E NMEA 0183

NMEA 0183 is an interface protocol created by the National Marine Electronics Association. The latest release of NMEA 0183 is Version 2.1 (October 15, 1995). This protocol was originally established to allow marine navigation equipment to share information. NMEA 0183 is a simple, yet comprehensive ASCII protocol which defines both the communication interface and the data format. Since it is a well established industry standard, NMEA 0183 has also gained popularity for use in applications other than marine electronics.

For those applications requiring output only from the GPS receiver, NMEA 0183 is a popular choice since, in many cases, an NMEA 0183 software application code already exists. The SVeeEight Plus GPS receiver is available with firmware that supports a subset of the NMEA 0183 messages: GGA and VTG. For a nominal fee, Trimble can offer custom firmware with a different selection of messages to meet your application requirements.

This appendix provides a brief overview of the NMEA protocol and describes both the standard and optional messages offered by the SVeeEight Plus GPS.

For a complete copy of the NMEA 0183 standard, contact:

NMEA National Office
PO Box 3435
New Bern, NC 28564-3435
U.S.A.
Telephone: +1-919-638-2626
Fax: +1-919-638-4885

E.1 The NMEA 0183 Communication Interface

NMEA 0183 allows a single source (talker) to transmit serial data over a single twisted wire pair to one or more receivers (listeners). Table E-1 lists the characteristics of the NMEA 0183 data transmissions.

Table E-1 NMEA 0183 Characteristics

Signal Characteristic	NMEA Standard
Baud Rate	4800
Data Bits	8
Parity	None (Disabled)
Stop Bits	1

E.2 NMEA 0183 Message Format

The NMEA 0183 protocol covers a broad array of navigation data. This broad array of information is separated into discrete messages which convey a specific set of information. The entire protocol encompasses over 50 messages, but only a sub-set of these messages apply to a GPS receiver like the SVeeEight Plus GPS. The NMEA message structure is described below.

*$IDMSG,D1,D2,D3,D4,.....,Dn*CS[CR][LF]*

"$"	The "$" signifies the start of a message.
ID	The talker identification is a two letter mnemonic which describes the source of the navigation information. The GP identification signifies a GPS source.
MSG	The message identification is a three letter mnemonic which describes the message content and the number and order of the data fields.
","	Commas serve as delimiters for the data fields.
Dn	Each message contains multiple data fields (Dn) which are delimited by commas.
"*"	The asterisk serves as a checksum delimiter.
CS	The checksum field contains two ASCII characters which indicate the hexadecimal value of the checksum.
[CR][LF]	The carriage return [CR] and line feed [LF] combination terminate the message.

NMEA 0183 messages vary in length, but each message is limited to 79 characters or less. This length limitation excludes the "$" and the [CR][LF]. The data field block, including delimiters, is limited to 74 characters or less.

Note – Many of the NMEA date fields are of variable length, and you should always use the comma delineators to parse the NMEA message date field.

E.3 NMEA 0183 Message Options

The SVeeEight Plus GPS receiver can output any or all of the messages listed in Table E-2. In its default configuration (as shipped from the factory), the SVeeEight Plus GPS receiver outputs two messages: GGA (NMEA Version 2.1) and VTG. These messages are output at a 1 second interval with the “GP” talker ID and checksums.

Note – You can configure a custom mix of the messages listed in Appendix E-2, SVeeEight Plus GPS NMEA Messages. See Configuring the SVeeEight Plus GPS Protocols, page 3-8 and TSIP command packets 0xBC, 0x7A, and 8E-26 in Appendix A, Trimble Standard Interface Protocol for details on configuring NMEA output.

Warning – If too many messages are specified for output, you may need to increase the unit’s baud rate.

Table E-2 SVeeEight Plus GPS NMEA Messages

Setting	Message	Description
Default	GGA	GPS fix data (NMEA Version 2.1)
	GLL	Geographic position - Latitude/Longitude
	GSA	GPS DOP and active satellites
	GSV	GPS satellites in view
	RMC	Recommended minimum specific GPS/Transit data
Default	VTG	Track made good and ground speed
	ZDA	Time & Date

The format for each message in Table E-2 is described in more detail in the next section.

