NMEA data

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Disclaimer

This site is based on personal research and is believed to be accurate but there is no guarantee that any of the information is correct or suitable for any purpose. I have been told by the NMEA folks that my information is old and out of date. The current version of NMEA at the time I wrote this is 3.01 which is not described here. This site is for historical information and is not intended to be used for any official purpose. For official data please contact the NMEA web site. Please see the bottom of this article for the sources of this data.

Introduction

The National Marine Electronics Association (NMEA) has developed a specification that defines the interface between various pieces of marine electronic equipment. The standard permits marine electronics to send information to computers and to other marine equipment. A full copy of this standard is available for purchase at their web site. None of the information on this site comes from this standard and I do not have a copy. Anyone attempting to design anything to this standard should obtain an official copy.

GPS receiver communication is defined within this specification. Most computer programs that provide real time position information understand and expect data to be in NMEA format. This data includes the complete PVT (position, velocity, time) solution computed by the GPS receiver. The idea of NMEA is to send a line of data called a sentence that is totally self contained and independent from other sentences. There are standard sentences for each device category and there is also the ability to define proprietary sentences for use by the individual company. All of the standard sentences have a two letter prefix that defines the device that uses that sentence type. (For gps receivers the prefix is GP.) which is followed by a three letter sequence that defines the sentence contents. In addition NMEA permits hardware manufactures to define their own proprietary sentences for

whatever purpose they see fit. All proprietary sentences begin with the letter P and are followed with 3 letters that identifies the manufacturer controlling that sentence. For example a Garmin sentence would start with PGRM and Magellan would begin with PMGN.

Each sentence begins with a '$' and ends with a carriage return/line feed sequence and can be no longer than 80 characters of visible text (plus the line terminators). The data is contained within this single line with data items separated by commas. The data itself is just ascii text and may extend over multiple sentences in certain specialized instances but is normally fully contained in one variable length sentence. The data may vary in the amount of precision contained in the message. For example time might be indicated to decimal parts of a second or location may be show with 3 or even 4 digits after the decimal point. Programs that read the data should only use the commas to determine the field boundaries and not depend on column positions. There is a provision for a checksum at the end of each sentence which may or may not be checked by the unit that reads the data. The checksum field consists of a '*' and two hex digits representing an 8 bit exclusive OR of all characters between, but not including, the '$' and '*'. A checksum is required on some sentences.

There have been several changes to the standard but for gps use the only ones that are likely to be encountered are 1.5 and 2.0 through 2.3. These just specify some different sentence configurations which may be peculiar to the needs of a particular device thus the gps may need to be changed to match the devices being interfaced to. Some gps's provide the ability configure a custom set the sentences while other may offer a set of fixed choices. Many gps receivers simply output a fixed set of sentences that cannot be changed by the user. The current version of the standard is 3.01. I have no specific information on this version, but I am not aware of any GPS products that require conformance to this version.

Hardware Connection

The hardware interface for GPS units is designed to meet the NMEA requirements. They are also compatible with most computer serial ports using RS232 protocols, however strictly speaking the NMEA standard is not RS232. They recommend conformance to EIA-422. The interface speed can be adjusted on some models but the NMEA standard is 4800 b/s (bit per second rate) with 8 bits of data, no parity, and one stop bit. All units that support NMEA should support this speed. Note that, at a b/s rate of 4800, you can easily send enough data to more than fill a full second of time. For this reason some units only send updates every two seconds or may send some data every second while reserving other data to be sent less often. In addition some units may send data a couple of seconds old while other units may send data that is collected within the second it is sent. Generally time is sent in some field within each second so it is pretty easy to figure out what a

particular gps is doing. Some sentences may be sent only during a particular action of the receiver such as while following a route while other receivers may always send the sentence and just null out the values. Other difference will be noted in the specific data descriptions defined later in the text.

At 4800 b/s you can only send 480 characters in one second. Since an NMEA sentence can be as long as 82 characters you can be limited to less than 6 different sentences. The actual limit is determined by the specific sentences used, but this shows that it is easy to overrun the capabilities if you want rapid sentence response. NMEA is designed to run as a process in the background spitting out sentences which are then captured as needed by the using program. Some programs cannot do this and these programs will sample the data stream, then use the data for screen display, and then sample the data again. Depending on the time needed to use the data there can easily be a lag of 4 seconds in the responsiveness to changed data. This may be fine in some applications but totally unacceptable in others. For example a car traveling at 60 mph will travel 88 feet in one second. Several second delays could make the entire system seem unresponsive and could cause you to miss your turn.

The NMEA standard has been around for many years (1983) and has undergone several revisions. The protocol has changed and the number and types of sentences may be different depending on the revision. Most GPS receivers understand the standard which is called: 0183 version 2. This standard dictates a transfer rate of 4800 b/s. Some receivers also understand older standards. The oldest standard was 0180 followed by 0182 which transferred data at 1200 b/s. An earlier version of 0183 called version 1.5 is also understood by some receivers. Some Garmin units and other brands can be set to 9600 for NMEA output or even higher but this is only recommended if you have determined that 4800 works ok and then you can try to set it faster. Setting it to run as fast as you can may improve the responsiveness of the program.

In order to use the hardware interface you will need a cable. Generally the cable is unique to the hardware model so you will need an cable made specifically for the brand and model of the unit you own. Some of the latest computers no longer include a serial port but only a USB port. Most gps receivers will work with Serial to USB adapters and serial ports attached via the pcmcia (pc card) adapter. For general NMEA use with a gps receiver you will only need two wires in the cable, data out from the gps and ground. A third wire, Data in, will be needed if you expect the receiver to accept data on this cable such as to upload waypoints or send DGPS data to the receiver.

GPS receivers may be used to interface with other NMEA devices such as autopilots, fishfinders, or even another gps receivers. They can also listen to Differential Beacon Receivers that can send data using the RTCM SC-104 standard. This data is consistent with the hardware requirements for NMEA input data. There are no handshake lines defined for NMEA.

NMEA sentences

NMEA consists of sentences, the first word of which, called a data type, defines the interpretation of the rest of the sentence. Each Data type would have its own unique interpretation and is defined in the NMEA standard. The GGA sentence (shown below) shows an example that provides essential fix data. Other sentences may repeat some of the same information but will also supply new data. Whatever device or program that reads the data can watch for the data sentence that it is interested in and simply ignore other sentences that is doesn't care about. In the NMEA standard there are no commands to indicate that the gps should do something different. Instead each receiver just sends all of the data and expects much of it to be ignored. Some receivers have commands inside the unit that can select a subset of all the sentences or, in some cases, even the individual sentences to send. There is no way to indicate anything back to the unit as to whether the sentence is being read correctly or to request a re-send of some data you didn't get. Instead the receiving unit just checks the checksum and ignores the data if the checksum is bad figuring the data will be sent again sometime later.

There are many sentences in the NMEA standard for all kinds of devices that may be used in a Marine environment. Some of the ones that have applicability to gps receivers are listed below: (all message start with GP.)

