSRF<MID>[1]	Data[2]	*CKSUM[3]	<CR> <LF>[4]

[1] Message Identifier consisting of three numeric characters. Input messages begin at MID 100.

[2] Message specific data. Refer to a specific message section for <data>...<data> definition.

[3] CKSUM is a two-hex character checksum as defined in the NMEA specification, NMEA-0183 Standard For Interfacing Marine Electronic Devices.

[4] Each message is terminated using Carriage Return (CR) Line Feed (LF) which is \r\n which is hex 0D 0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited. Table 2-1 describes the NMEA input messages.

Message	MID*	Description
SetSerialPort	100	Set PORT A parameters and protocol
NavigationInitialization	101	Parameters required for start using X/Y/Z**
SetDGPSPort	102	Set PORT B parameters for DGPS input
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLANavigationInitialization	104	Parameters required for start using Lat/Lon/Alt**
Development Data On/Off	105	Development Data messages On/Off
Select Datum	106	Selection of datum to be used for coordinate transformations
MSK Receiver Interface	MSK	Command message to a MSK radio-beacon receiver
**Message Identification (MID)* ***Input coordinates must be WGS84*		

Table 2-1: NMEA input messages

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NMEA input messages 100 to 106 are SiRF proprietary NMEA messages. The MSK NMEA string is as defined by the NMEA 0183 standard.

Table 2-2 provides a summary of supported SiRF NMEA input messages by the specific SiRF platforms.

Message ID	SiRF software options		
	GSW2	SiRFDRive	SiRFXTrac
100	✓	✓	✓
101	✓	✓	X
102	✓	✓	X
103	✓	✓	✓
104	✓	✓	X
105	✓	✓	✓
106	✓	✓	✓
MSK	✓	✓	X

Table 2-2: Supported NMEA input messages

100—SetSerialPort

This command message is used to set the protocol (SiRF binary or NMEA) and/or the communication parameters (baud, data bits, stop bits, and parity). Generally, this command is used to switch the module back to SiRF binary protocol mode where a more extensive command message set is available. When a valid message is received, the parameters are stored in battery-backed SRAM and the Evaluation Receiver restarts using the saved parameters.

This message contains the input values for the following example:

Switch to SiRF binary protocol at 9600,8,N,1 – $PSRF100,0,9600,8,1,0*0C

Name	Field type	Example	Description
Message ID	string	$PSRF100	PSRF100 protocol header
Protocol	digit	0	0=SiRF binary†, 1=NMEA
Baud	numeric	9600	4800, 9600, 19200, 38400
Data Bits	digit	8	7, 8
Stop Bits	digit	1	0, 1
Parity	digit	0	0=None, 1=Odd, 2=Even
Checksum	hexadecimal	*0C	
<CR> <LF>			end of message termination
†SiRF protocol is only valid for 8 data bits, 1stop bit, and no parity.			

Table 2-3: Set serial port data format

101—NavigationInitialization

This command is used to initialize the Evaluation Receiver by providing current position (in X, Y, Z coordinates), clock offset, and time. This enables the Evaluation Receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the Evaluation Receiver to acquire signals quickly.

This message contains the input values for the following example:

Start using known position and time –

$PSRF101,-2686700,-304200,3851624,96000,497260,921,12,3*1C

Name	Field type	Example	Units	Description
Message ID	string	$PSRF101		PSRF101 protocol header
ECEF X	numeric	-2686700	metres	X coordinate position
ECEF Y	numeric	-304200	metres	Y coordinate position
ECEF Z	numeric	3851624	metres	Z coordinate position
Clk Offset	numeric	96000	Hz	clock offset of the evaluation receiver
Time Of Week	numeric	497260	seconds	GPS Time Of Week
WeekNo	numeric	921		GPS Week Number
Channel Count	numeric	12		Range 1 to 12
Reset Cfg	numeric	3		See Reset Configuration (table 2-5)
Checksum	hexadecimal	*1C		
<CR> <LF>				end of message termination

