NMEA Protocol Reference Manual

Technology Solutions UK Ltd Suite C,
Loughborough Technology Centre,
Epinal Way,
Loughborough,
Leicestershire,
LE11 3GE,
United Kingdom.

Tel: +44 (0) 1509 238248
Fax: +44 (0) 1509 220020

Email: enquiries@tsl.uk.com

The material in this manual is provided courtesy of SiRF Technology and Navman NZ Ltd.

Contents

1 NMEA output messages 3
1.1 Summary 3
1.2 GGA - Global Positioning System Fixed Data 3
1.3 GLL - Geographic Position - Latitude/Longitude 5
1.4 GSA - GNSS DOP and Active Satellites 5
1.5 GSV - GNSS Satellites in View 6
1.6 RMC - Recommended Minimum Specific GNSS Data 7
1.7 VTG - Course Over Ground and Ground Speed 7
1.8 150 - OkToSend 8
2 NMEA input messages 9
2.1 Summary 9
2.2 100 – Set Serial Port 9
2.3 101 - Navigation Initialisation 10
2.4 103 – Query/Rate control 11
2.5 104 - LLA Navigation Initialisation 13
2.6 105 - Development Data On/Off 13
2.7 106 – Select Datum 15

History

Version	Date	Modifications
1.0	09/11/06	Document Creation

1 NMEA output messages

1.1 Summary

The table below lists each of the NMEA Version 2.20 output messages available on the GPS 1058:

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
RMC	Time, date, position, course and speed data
VTG	Course and speed information relative to the ground
150	OK to send message

1.2 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		0 – Fix not available or invalid. 1 – GPS SPS mode, fix valid. 2 – Differential GPS, SPS mode, fix valid. The valid position fix indicator is derived from the SiRF Binary MID 2 Mode 1.

Name	Field type	Example	Units	Description
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

1.3 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[1]	character	A	A=data valid or V=data not valid
Checksum	hexadecimal	*41	
<CR><LF>			End of message termination
[1] *A data valid status should not be confused with a valid position fix quality indicator.*			

1.4 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	M – Manual; forced to operate in 2D or 3D mode. A – 2D automatic; allowed to automatically switch 2D/3D.
Mode 2	digit	3	1 – Fix not available. 2 – 2D (<4SVs used) 3 – 3D (>3SVs used)
Satellite Used[†]	numeric	07	Sv on Channel 1
Satellite Used[†]	numeric	02	Sv on Channel 2
....			....
Satellite Used[†]	numeric		Sv on Channel 12

Name	Field type	Example	Description
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*			

1.5 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

Name	Field type	Example	Units	Description
Checksum	hexadecimal	*71		
<CR> <LF>				end.of.message.termination
†Depending on the nu*mber of satellites tracked, multiple messages of GSV data may be required*				
††Satellite used in solution.				

1.6 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[1]	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
[1]A data valid status should not be confused with a valid position fix quality indicator.				

1.7 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

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.

1.8 150 - OkToSend

This message is being sent out during the trickle power mode to communicate with an outside program 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

The not OkToSend message reads:

not OkToSend – $PSRF150,0*3E

2 NMEA input messages

2.1 Summary

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). If the receiver is in SiRF binary mode, all NMEA input messages are ignored.

Message Structure:

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

[1] Message Identifier consisting of three numeric characters. Input messages begin at MID100.

[2] Message specific data. Refer to a specific message selection 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 OD OA. 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. The following table describes the NMEA input messages supported on the GPS 1058:

Message	MID	Description
Set Serial Port	100	Set serial port parameters and protocol.
Navigation Initialisation	101	Parameters required for start using X/Y/Z. Coordinates must be WGS84.
Query/Rate control	103	Query standard NMEA message and/or set output rate.
LLA Navigation Initialisation	104	Parameters required for start using Lat/Lon/Alt. Coordinates must be WGS84.
Development data on/off	105	Development data messages on/off.
Select Datum	106	Selection of datum to be used for coordinate transformations.

2.2 100 – Set Serial Port

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	Units	Description
Message ID	string	$PSRF100		PSRF100 protocol header
Protocol	digit	0		0=SiRF binary†, 1=NMEA
Baud	numeric	9600		4800, 9600, 19200, 38400, 57600, 115200
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.				

2.3 101 - Navigation Initialisation

This command is used to initialize the GPS 1058 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 GPS 1058 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*1

Name	Field type	Example	Units	Description
Message ID	string	$PSRF101		PSRF101 protocol header
ECEF X	numeric	-2686700	metres	X coordinate position
ECEF Y	numeric	-4304200	metres	Y coordinate position
ECEF Z	numeric	3851624	metres	Z coordinate position
Clk Offset	numeric	96000	Hz	Clock offset of the GPS 1058
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		1 – Hot start, all data valid. 2 – Warm start, Ephemeris cleared. 3 – Warm start with initilisation, Ephemeris cleared, initilisation 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.
Checksum	hexadecimal	*1C		
<CR> <LF>				end of message termination

2.4 103 – 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 examples:

Query the GGA message with checksum enabled;

$PSRF103,00,01,00,01*25

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

Name	Field type	Example	Units	Description
Message ID	string	$PSRF103		PSRF103 protocol header
Msg	numeric	00		00 – GGA 01 – GLL 02 – GSA 03 – GSV 04 – RMC 05 - VTG
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

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, (2×5 = 10)).

2.5 104 - LLA Navigation Initialisation

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		1 – Hot start, all data valid. 2 – Warm start, Ephemeris cleared. 3 – Warm start with initialisation, Ephemeris cleared, initialisation 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.
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.				

2.6 105 - 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 examples:

Debug On;

$PSRF105,1*3E

Debug Off

$PSRF105,0*3F

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

2.7 106 – 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	Units	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

+ About TSL

TSL designs and manufactures both standard and custom embedded, snap on and standalone peripherals for handheld computer terminals. Embedded technologies include:

- GPS
- RFID – Low Frequency, High Frequency and UHF
- GPRS/GSM
- IrDA
- Contact Smartcard
- Fingerprint Biometrics
- 1D and 2D Barcode Scanning
- Bluetooth
- 802.11 WiFi
- Magnetic Card Readers
- OCR – B and ePassport

Utilizing class leading Industrial design, TSL develops products from concept through to high volume manufacture for Blue Chip companies around the world. Using the above technologies TSL develops innovative products in a timely and cost effective manner for a broad range of handheld devices.

Telephone: +44 (0)1509 238248
Fax: +44 (0)1509 220020

Postal Address:
Technology Solutions (UK) Limited,
Suite C, Loughborough Technology Centre,
Epinal Way,
Loughborough,
Leicestershire,
LE11 3GE.
United Kingdom.

Email: enquiries@tsl.uk.com