- AAM - Waypoint Arrival Alarm
- ALM - Almanac data
- APA - Auto Pilot A sentence
- APB - Auto Pilot B sentence
- BOD - Bearing Origin to Destination
- BWC - Bearing using Great Circle route
- DTM - Datum being used.
- GGA - Fix information
- GLL - Lat/Lon data
- GRS - GPS Range Residuals
- GSA - Overall Satellite data
- GST - GPS Pseudorange Noise Statistics
- GSV - Detailed Satellite data
- MSK - send control for a beacon receiver
- MSS - Beacon receiver status information.
- RMA - recommended Loran data
- RMB - recommended navigation data for gps
- RMC - recommended minimum data for gps
- RTE - route message
- TRF - Transit Fix Data
- STN - Multiple Data ID
- VBW - dual Ground / Water Spped
- VTG - Vector track an Speed over the Ground
- WCV - Waypoint closure velocity (Velocity Made Good)

- [WPL](#) - Waypoint Location information
- XTC - cross track error
- [XTE](#) - measured cross track error
- ZTG - Zulu (UTC) time and time to go (to destination)
- [ZDA](#) - Date and Time

Some gps receivers with special capabilities output these special messages.

- [HCHDG](#) - Compass output
- [PSLIB](#) - Remote Control for a DGPS receiver

In addition some GPS receivers can mimic Loran-C receivers by outputing the LC prefix in some of their messages so that they can be used to interface to equipment that is expecting this prefix instead of the GP one.

The last version 2 iteration of the NMEA standard was 2.3. It added a mode indicator to several sentences which is used to indicate the kind of fix the receiver currently has. This indication is part of the signal integrity information needed by the FAA. The value can be A=autonomous, D=differential, E=Estimated, N=not valid, S=Simulator. Sometimes there can be a null value as well. Only the A and D values will correspond to an Active and reliable Sentence. This mode character has been added to the RMC, RMB, VTG, and GLL, sentences and optionally some others including the BWC and XTE sentences.

If you are interfacing a GPS unit to another device, including a computer program, you need to ensure that the receiving unit is given all of the sentences that it needs. If it needs a sentence that your GPS does not send then the interface to that unit is likely to fail. Here is a [Link](#) for the needs of some typical programs. The sentences sent by some typical receivers include:

NMEA 2.0

Name	Garmin	Magellan	Lowrance	SiRF	Notes:
GPAPB	N	Y	Y	N	Auto Pilot B
GPBOD	Y	N	N	N	bearing, origin to destination - earlier G-12's do not transmit this
GPGGA	Y	Y	Y	Y	fix data
GPGLL	Y	Y	Y	Y	Lat/Lon data - earlier G-12's do not transmit this
GPGSA	Y	Y	Y	Y	overall satellite reception data, missing on some Garmin models
GPGSV	Y	Y	Y	Y	detailed satellite data, missing on some Garmin models

GPRMB	Y	Y	Y	N	minimum recommended data when following a route
GPRMC	Y	Y	Y	Y	minimum recommended data
GPRTE	Y	U	U	N	route data, only when there is an active route. (this is sometimes bidirectional)
GPWPL	Y	Y	U	N	waypoint data, only when there is an active route (this is sometimes bidirectional)

NMEA 1.5 - some units do not support version 1.5. Lowrance units provide the ability to customize the NMEA output by sentences so that you can develop your own custom sentence structure.

Name	Garmin	Magellan	Notes:
GPAPA	N	Y	Automatic Pilot A
GPBOD	Y	N	bearing origin to destination - earlier G-12's do not send this
GPBWC	Y	Y	bearing to waypoint using great circle route.
GPGLL	Y	Y	lat/lon - earlier G-12's do not send this
GPRMC	Y	N	minimum recommend data
GPRMB	Y	N	minimum recommended data when following a route
GPVTG	Y	Y	vector track and speed over ground
GPWPL	Y	N	waypoint data (only when active goto)
GPXTE	Y	Y	cross track error

The NMEA 2.3 output from the Garmin Legend, Vista, and perhaps some others include the BWC, VTG, and XTE sentences.

The Trimble Scoutmaster outputs: APA, APB, BWC, GGA, GLL, GSA, GSV, RMB, RMC, VTG, WCV, XTE, ZTG.

The Motorola Encore outputs: GGA, GLL, GSV, RMC, VTG, ZDA and a proprietary sentence PMOTG.

Units based on the SiRF chipset can output: GGA, GLL, GSA, GSV, RMC, and VTG. What is actually output is based on which sentences are selected by the user or application program. See below for more details. Some implementations have enhanced the SiRF capabilities with other sentences as well by changing the firmware. For example, the u-blox receivers add ZDA and some proprietary sentences to the above list of sentences. Check your documentation for more details.

Garmin receivers send the following Proprietary Sentences:

- PGRME (estimated error) - not sent if set to 0183 1.5
- PGRMM (map datum)
- PGRMZ (altitude)
- PSLIB (beacon receiver control)

Note that Garmin converts lat/lon coordinates to the datum chosen by the user when sending this data. This is indicated in the proprietary sentence PGRMM. This can help programs that use maps with other datums but is not an NMEA standard. Be sure and set your datum to WGS84 on Garmin units when communicating to other NMEA devices.

Magellan also converts lat/lon coordinates to the datum chosen on the receiver but do not indicate this in a message. Magellan units use proprietary sentences for waypoint maintenance and other tasks. They use a prefix of PMGN for this data.

Most other units always output NMEA messages in the WGS84 datum. Be sure and check the user documentation to be sure.

It is possible to just view the information presented on the NMEA interface using a simple terminal program. If the terminal program can log the session then you can build a history of the entire session into a file. More sophisticated logging programs can filter the messages to only certain sentences or only collect sentences at prescribed intervals. Some computer programs that provide real time display and logging actually save the log in an ascii format that can be viewed with a text editor or used independently from the program that generated it.

NMEA input

Some units also support an NMEA input mode. While not too many programs support this mode it does provide a standardized way to update or add waypoint and route data. Note that there is no handshaking or commands in NMEA mode so you just send the data in the correct sentence and the unit will accept the data and add or overwrite the information in memory. If the data is not in the correct format it will simply be ignored. A carriage return/line feed sequence is required. If the waypoint name is the same you will overwrite existing data but no warning will be issued. The sentence construction is identical to what the unit downloads so you can, for example, capture a WPL sentence from one unit and then send that same sentence to another unit but be careful if the two units support waypoint names of different lengths since the receiving unit might truncate the name and overwrite a waypoint accidently. If you create a sentence from scratch you should create a correct checksum. Be sure you know and have set you unit to the correct datum. Many units support the input of WPL sentences and a few support RTE as well.

On NMEA input the receiver stores information based on interpreting the sentence itself. While some receivers accept standard NMEA input this can only be used to update a waypoint or similar task and not to send a command to the unit. Proprietary input sentences could be used to send commands. Since the Magellan upload and download maintenance protocol is based on NMEA sentences they support a modified WPL message that adds comments, altitude, and icon data.

Some marine units may accept input for alarms such as deep or shallow water based on the DPT sentence or MTW to read the water temperature. For example the Garmin Map76 supports DPT, MTW (temperature), and VHW (speed) input sentences. Other units may use NMEA input to provide initialization data via proprietary sentences, or to select which NMEA sentences to output.

Decode of selected position sentences

The most important NMEA sentences include the GGA which provides the current Fix data, the RMC which provides the minimum gps sentences information, and the GSA which provides the Satellite status data.