E.4 NMEA 0183 Message Formats

E.4.1 GGA - GPS Fix Data

The GGA message includes time, position and fix related data for the GPS receiver.

*$GP GGA,hhmmss,llll.lll,a,nnnnn.nnn,b,t,uu,v.v,w.w,M,x.x,M,y.y,zzzz*hh <CR><LF>*

Table E-3 GGA - GPS Fix Data Message Parameters

Field	Description
1	UTC of Position
2,3	Latitude, N (North) or S (South)
4,5	Longitude, E (East) or W (West)
6	GPS Quality Indicator: 0 = No GPS, 1 = GPS, 2 = DGPS
7	Number of Satellites in Use
8	Horizontal Dilution of Precision (HDOP)
9, 10	Antenna Altitude in Meters, M = Meters
11, 12	Geoidal Separation in Meters, M=Meters. Geoidal separation is the difference between the WGS-84 earth ellipsoid and mean-sea-level.
13	Age of Differential GPS Data. Time in seconds since the last Type 1 or 9 Update
14	Differential Reference Station ID (0000 to 1023)
hh	Checksum

E.4.2 GLL - Geographic Position - Latitude/Longitude

The GLL message contains the latitude and longitude of the present vessel position, the time of the position fix and the status.

*$GP GLL,llll.lll,a,yyyyy.yyy,a,hhmmss.s,A*hh<CR><LF>*

Table E-4 GLL - Geographic Position - Latitude / Longitude Message Parameters

Field #	Description
1,2	Latitude, N (North) or S (South)
3,4	Longitude, E (East) or W (West)
5	UTC of position
6	Status: A = Valid, V= Invalid
hh	Checksum

E.4.3 GSA - GPS DOP and Active Satellites

The GSA messages indicate the GPS receiver's operating mode and lists the satellites used for navigation and the DOP values of the position solution.

*$GP GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x*hh<CR><LF>*

Table E-5 GSA - GPS DOP and Active Satellites Message Parameters

Field #	Description
1	Mode: M = Manual, A = Automatic. In manual mode, the receiver is forced to operate in either 2D or 3D mode. In automatic mode, the receiver is allowed to switch between 2D and 3D modes subject to the PDOP and satellite masks.
2	Current Mode: 1 = fix not available, 2 = 2D, 3 = 3D
3 to 14	PRN numbers of the satellites used in the position solution. When less than 12 satellites are used, the unused fields are null
15	Position dilution of precision (PDOP)
16	Horizontal dilution of precision (HDOP)
17	Vertical dilution of precision (VDOP)
hh	Checksum

E.4.4 GSV - GPS Satellites in View

The GSV message identifies the GPS satellites in view, including their PRN number, elevation, azimuth and SNR value. Each message contains data for four satellites. Second and third messages are sent when more than 4 satellites are in view. Fields #1 and #2 indicate the total number of messages being sent and the number of each message respectively.

*$GP GSV,x,x,xx,xx,xx,xxx,xx,xx,xx,xxx,xx,xx,xx,xxx,xx,xx,xx,xxx,xx*hh<CR><LF>*

Table E-6 GSV - GPS Satellites in View Message Parameters

Field #	Description
1	Total number of GSV messages
2	Message number: 1 to 3
3	Total number of satellites in view
4	Satellite PRN number
5	Satellite elevation in degrees (90° Maximum)
6	Satellite azimuth in degrees true (000 to 359)
7	Satellite SNR (C/No), null when not tracking
8,9,10,11	PRN, elevation, azimuth and SNR for second satellite
12,13,14,15	PRN, elevation, azimuth and SNR for third satellite
16,17,18,19	PRN, elevation, azimuth and SNR for fourth satellite
hh	Checksum

E.4.5 RMC - Recommended Minimum Specific GPS/Transit Data

The RMC message contains the time, date, position, course, and speed data provided by the GPS navigation receiver. A checksum is mandatory for this message and the transmission interval may not exceed 2 seconds. All data fields must be provided unless the data is temporarily unavailable. Null fields may be used when data is temporarily unavailable.