Table 2-4: Navigation initialization data format

No.	Description
1	Hot Start— All data valid
2	Warm Start—Ephemeris cleared
3	Warm Start (with Init)—Ephemeris cleared, initialization data loaded
4	Cold Start—Clears all data in memory
8	Clear Memory—Clears all data in memory and resets the receiver back to factory defaults

Table 2-5: Reset configuration

102—SetDGPSPort

This command is used to control the serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. If a DGPS receiver is used that has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters are stored in battery-backed SRAM and the receiver restarts using the saved parameters.

This message contains the input values for the following example:

Set DGPS Port to be 9600,8,N,1 – $PSRF102,9600,8,1,0*12

Name	Field type	Example	Description
Message ID	string	$PSRF102	PSRF102 protocol header
Baud	numeric	9600	4800, 9600, 19200, 38400
Data Bits	digit	8	7, 8
Stop Bits	digit	1	0, 1
Parity	digit	0	0=None, 1=Odd, 2=Even
Checksum	hexadecimal	*12	
<CR> <LF>			end of message termination

Table 2-6: Set DGPS port data format

103—Query/Rate Control

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. Using this command message, standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery-backed SRAM for each entry when the message is accepted.

This message contains the input values for the following example:

Query the GGA message with checksum enabled – $PSRF103,00,01,00,01*25

Name	Field type	Example	Units	Description
Message ID	string	$PSRF103		PSRF103 protocol header
Msg	numeric	00		See Messages (table 2-8)
Mode	numeric	01		0=SetRate, 1=Query
Rate	numeric	00	seconds	Output : off=0, max.=255
Cksum Enable	numeric	01		0=Disable Checksum, 1=Enable Checksum
Checksum	hexadecimal	*25		
<CR> <LF>				end of message termination

Table 2-7: Query/rate control data format

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG
6	MSS (if internal beacon is supported)
7	reserved
8	ZDA (if 1PPS output is supported)
9	reserved

Table 2-8: Messages

Enable VTG message for a 1 Hz constant output with checksum enabled – $PSRF103,05,00,01,01*20

Disable VTG message – $PSRF103,05,00,00,01*21

In TricklePower mode, update rate is specified by the user. When switching to NMEA protocol, the message update rate is also required. The resulting update rate is the product of the TricklePower Update rate and the NMEA update rate (i.e. TricklePower update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 x 5 = 10)).

104—LLANavigationInitialization

This command is used to initialize the Evaluation Receiver by providing current position (in latitude, longitude, and altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to acquire signals quickly.

This message contains the input values for the following example:

Start using known position and time –

$PSRF104,37.3875111,-121.97232,0,96000,237759,1946,12,1*07

Name	Field type	Example	Units	Description
Message ID	string	$PSRF104		PSRF104 protocol header
Lat	numeric	37.3875111	degrees	Latitude position (Range 90 to -90)
Long	numeric	-121.97232	degrees	Longitude position (Range 180 to -180)
Alt	numeric	0	metres	Altitude position
Clk Offset	numeric	96000	Hz	Clock Offset of the Evaluation Receiver†
Time Of Week	numeric	237759	seconds	GPS Time Of Week
Week No	numeric	1946		Extended GPS Week Number (1024 added)
Channel Count	numeric	12		Range 1 to 12
Reset Cfg	numeric	1		See Reset Configuration (table 2-10)
Checksum	hexadecimal	*07		
<CR> <LF>				end of message termination
†*Use 0 for last saved value if available. If this is unavailable, a default value of 96000 is used.*				

Table 2-9: LLA navigation initialization data format

Hex	Description
1	Hot Start— All data valid
2	Warm Start—Ephemeris cleared
3	Warm Start (with Init)—Ephemeris cleared, initialization data loaded
4	Cold Start—Clears all data in memory
8	Clear Memory—Clears all data in memory and resets receiver back to factory defaults

Table 2-10: Reset configuration

105—Development Data On/Off

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables the user to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.