GGA - essential fix data which provide 3D location and accuracy data.

```
$GPGGA,123519,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47


Where:
     GGA          Global Positioning System Fix Data
     123519       Fix taken at 12:35:19 UTC
     4807.038,N   Latitude 48 deg 07.038' N
     01131.000,E  Longitude 11 deg 31.000' E
     1            Fix quality: 0 = invalid
                               1 = GPS fix (SPS)
                               2 = DGPS fix
                               3 = PPS fix
                               4 = Real Time Kinematic
                               5 = Float RTK
                               6 = estimated (dead reckoning) (2.3 feature)
                               7 = Manual input mode
                               8 = Simulation mode
     08           Number of satellites being tracked
     0.9          Horizontal dilution of position
     545.4,M      Altitude, Meters, above mean sea level
     46.9,M       Height of geoid (mean sea level) above WGS84
                     ellipsoid
     (empty field) time in seconds since last DGPS update
     (empty field) DGPS station ID number
     *47          the checksum data, always begins with *
```

If the height of geoid is missing then the altitude should be suspect. Some non-standard implementations report altitude with respect to the ellipsoid rather than geoid altitude. Some units do not report negative altitudes at all. This is the only sentence that reports altitude.

GSA - GPS DOP and active satellites. This sentence provides details on the nature of the fix. It includes the numbers of the satellites being used in the current solution and the DOP. DOP (dilution of precision) is an indication of the effect of satellite geometry on the accuracy of the fix. It is a unitless number where smaller is better. For 3D fixes using 4 satellites a 1.0 would be considered to be a perfect number, however for overdetermined solutions it is possible to see numbers below 1.0.

There are differences in the way the PRN's are presented which can effect the ability of some programs to display this data. For example, in the example shown below there are 5 satellites in the solution and the null fields are scattered indicating that the almanac would show satellites in the null positions that are not being used as part of this solution. Other receivers might output all of the satellites used at the beginning of the sentence with the null field all stacked up at the end. This difference accounts for some satellite display programs not always being able to display the satellites being tracked. Some units may show all satellites that have ephemeris data without regard to their use as part of the solution but this is non-standard.

```
    $GPGSA,A,3,04,05,,09,12,,,24,,,,,2.5,1.3,2.1*39

Where:
    GSA        Satellite status
    A          Auto selection of 2D or 3D fix (M = manual)
    3          3D fix - values include: 1 = no fix
                                        2 = 2D fix
                                        3 = 3D fix
    04,05... PRNs of satellites used for fix (space for 12)
    2.5        PDOP (dilution of precision)
    1.3        Horizontal dilution of precision (HDOP)
    2.1        Vertical dilution of precision (VDOP)
    *39        the checksum data, always begins with *
```

GSV - Satellites in View shows data about the satellites that the unit might be able to find based on its viewing mask and almanac data. It also shows current ability to track this data. Note that one GSV sentence only can provide data for up to 4 satellites and thus there may need to be 3 sentences for the full information. It is reasonable for the GSV sentence to contain more satellites than GGA might indicate since GSV may include satellites that are not used as part of the solution. It is not a requirment that the GSV sentences all appear in sequence. To avoid overloading the data bandwidth some receivers may place the various sentences in totally different samples since each sentence identifies which one it is.

The field called SNR (Signal to Noise Ratio) in the NMEA standard is often referred to as signal strength. SNR is an indirect but more useful value that raw signal strength. It can range from 0 to 99 and has units of dB according to the NMEA standard, but the various manufacturers send different ranges of numbers with different starting numbers so the values themselves cannot necessarily be used to evaluate different units. The range of working values

in a given gps will usually show a difference of about 25 to 35 between the lowest and highest values, however 0 is a special case and may be shown on satellites that are in view but not being tracked.

```
$GPGSV,2,1,08,01,40,083,46,02,17,308,41,12,07,344,39,14,22,228,45*75
```

```
Where:
    GSV          Satellites in view
    2            Number of sentences for full data
    1            sentence 1 of 2
    08           Number of satellites in view

    01           Satellite PRN number
    40           Elevation, degrees
    083          Azimuth, degrees
    46           SNR - higher is better
         for up to 4 satellites per sentence
    *75          the checksum data, always begins with *
```

RMC - NMEA has its own version of essential gps pvt (position, velocity, time) data. It is called RMC, The Recommended Minimum, which will look similar to:

```
$GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A
```

```
Where:
    RMC          Recommended Minimum sentence C
    123519       Fix taken at 12:35:19 UTC
    A            Status A=active or V=Void.
    4807.038,N   Latitude 48 deg 07.038' N
    01131.000,E  Longitude 11 deg 31.000' E
    022.4        Speed over the ground in knots
    084.4        Track angle in degrees True
    230394       Date - 23rd of March 1994
    003.1,W      Magnetic Variation
    *6A          The checksum data, always begins with *
```

Note that, as of the 2.3 release of NMEA, there is a new field in the RMC sentence at the end just prior to the checksum. For more information on this field [see here](#).

GLL - Geographic Latitude and Longitude is a holdover from Loran data and some old units may not send the time and data active information if they are emulating Loran data. If a gps is emulating Loran data they may use the LC Loran prefix instead of GP.

```
$GPGLL,4916.45,N,12311.12,W,225444,A,*1D
```

```
Where:
    GLL          Geographic position, Latitude and Longitude
    4916.46,N    Latitude 49 deg. 16.45 min. North
    12311.12,W   Longitude 123 deg. 11.12 min. West
    225444       Fix taken at 22:54:44 UTC
    A            Data Active or V (void)
```

```
       *iD          checksum data
```

Note that, as of the 2.3 release of NMEA, there is a new field in the GLL sentence at the end just prior to the checksum. For more information on this field [see here](#).

VTG - Velocity made good. The gps receiver may use the LC prefix instead of GP if it is emulating Loran output.

```
  $GPVTG,054.7,T,034.4,M,005.5,N,010.2,K*48
```

```
where:
        VTG          Track made good and ground speed
        054.7,T      True track made good (degrees)
        034.4,M      Magnetic track made good
        005.5,N      Ground speed, knots
        010.2,K      Ground speed, Kilometers per hour
        *48          Checksum
```

Note that, as of the 2.3 release of NMEA, there is a new field in the VTG sentence at the end just prior to the checksum. For more information on this field [see here](#).

Receivers that don't have a magnetic deviation (variation) table built in will null out the Magnetic track made good.

Decode of some Navigation Sentences

WPL - Waypoint Location data provides essential waypoint data. It is output when navigating to indicate data about the destination and is sometimes supported on input to redefine a waypoint location. Note that waypoint data as defined in the standard does not define altitude, comments, or icon data. When a route is active, this sentence is sent once for each waypoint in the route, in sequence. When all waypoints have been reported, the RTE sentence is sent in the next data set. In any group of sentences, only one WPL sentence, or an RTE sentence, will be sent.

```
$GPWPL,4807.038,N,01131.000,E,WPTNME*5C
```

```
With an interpretation of:
```

```
    WPL          Waypoint Location
    4807.038,N   Latitude
    01131.000,E  Longitude
    WPTNME       Waypoint Name
    *5C          The checksum data, always begins with *
```

AAM - Waypoint Arrival Alarm is generated by some units to indicate the Status of arrival (entering the arrival circle, or passing the perpendicular of the course line) at the destination waypoint.

```
  $GPAAM,A,A,0.10,N,WPTNME*32
```

```
Where:
    AAM     Arrival Alarm
    A       Arrival circle entered
    A       Perpendicular passed
    0.10    Circle radius
    N       Nautical miles
    WPTNME  Waypoint name
    *32     Checksum data
```

APB - Autopilot format B is sent by some gps receivers to allow them to be used to control an autopilot unit. This sentence is commonly used by autopilots and contains navigation receiver warning flag status, cross-track-error, waypoint arrival status, initial bearing from origin waypoint to the destination, continuous bearing from present position to destination and recommended heading-to-steer to destination waypoint for the active navigation leg of the journey.