*$GP RMC,hhmmss.s,A,llll.lll,a,yyyyy.yyy,a,x.x,x.x,xxxxxx,x.x,a*hh<CR><LF>*

Table E-7 RMC - Recommended Minimum Specific GPS / Transit Data Message Parameters

Field #	Description
1	UTC of Position Fix.
2	Status: A = Valid, V = navigation receiver warning
3,4	Latitude, N (North) or S (South).
5,6	Longitude, E (East) or W (West).
7	Speed over the ground (SOG) in knots
8	Track made good in degrees true.
9	Date: dd/mm/yy
10,11	Magnetic variation in degrees, E = East / W= West
hh	Checksum (Mandatory for RMC)

E.4.6 VTG - Track Made Good and Ground Speed

The VTG message conveys the actual track made good (COG) and the speed relative to the ground (SOG).

*$GP VTG,x.x,T,x.x,M,x.x,N,x.x,K*hh<CR><LF>*

Table E-8 VTG - Track Made Good and Ground Speed Message Parameters

Field #	Description
1	Track made good in degrees true.
2	Track made good in degrees magnetic.
3,4	Speed over the ground (SOG) in knots.
5,6	Speed over the ground (SOG) in kilometer per hour.
hh	Checksum

E.4.7 ZDA - Time & Date

The ZDA message contains UTC, the day, the month, the year and the local time zone.

*$GP ZDA,hhmmss.s,xx,xx,xxxx,,*hh<CR><LF>*

Table E-9 ZDA - Time & Date Message Parameters

Field #	Description
1	UTC
2	Day (01 to 31)
3	Month (01 to 12)
4	Year
5	unused
6	unused
hh	Checksum

Note – Fields #5 and #6 are null fields in the SVeeEight Plus GPS receiver output. A GPS receiver cannot independently identify the local time zone offsets.

Caution – If UTC offset is not available, time output will be in GPS time.

Note – GPS time can be used as a timetag for the 1PPS. The ZDA message comes out 100-500 msec after the PPS.

E.5 Exception Behavior

When no position fix is available, some of the data fields in the NMEA messages are blank. A blank field has no characters between the commas. There are three general cases when no fix is available: at power-up without BBRAM (cold start); at power with BBRAM (warm start); and when the GPS signal is temporarily blocked. These three cases have different NMEA output behavior in the SVeeEight Plus GPS receiver. This section describes the behavior for the current product. The specification for this behavior may change in future products.

E.5.1 Power-up with No BBRAM

In this case, no previous position fix is available in battery-backed memory. At power-up, the receiver goes into a special "heartbeat" mode. In the heartbeat mode, GGA messages are output every second until the first position fix is achieved. The message list and the output rate specified by the user (See TSIP Command 0x7A) are not in effect during this period.

At first the GGA message has all blank fields.

After the first GPS satellite is tracked, and GPS time is established, the GGA message has only the time field filled; all others are blank.

After the first position fix, the heartbeat messages stop. The messages are then output according to the user-specified message list and output rate.

E.5.2 Power-up with BBRAM

In this case, a previous fix is available in battery-backed memory at power-up.

At power-up, the receiver outputs a single GGA message with all fields blank except the time field, which has the RTC time (if available).

After this single GGA message, messages are output according to the user-specified message list and output rate.

If RTC time is available at power-up, the time output fields are always filled; otherwise, the time fields are blank until the first fix. Most fields, including the position and velocity fields, are blank until the first position fix.

E.5.3 Interruption of GPS Signal

If the GPS signal is interrupted temporarily, the NMEA continues to be output according to the user-specified message list and output rate. Position and velocity fields are blank until the next fix, but most other fields are filled.