This message contains the input values for the following example:

Debug On – $PSRF105,1*3E

Name	Field type	Example	Description
Message ID	string	$PSRF105	PSRF105 protocol header
Debug	digit	1	0=Off, 1=On
Checksum	hexadecimal	*3E	
<CR> <LF>			end of message termination

Table 2-11: Development data on/off data format

Debug Off – $PSRF105,0*3F

106—Select Datum

GPS receivers perform initial position and velocity calculations using an earth-centered earth-fixed (ECEF) coordinate system. Results may be converted to an earth model (geoid) defined by the selected datum. The default datum is WGS 84 (World Geodetic System 1984) which provides a worldwide common grid system that may be translated into local coordinate systems or map datums. (Local map datums are a best fit to the local shape of the earth and not valid worldwide.)

This Message contains the input values for the following examples:

Datum select TOKYO_MEAN – $PSRF106,178*32

Name	Field type	Example	Description
Message ID	string	$PSRF106	PSRF106 protocol header
Datum	numeric	178	21=WGS84 178=TOKYO_MEAN 179=TOKYO_JAPAN 180=TOKYO_KOREA 181=TOKYO_OKINAWA
Checksum	hexadecimal	*32	
<CR> <LF>			end of message termination

Table 2-12: Select datum data format

MSK—MSK Receiver Interface

Table 2-13 contains the values for the following example:

$GPMSK,318.0,A,100,M,2,*45

Name	Field type	Example	Units	Description
Message ID	string	$GPMSK		MSK protocol header
Beacon Frequency	numeric	318.0	kHz	frequency to use
Auto/Manual Frequency†	character	A		A : Auto, M : Manual
Beacon Bit Rate	numeric	100		bits per second
Auto/Manual Bit Rate1	character	M		A : Auto, M : Manual
Interval for Sending $--MSS††	numeric	2	seconds	sending of MSS messages for status
Checksum	hexadecimal	*45		
<CR> <LF>				end of message termination

†If Auto is specified the previous field value is ignored.
††When status data is not to be transmitted this field is null.

Table 2-13: RMC data format

The NMEA messages supported by the Evaluation Receiver does not provide the ability to change the DGPS source. If you need to change the DGPS source to internal beacon, use the SiRF binary protocol and then switch to NMEA.

3. Navman proprietary messages

3.1 Low power mode messages

Navman has added a number of proprietary NMEA input messages to configure the TricklePower^{TM} and Push-To-Fix^{TM} modes.

3.1.1 Low power configuration

The following message sets the receiver to low power mode:

$PSRF151,a,bbbb,cccc[*CS]

where:

Field	Description
a	Push-To-Fix* (1=on, 0=off)
b	TricklePower duty cycle (parts per thousand)
c	TricklePower on time (milliseconds)
*Note that Push-To-Fix^{TM} does not require fields b and c so they may be left blank	

Table 3-1: Low power modes message values

This message is the NMEA equivalent of the SiRF Binary input message ID 151.

System response:

$PTTK,LPSET,a,bbbb,cccc*CS

The updated values returned by the system are as described in Table 3-1.

3.1.2 Low power acquisition configuration

The following message sets the acquisition parameters of the low power mode:

$PSRF167,aaaa,bbbb,cccc,d[*CS]

where:

Field	Description
a	maximum off time (milliseconds)
b	maximum search time (milliseconds)
c	Push-To-Fix period (seconds)
d	adaptive TricklePower (1=on, 0=off)

Table 3-2: Low power acquisition input values

This message is the NMEA equivalent of the SiRF Binary input message ID 167.

System response:

$PTTK,LPACQ,aaaa,bbbb,cccc,d*CS

The updated values returned by the system are as described in Table 3-2.