Note: some autopilots, Robertson in particular, misinterpret "bearing from origin to destination" as "bearing from present position to destination". This is likely due to the difference between the APB sentence and the APA sentence. for the APA sentence this would be the correct thing to do for the data in the same field. APA only differs from APB in this one field and APA leaves off the last two fields where this distinction is clearly spelled out. This will result in poor performance if the boat is sufficiently off-course that the two bearings are different.

```
    $GPAPB,A,A,0.10,R,N,V,V,011,M,DEST,011,M,011,M*3C

where:
    APB     Autopilot format B
    A       Loran-C blink/SNR warning, general warning
    A       Loran-C cycle warning
    0.10    cross-track error distance
    R       steer Right to correct (or L for Left)
    N       cross-track error units - nautical miles (K for kilometers)
    V       arrival alarm - circle
    V       arrival alarm - perpendicular
    011,M   magnetic bearing, origin to destination
    DEST    destination waypoint ID
    011,M   magnetic bearing, present position to destination
    011,M   magnetic heading to steer (bearings could True as 033,T)
```

BOD - Bearing - Origin to Destination shows the bearing angle of the line, calculated at the origin waypoint, extending to the destination waypoint from the origin waypoint for the active navigation leg of the journey.

```
    $GPBOD,045.,T,023.,M,DEST,START*01

where:
        BOD         Bearing - origin to destination waypoint
        045.,T      bearing 045 True from "START" to "DEST"
        023.,M      bearing 023 Magnetic from "START" to "DEST"
        DEST        destination waypoint ID
        START       origin waypoint ID
```

```
        *01             checksum
```

BWC - Bearing & Distance to Waypoint using a Great Circle route. Time (UTC) and distance & bearing to, and location of, a specified waypoint from present position along the great circle path.

```
    $GPBWC,225444,4917.24,N,12309.57,W,051.9,T,031.6,M,001.3,N,004*29
```

where:
```
        BWC             Bearing and distance to waypoint - great circle
        225444          UTC time of fix 22:54:44
        4917.24,N       Latitude of waypoint
        12309.57,W      Longitude of waypoint
        051.9,T         Bearing to waypoint, degrees true
        031.6,M         Bearing to waypoint, degrees magnetic
        001.3,N         Distance to waypoint, Nautical miles
        004             Waypoint ID
        *29             checksum
```

RMB - The recommended minimum navigation sentence is sent whenever a route or a goto is active. On some systems it is sent all of the time with null data. The Arrival alarm flag is similar to the arrival alarm inside the unit and can be decoded to drive an external alarm. Note the use of leading zeros in this message to preserve the character spacing. This is done, I believe, because some autopilots may depend on exact character spacing.

```
    $GPRMB,A,0.66,L,003,004,4917.24,N,12309.57,W,001.3,052.5,000.5,V*20
```

where:
```
        RMB             Recommended minimum navigation information
        A               Data status A = OK, V = Void (warning)
        0.66,L          Cross-track error (nautical miles, 9.99 max),
                            steer Left to correct (or R = right)
        003             Origin waypoint ID
        004             Destination waypoint ID
        4917.24,N       Destination waypoint latitude 49 deg. 17.24 min. N
        12309.57,W      Destination waypoint longitude 123 deg. 09.57 min. W
        001.3           Range to destination, nautical miles (999.9 max)
        052.5           True bearing to destination
        000.5           Velocity towards destination, knots
        V               Arrival alarm  A = arrived, V = not arrived
        *20             checksum
```

RTE - RTE is sent to indicate the names of the waypoints used in an active route. There are two types of RTE sentences. This route sentence can list all of the waypoints in the entire route or it can list only those still ahead. Because an NMEA sentence is limited to 80 characters there may need to be multiple sentences to identify all of the waypoints. The data about the waypoints themselves will be sent in subsequent WPL sentences which will be sent in future cycles of the NMEA data.

```
    $GPRTE,2,1,c,0,W3IWI,DRIVWY,32CEDR,32-29,32BKLD,32-I95,32-US1,BW-32,BW-198*69
```

Where:
```
        RTE             Waypoints in active route
```

```
        2               total number of sentences needed for full data
        1               this is sentence 1 of 2
        c               Type c = complete list of waypoints in this route
                        w = first listed waypoint is start of current leg
        0               Route identifier
        W3IWI,...       Waypoint identifiers (names)
        *69             checksum
```

XTE - Measured cross track error is a small subset of the RMB message for compatibility with some older equipment designed to work with Loran. Note that the same limitations apply to this message as the ones in the RMB since it is expected to be decoded by an autopilot.

```
  $GPXTE,A,A,0.67,L,N*6F
```

Where:
```
        XTE             Cross track error, measured
        A               General warning flag V = warning
                                (Loran-C Blink or SNR warning)
        A               Not used for GPS (Loran-C cycle lock flag)
        0.67            cross track error distance
        L               Steer left to correct error (or R for right)
        N               Distance units - Nautical miles
        *6F             checksum
```

Other sentences that may be useful

ALM - GPS Almanac Data contains GPS week number, satellite health and the complete almanac data for one satellite. Multiple messages may be transmitted, one for each satellite in the GPS constellation, up to maximum of 32 messages. Note that these sentences can take a long time to send so they are not generally sent automatically by the gps receiver. (Sorry I don't have an exact example of the sentence.) Note that this sentence breaks the 80 character rule. Also note that this sentence is often accepted as input so that you can preload a new almanac in a receiver.

```
    $GPALM,A.B,C.D,E,F,hh,hhhh,...
```

Where:
```
    ALM   Almanac Data being sent
    A     Total number of messages
    B     Message number
    C     Satellite PRN number
    D     GPS week number (0-1023)
    E     Satellite health (bits 17-24 of message)
    F     eccentricity
    hh    t index OA, almanac reference time
    hhhh  sigma index 1, inclination angle
    ...   OMEGADOT rate of right ascension
          SQRA(A) root of semi-major axis
          Omega, argument of perigee
          Omega index 0, longitude of ascension node
          M index 0, mean anomaly
          a index f0, clock parameter
          a index f1, clock parameter
```

HCHDG - Compass output is used on Garmin etrex summit, vista , and 76S receivers to output the value of the internal flux-gate compass. Only the magnetic heading and magnetic variation is shown in the message.

```
$HCHDG,101.1,,,7.1,W*3C
```

```
where:
    HCHDG    Magnetic heading, deviation, variation
    101.1    heading
    ,,       deviation (no data)
    7.1,W    variation
```

ZDA - Data and Time

```
$GPZDA,hhmmss.ss,dd,mm,yyyy,xx,yy*CC
$GPZDA,201530.00,04,07,2002,00,00*60
```

```
where:
        hhmmss     HrMinSec(UTC)
        dd,mm,yyy  Day,Month,Year
        xx         local zone hours -13..13
        yy         local zone minutes 0..59
        *CC        checksum
```

MSK - Control for a Beacon Receiver

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

```
where:
     318.0       Frequency to use
     A           Frequency mode, A=auto, M=manual
     100         Beacon bit rate
     M           Bitrate, A=auto, M=manual
     2           frequency for MSS message status (null for no status)
     *45         checksum
```

MSS - Beacon Receiver Status

```
$GPMSS,55,27,318.0,100,*66
```

```
where:
     55          signal strength in dB
     27          signal to noise ratio in dB
     318.0       Beacon Frequency in KHz
     100         Beacon bitrate in bps
     *66         checksum
```

Proprietary Sentences

Proprietary sentences can either be output from the gps or used as input to control information. They always start with P which is followed by a 3 character manufactures code and additional characters to define the sentence type.

Garmin

The following are Garmin proprietary sentences. "P" denotes proprietary, "GRM" is Garmin's manufacturer code, and "M" or "Z" indicates the specific sentence type. Note that the PGRME sentence is not set if the output is set to NMEA 1.5 mode.

```
  $PGRME,15.0,M,45.0,M,25.0,M*1C

where:
    15.0,M        Estimated horizontal position error in meters (HPE)
    45.0,M        Estimated vertical error (VPE) in meters
    25.0,M        Overall spherical equivalent position error


  $PGRMZ,93,f,3*21

where:
    93,f          Altitude in feet
    3             Position fix dimensions 2 = user altitude
                                          3 = GPS altitude
  This sentence shows in feet, regardless of units shown on the display.
  Note that for units with an altimeter this will be altitude computed
  by the internal altimeter.


  $PGRMM,NAD27 Canada*2F
     Currently active horizontal datum
```

PSLIB

Proprietary sentences are used to control a Starlink differential beacon receiver. (Garmin's DBR is Starlink compatible as are many others.) When the GPS receiver is set to change the DBR frequency or b/s rate, the "J" sentence is replaced (just once) by (for example): $PSLIB,320.0,200*59 to set the DBR to 320 KHz, 200 b/s.

```
     $PSLIB,,,J*22   Status request
     $PSLIB,,,K*23   configuration request
```

These two sentences are normally sent together in each group of sentences from the GPS. The three fields are: Frequency, bit Rate, Request Type. The value in the third field may be: J = status request, K = configuration request, or null (blank) = tuning message. The correct values for frequency range from 283.5-325.0 KHz while the bit rate can be set to 0, 25, 50, 100 or 200 bps.

Magellan

Magellan uses proprietary sentences to do all of their waypoint and route maintenance. They use the MGN prefix for their sentences. This use is documented in their interface specification and will not be repeated here. However, they also send proprietary sentences to augment the gps data just like Garmin does. Here is an example of a sentence sent by the GPS Companion product:

```
   $PMGNST,02.12,3,T,534,05.0,+03327,00*40
```

```
where:
     ST      status information
     02.12   Version number?
     3       2D or 3D
     T       True if we have a fix False otherwise
     534     numbers change - unknown
     05.0    time left on the gps battery in hours
     +03327  numbers change (freq. compensation?)
     00      PRN number receiving current focus
     *40     checksum
```

A tracklog on a Meridian is made up of propretary sentences that look like:

```
$PMGNTRK,4322.061,N,07948.473,W,00116,M,173949.42,A,,020602*67
$PMGNTRK,4322.058,N,07948.483,W,00090,M,174202.45,A,,020602*69.
```

```
where

     TRK       Tracklog
     4322.071  Latitude
     N         North or South
     07948.473 Longitude
     W         East or West
     00116     Altitude
     M         Meters or Feet
     173949.42 UTC time
     A         Active or Void
     ,,        Track Name
     020602    date
     *67       checksum
```

Motorola

The **PMOTG** is used by Motorola Oncore receivers to send a command to the receiver. This command is used to set the output of the sentence to a particular frequency in seconds (or to 0) or to switch the output formula to motorola binary, gps, or loran.

```
   $PMOTG,xxx,yyyy
```

```
where:
     xxx    the sentence to be controlled
     yyyy   the time interval (0-9999 seconds)
```

```
or $PMOTG,FOR,y
```

```
where:
     y    MPB=0, GPS=1, Loran=2
```

Rockwell International

The Rockwell chipset is used on a number of gps receivers. It outputs some proprietary sentences with the **PRWI** prefix and accepts input from some

special sentences similar to the approach used by Magellan. It can also be switched to a separate binary mode using a proprietary sentence. The input sentence most used to initialize the unit is $PRWIINIT and one output sentence is $PRWIRID

```
$PRWIRID,12,01.83,12/15/97,0003,*42
```

```
where:
    $PRWIRID
    12          12 channel unit
    01.83       software version
    12/15/97    software date
    0003        software options (HEX value)
                Bit 0 minimize ROM usage
                Bit 1 minimize RAM usage
    *42         checksum
```

An input sentence that will define which NMEA sentences are to be output from the Rockwell unit is:

```
$PRWIILOG,GGA,A,T,1,0
```

```
where:
    $PRWIILOG
    GGA         type of sentence
    A           A=activate, V=deactivate
    T           cyclic
    1           every 1 second
    0           ??
```

The initialization sentence which can be input to speed up acquisition looks like:

```
$PRWIINIT,V,,,4308.750,N,07159.791,W,100.0,0.0,M,0.0,T,175244,230503*77
```

```
where:
    $PRWIINIT      INIT = initialization
    V              V = reset, A = no reset
    ,,             Reserved for future use
    4308.750       Latitude
    N              N = North, S = South
    07159.791      Longitude
    W              W = West, E = East
    100.0          Altitude in meters
    0.0            Speed
    M              M = m/s, N = knots, K = km/hr
    0.0            Heading
    T              T = True, M = Magnetic
    175244         UTC time (hour, min, sec)
    230503         UTC date (day, month, year)
    *77            Checksum
```

Note: Commas may be used to signify using existing data. If units are supplied then the data must be present. Speed and direction must be supplied together. Lat/Lon must be supplied together. UTC time and date must be supplied together. If heading is magnetic then lat/lon needs to be

supplied along with UTC time and date.

The sentences available for the Rockwell Jupiter chipset are: GGA, GSA, GSV, VTG, RMC and some proprietary sentences.

SiRF

The SiRF line of chips support several input sentences that permit the user to customize the way the chip behaves. In addition SiRF has a binary protocol that is even more powerful permitting different implementations to behave entirely differently. However, most applications do not attempt to customize the behavior so a user will need to make sure that the any customization is compatible with the application they are planning to use. There are 5 input sentences defined that begin with $PSRF which is followed by three digits. Each sentence takes a fix amount of input fields which must exist, no null fields, and is terminated with the standard CR/LF sequence. The checksum is required.

The sentences 100 and 102 set the serial ports. 100 sets the main port A while 102 sets the DGPS input port B. 100 has an extra field that can be used to switch the interface to binary mode. Binary mode requires 8 bits, 1 stop bit, no parity. There is a command in binary mode that will switch the interface back to NMEA. Do not use the NMEA command to switch to binary mode unless you have the ability to switch it back. You could render your gps inoperative.

```
 $PSRF100,0,9600,8,1,0*0C
 $PSRF102,9600,8,1,0*3C

where
   $PSRF100
   0          0=SiRF, 1=NMEA  - This is where the protocol is changed.
   9600       b/s rate 4800, 9600, 19200, 38400
   8          7, 8 Databits
   1          0, 1 Stopbits
   0          0=none, 1=odd, 2=even Parity
   *0C        checksum
```

The sentences 101 and 104 can be used to initialize values to be used by the gps. Supplying these values can shorten the initial lock time. If the clock offset is set to 0 then an internal default will be used. Sentence 101 supplies data in the internal ECEF (Earth centered, Earth Fixed) format in meters while sentence 104 supplies the data in the traditional Lat / Lon format.

```
 $PSRF101,-2686700,-4304200,3851624,95000,497260,921,12,3*22
 $PSRF104,37.3875111,-121.97232,0,95000,237759,922,12,3*3A

where
   $PSRF104
   37.3875111 Latitude in degrees
   -121.97232 Longitude in degrees
   0          Ellipsoid Altitude in meters
```

```
    95000       Clock offset
    237759      GPS Time of Week in seconds
    922         GPS Week Number
    12          Channel count (1 to 12)
    3           Reset config where
                1 = warm start, ephemeris valid
                2 = clear ephemeris, warm start (First Fix)
                3 = initialize with data, clear ephemeris
                4 = cold start, clear all data
                8 = cold start, set factory defaults
    *3A         checksum
```

The sentence 103 is used to control which NMEA sentences are to be sent and how often. Each sentence type is controlled individually. If the query bit is set then the gps responds by sending this message in the next second no matter what the rate is set to. Note that if trickle power is in use (can only be set in binary mode) then the actual update rate will be the selected update rate times the trickle rate which could mean that the data will be sent less frequently than was set here.

```
 $PSRF103,05,00,01,01*20
```

```
where
    $PSRF103
    05          00=GGA
                01=GLL
                02=GSA
                03=GSV
                04=RMC
                05=VTG
    00          mode, 0=set rate, 1=query
    01          rate in seconds, 0-255
    01          checksum 0=no, 1=yes
    *20         checksum
```

The 105 sentence controls a debug mode which causes the gps to report any errors it finds with the input data. $PSRF105,1*3E would turn debug on while $PSRF105,0*3F would turn it off.

Magnavox

The old Magnavox system used mostly proprietary sentences. The Magnavox system was acquired by Leica Geosystems in 1994. Information on this system can be found at [this site](). The NMEA sentences themselves are described [here](). They all use the MVX prefix and include:

Control Port Input sentences

- $PMVXG,000 Initialization/Mode Control - Part A
- $PMVXG,001 Initialization/Mode Control - Part B
- $PMVXG,007 Control Port Configuration
- $PMVXG,023 Time Recovery Configuration
- $CDGPQ,YYY Query From a Remote Device / Request to Output a

Sentence

Control Port Output Sentences

- $PMVXG,000 Receiver Status
- $PMVXG,021 Position, Height, Velocity
- $PMVXG,022 DOPs
- $PMVXG,030 Software Configuration
- $PMVXG,101 Control Sentence Accept/Reject
- $PMVXG,523 Time Recovery Configuration
- $PMVXG,830 Time Recovery Results

Sony

The Sony interface uses a proprietary sentence that looks like:

```
$PSNY,0,00,05,500,06,06,06,06*14
```

```
where
   PSNY
   0           Preamp (external antenna) status
               0 = Normal
               1 = Open
               2 = shorted
   00          Geodesic system (datum) 0-25, 0 = WGS84
   05          Elevation mask in degrees
   500         Speed Limit in Km
   06          PDOP limit with DGPS on
   06          HDOP limit with DGPS on
   06          PDOP limit with DGPS off
   06          HDOP limit with DGPS off
   *14         Checksum
```

Sample Streams

These streams will be modified when a route is active with the inclusion of route specific data.

Garmin

Garmin g12 sentences for version 4.57

```
$GPRMC,183729,A,3907.356,N,12102.482,W,000.0,360.0,080301,015.5,E*6F
$GPRMB,A,,,,,,,,,,,,V*71
$GPGGA,183730,3907.356,N,12102.482,W,1,05,1.6,646.4,M,-24.1,M,,*75
$GPGSA,A,3,02,,,07,,09,24,26,,,,,1.6,1.6,1.0*3D
$GPGSV,2,1,08,02,43,088,38,04,42,145,00,05,11,291,00,07,60,043,35*71
$GPGSV,2,2,08,08,02,145,00,09,46,303,47,24,16,178,32,26,18,231,43*77
$PGRME,22.0,M,52.9,M,51.0,M*14
$GPGLL,3907.360,N,12102.481,W,183730,A*33
$PGRMZ,2062,f,3*2D
$PGRMM,WGS 84*06
$GPBOD,,T,,M,,*47
```

```
$GPRTE,1,1,c,0*07
$GPRMC,183731,A,3907.482,N,12102.436,W,000.0,360.0,080301,015.5,E*67
$GPRMB,A,,,,,,,,,,,,,V*71
```

Here are some observations:

- Notice the complete cycle shows an update interval of 2 seconds which is caused by the fact that there is too much data to fit in one second at 4800 b/s.
- Upping the b/s rate to 9600 will cause an update every second.
- Notice that the samples are in real time for each sentence because the GGA sentence shows an update in the time of 1 second.
- It would be possible to provide update data every second by parsing more sentences since the data is adjusted every second.
- Notice the gaps in the GSA message where the satellites in use are shown in a there slots as compared to the GSV locations. Some tools do not decode this configuration correctly.
- Note the GGA sentence starts the sequence every two seconds.
- This sample is similar for other Garmin receivers designed in the same time frame as the G-12.

Garmin etrex summit outputs

```
$GPRMC,002454,A,3553.5295,N,13938.6570,E,0.0,43.1,180700,7.1,W,A*3F
$GPRMB,A,,,,,,,,,,,,,A,A*0B
$GPGGA,002454,3553.5295,N,13938.6570,E,1,05,2.2,18.3,M,39.0,M,,*7F
$GPGSA,A,3,01,04,07,16,20,,,,,,,,3.6,2.2,2.7*35
$GPGSV,3,1,09,01,38,103,37,02,23,215,00,04,38,297,37,05,00,328,00*70
$GPGSV,3,2,09,07,77,299,47,11,07,087,00,16,74,041,47,20,38,044,43*73
$GPGSV,3,3,09,24,12,282,00*4D
$GPGLL,3553.5295,N,13938.6570,E,002454,A,A*4F
$GPBOD,,T,,M,,*47
$PGRME,8.6,M,9.6,M,12.9,M*15
$PGRMZ,51,f*30
$HCHDG,101.1,,,7.1,W*3C
$GPRTE,1,1,c,*37
$GPRMC,002456,A,3553.5295,N,13938.6570,E,0.0,43.1,180700,7.1,W,A*3D
```

Some observations as compared to the G-12:

- Information is buffered. It is all for the same second.
- Information is only updated every two seconds at 4800 b/s.
- Lat/Lon numbers have an extra digit.
- This is NMEA 2.3 data as indicated by the extra A at the end of RMC, RMB and GLL.
- Note that the satellites in use have been shoved to the left of the GSA message instead of the slot location.
- The RMC sentence starts the sequence.
- Note the HCHDG sentence for the built in compass.
- Except for the compass output this sentence list is similar for most Garmin units designed around the time of the Summit receivers, beginning with the emap.

Garmin etrex Vista release 2.42 outputs

```
$GPRMC,023042,A,3907.3837,N,12102.4684,W,0.0,156.1,131102,15.3,E,A*36
$GPRMB,A,,,,,,,,,,,,A,A*0B
$GPGGA,023042,3907.3837,N,12102.4684,W,1,04,2.3,507.3,M,-24.1,M,,*75
$GPGSA,A,3,04,05,,,09,,,24,,,,,2.8,2.3,1.0*36
$GPGSV,3,2,11,09,47,229,42,10,04,157,00,14,00,305,00,24,70,154,33*79
$GPGLL,3907.3837,N,12102.4684,W,023042,A,A*5E
$GPBOD,,T,,M,,*47
$GPVTG,156.1,T,140.9,M,0.0,N,0.0,K*41
$PGRME,8.4,M,23.8,M,25.7,M*2B
$PGRMZ,1735,f*34
$PGRMM,WGS 84*06
$HCHDG,,,,15.3,E*30
$GPRTE,1,1,c,*37
$GPRMC,023044,A,3907.3840,N,12102.4692,W,0.0,156.1,131102,15.3,E,A*37
```

Some observations as compared to the Summit:

- Output still repeats at a rate of once every 2 seconds and is NMEA 2.3 Data
- The satellite status sentences are interleaved. The GSV sentences are only sent one in each two second group. Note the example shows sentence two of three. Thus the complete cycle would take 6 seconds.
- New sentence VTG.
- The altitude in PGRMZ is from the altimeter while the altitude in the GGA is from the gps computation.
- Note the HCHDG sentence for the built in compass and is missing for the Legend.

Garmin basic yellow etrex European version

```
$GPRMC,152926,V,6027.8259,N,02225.6713,E,10.8,0.0,190803,5.9,E,S*22
$GPRMB,V,,,,,,,,,,,,A,S*0E
$GPGGA,152926,6027.8259,N,02225.6713,E,8,09,2.0,44.7,M,20.6,M,,*79
$GPGSA,A,3,07,08,09,11,18,23,26,28,29,,,,6.6,2.0,3.0*38
$GPGSV,3,1,09,07,29,138,44,08,22,099,42,09,30,273,44,11,07,057,35*75
$GPGSV,3,2,09,18,28,305,43,23,14,340,39,26,64,222,49,28,60,084,49*7E
$GPGSV,3,3,09,29,52,187,48*4E
$GPGLL,6027.8259,N,02225.6713,E,152926,V,S*48
$GPBOD,,T,,M,,*47
$PGRME,15.0,M,22.5,M,15.0,M*1B
$PGRMZ,147,f,3*19
$GPRTE,1,1,c,*37
$GPRMC,152928,V,6027.8319,N,02225.6713,E,10.8,0.0,190803,5.9,E,S*29
```

Some Ovservations:

- The sentence sequence starts with RMC and repeats every 2 seconds.
- The PGRMM sentence is missing so the datum is not identified.

Magellan

Magellan GPS companion sentences

```
$GPGGA,184050.84,3907.3839,N,12102.4772,W,1,05,1.8,00543,M,,,,*33
$GPRMC,184050.84,A,3907.3839,N,12102.4772,W,00.0,000.0,080301,15,E*54
$GPGSA,A,3,24,07,09,26,05,,,,,,,,03.6,01.8,03.1*05
$PMGNST,02.12,3,T,534,05.0,+03327,00*40
$GPGLL,3907.3839,N,12102.4771,W,184051.812,A*2D
$GPGGA,184051.81,3907.3839,N,12102.4771,W,1,05,1.8,00543,M,,,,*34
$GPRMC,184051.81,A,3907.3839,N,12102.4771,W,00.0,000.0,080301,15,E*53
$GPGSA,A,3,24,07,09,26,05,,,,,,,,03.6,01.8,03.1*05
$GPGSV,3,1,08,07,57,045,43,09,48,303,48,04,44,144,,02,39,092,*7F
$GPGSV,3,2,08,24,18,178,44,26,17,230,41,05,13,292,43,08,01,147,*75
$GPGSV,3,3,08,,,,,,,,,,,,,,,,*71
$GPGLL,3907.3840,N,12102.4770,W,184052.812,A*21
```

Some observations:

- Complete cycle takes two seconds.
- RMC, GGA, GSA, and GLL are update every second.
- GSV data is swapped with MGNST data every other second.
- Time is shown to .xx and for GLL .xxx precision but the unit output is not that accurate. Data seems asynchronous and not tied to top of any particular second.
- Lat/Lon has an extra digit as compared to the Garmin G-12.
- There is a third GSV sentence that is technically not required.
- Notice that all the satellites used are shoved to the left in the GSA message.
- No geoid corrections are shown in the GGA message. This indicates that altitude is shown with respect to the ellipsoid instead of MSL.

Magellan 315 shown in simulation mode.

```
$GPAPB,A,A,0.0,L,N,,,1.1,M,SIM002,1.1,M,,,*21
$GPGSA,A,3,01,02,03,04,,,,,,,,,2.0,2.0,2.0*34
$GPGSV,3,1,11,01,77,103,,13,53,215,,04,47,300,,20,47,090,*76
$GPGSV,3,2,11,19,24,158,,07,21,237,,25,16,039,,24,11,315,*73
$GPGSV,3,3,11,11,08,149,,27,00,179,,30,00,354,,,,,*46
$GPGLL,5100.2111,N,00500.0006,E,104715.203,A*37
$GPGGA,104715.20,5100.2111,N,00500.0006,E,1,04,2.0,-0047,M,,,,*39
$GPRMB,A,0.00,L,SIM001,SIM002,5102.6069,N,00500.0000,E,002.4,000.,021.7,V*0D
$GPRMC,104715.20,A,5100.2111,N,00500.0006,E,21.7,003.0,140801,01.,W*70
$GPAPB,A,A,0.0,L,N,,,1.1,M,SIM002,1.1,M,,,*21
$GPGSA,A,3,01,02,03,04,,,,,,,,,2.0,2.0,2.0*34
```

Some observations:

- This listing shows navigation sentences simulating a route between two locations, SIM001 and SIM002.
- GLL starts the sequence and time stamp in the GLL message shows more precision.
- Update is every 2 seconds.
- NMEA data is only transmitted in simulation mode or you have an actual fix.

Others

Raytheon RN300 sentences:

```
$GPGGA,171537,3350.975,N,11823.991,W,2,07,1.1,-25.8,M,,M,1.8,,D*17
$GPGLL,3350.975,N,11823.991,W,171537,A,D*50
$GPRMC,171537,A,3350.975,N,11823.991,W,0.0,096.5,060401,013.0,E,D*07
$GPVTG,096.5,T,083.5,M,0.0,N,0.0,K,D*22
$GPGSA,A,2,04,09,07,24,02,05,26,,,,,,1.1,*3C
$GPGSV,2,1,07,04,62,120,47,09,52,292,53,07,42,044,41,24,38,179,45*7B
$GPGSV,2,2,07,02,34,101,43,05,18,304,40,26,09,223,36,,,,*48
$PRAYA,6,1,122,0,0,2,36,1,1,,,,,*5A
$GPDTM,W84,,0.000000,N,0.000000,E,0.0,W84*6F
$GPGGA,171538,3350.974,N,11823.991,W,2,07,1.1,-25.8,M,,M,1.8,,D*19
```

Some observations:

- Complete cycle every second triggered off of GGA.
- Date is NMEA 2.3 with integrity value added.
- The proprietary raytheon sentences seems to be for WAAS SV #122.
- Note the new DTM sentences that permits conversion of NMEA datum being used to WGS84.
- The satellites are listed in an arbitrary order, stacked to the left.

NavMan 3400 (SiRF chipset sentences)

```
$GPGGA,230611.016,3907.3813,N,12102.4635,W,0,04,5.7,507.9,M,,,,0000*11
$GPGLL,3907.3813,N,12102.4635,W,230611.016,V*31
$GPGSA,A,1,27,08,28,13,,,,,,,,,21.7,5.7,20.9*38
$GPGSV,3,1,10,27,68,048,42,08,63,326,43,28,48,239,40,13,39,154,39*7E
$GPGSV,3,2,10,31,38,069,34,10,23,282,,03,12,041,,29,09,319,*7C
$GPGSV,3,3,10,23,07,325,,01,05,145,*7E
$GPRMC,230611.016,V,3907.3813,N,12102.4635,W,0.14,136.40,041002,,*04
$GPVTG,136.40,T,,M,0.14,N,0.3,K*66
$GPGGA,230612.015,3907.3815,N,12102.4634,W,0,04,5.7,508.3,M,,,,0000*13
```

Some observations:

- A cycle is every second triggered off of GGA.
- The GSA, GSV sentences are only sent every 4 seconds or so. The actual sentences sent and the rate is adjustable using proprietary NMEA commands.
- Altitude is based on the ellipsoid model and is not corrected for geoid. Note that no geoid corrections are shown in GGA.
- All headings are stated as true direction. There are no magnetic direction outputs.
- The ,0000 at the end of GGA is non standard.
- Lat/Lon has an extra digit as compared to the Garmin G-12.
- The clock is shown with millisecond precision.
- The Navman sends 10 lines of non-nmea ascii data when it is first turned on. Each line does begin with a $.
- This is a sample sentence sequence. The Navman can be programmed to send less sentences or sentences at a different rate.
- The Navman uses the SiRF chipset, see above for more data on this chipset.

- Sentences are stated to be NMEA 2.2 based on documentation.

Earhmate with SiRF chipset (firmware 2.31)

```
$GPGGA,120557.916,5058.7456,N,00647.0515,E,2,06,1.7,108.5,M,47.6,M,1.5,0000*7A
$GPGSA,A,3,20,11,25,01,14,31,,,,,,,2.6,1.7,1.9*3B
$GPGSV,2,1,08,11,74,137,45,20,58,248,43,07,27,309,00,14,23,044,36*7A
$GPGSV,2,2,08,01,14,187,41,25,13,099,39,31,11,172,37,28,09,265,*71
$GPRMC,120557.916,A,5058.7456,N,00647.0515,E,0.00,82.33,220503,,*39
$GPGGA,120558.916,5058.7457,N,00647.0514,E,2,06,1.7,109.0,M,47.6,M,1.5,0000*71
```

Some observations in comparison with the NavMan.

- This unit show WAAS/EGNOS (WADGPS) in use. The GGA sentence shows a 2 indicating differential gps corrections. The 1.5 at the end shows the age of the dgps correction signal.
- This is a new chipset firmware release and does support Geoid height in the altitude as shown in the GGA sentence.
- The RMC sentences shows that there is no support for Magnetic headings.
- When WAAS/EGNOS was not in use a GLL sentence showed up after the GGA.

Evermore GM-305

```
$GPGGA,001430.003,3907.3885,N,12102.4767,W,1,05,02.1,00545.6,M,-26.0,M,,*5F
$GPGSA,A,3,15,18,14,,,31,,,23,,,,04.5,02.1,04.0*0F
$GPGSV,3,1,10,15,48,123,35,18,36,064,36,14,77,186,39,03,36,239,29*7A
$GPGSV,3,2,10,09,08,059,,31,35,276,35,17,10,125,,11,08,306,*79
$GPGSV,3,3,10,23,41,059,37,25,06,173,*70
$GPRMC,001430.003,A,3907.3885,N,12102.4767,W,000.0,175.3,220403,015.4,E*71
$GPGGA,001431.003,3907.3885,N,12102.4767,W,1,05,02.1,00545.5,M,-26.0,M,,*5D
```

Some observations

- This chipset is used in the Deluo universal mouse gps.
- Update is every second by default.
- Actual sentences are programmable using proprietary interface. GLL and VTG can be added and others removed. The update interval can be modified.
- Altitude is given relative to MSL (Geoid height) in GGA
- Magnetic and True headings are supported.

Sony

```
$GPVTG,139.7,T,,M,010.3,N,019.1,K*67
$GPGGA,050306,4259.8839,N,07130.3922,W,0,00,99.9,0010,M,,M,000,0000*66
$GPGLL,4259.8839,N,07130.3922,W,050306,V*20
$GPRMC,050306,V,4259.8839,N,07130.3922,W,010.3,139.7,291003,,*10
$GPZDA,050306,29,10,2003,,*43
$GPGSA,A,1,,,,,,,,,,,,,,99.9,99.9,99.9*09
$PSNY,0,00,05,500,06,06,06,06*14
```

Some observations

- This is the format of Digittraveler from RadioShack.
- If batteries are removed for 5 minutes on the Digitraveler the data is wrong.
- The Sony proprietary message is described above.
- Altitude is Ellipsoid, not MSL.
- Heading is True only, Magnetic variation is not provided.
- VTG, GGA, GLL, RMC, ZDA output every second. GSA and PSNY are alternated with GSV data.

UBlox

```
$GPRMC,162254.00,A,3723.02837,N,12159.39853,W,0.820,188.36,110706,,,A*74
$GPVTG,188.36,T,,M,0.820,N,1.519,K,A*3F
$GPGGA,162254.00,3723.02837,N,12159.39853,W,1,03,2.36,525.6,M,-25.6,M,,*65
$GPGSA,A,2,25,01,22,,,,,,,,,,2.56,2.36,1.00*02
$GPGSV,4,1,14,25,15,175,30,14,80,041,,19,38,259,14,01,52,223,18*76
$GPGSV,4,2,14,18,16,079,,11,19,312,,14,80,041,,21,04,135,25*7D
$GPGSV,4,3,14,15,27,134,18,03,25,222,,22,51,057,16,09,07,036,*79
$GPGSV,4,4,14,07,01,181,,15,25,135,*76
$GPGLL,3723.02837,N,12159.39853,W,162254.00,A,A*7C
$GPZDA,162254.00,11,07,2006,00,00*63
```

Some observations

- This is a 16 channel unit and shows up to 4 GSV sentences.
- The sentences were captured at 9600 b/s, some are missing at 4800.
- WAAS satellites can be used for ranging even if WAAS is turned off.

Credits

Peter's and Joe's web sites were used as primary sources for data in this article as well as personal research. Some data was obtained from the Garmin product manuals and product manuals from other manufacturers. The sample data streams were collected as captured from the appropriate devices directly or supplied to me by someone who captured them. All rights to this presentation are reserved.

While I didn't use this page as a source there is some good data on Glenn Baddeley's site. It includes some sentences that are not on this page.

Dale DePriest