This is a list of NMEA 0183 sentences with field descriptions.
It is primarily intended to help people understand GPS reports.

This list may originally have been redacted from the document cited as
[NMEA2000]; see the list of sources at the end of this document.
The official NMEA standard was not consulted at any point, thus this
document is not a derivative work of that standard and is not
controlled by the rapacious lawyers of NMEA.

It is originally from the gpsdrive distribution, but adds more
information on the following topics:

* Old and new forms of VTG
* Units used in GGA
* Vendor extensions PRWIZCH and PMGNST
* FAA Mode Indicator field for RMC, RMB, VTG, GLL, BWC, XTE.
* New documentation on BWC, DTM, GBS, GRS, GST, MSK, and MSS sentences.
* Sentence examples merged from [GIDS]
* Sentence explanations from [GIDS] and elsewhere
* Corrected badly mangled ZDA description.
* Corrected DPT titling
* Common talker IDs
* Sentences HFB, ITS, TPC, TDS, TFI, TPC, TPR, TPT from [GLOBALSAT].

Many of these are only emitted by high-end maritime navigation systems.
Most GPS sensors emit only RMC, GSA, GSV, GLL, and VTG. Note that the
form of VTG is variable with NMEA version.

In NMEA 2.3, several sentences (APB, BWC, BWR, GLL, RMA, RMB, RMC,
VTG, WCV, and XTE) got a new last field carrying the signal integrity
information needed by the FAA. (The values in the GGA mode field were
extended to carry this information as well.) Here are the values:

FAA Mode Indicator
     A = Autonomous mode
     D = Differential Mode
     E = Estimated (dead-reckoning) mode
     M = Manual Input Mode
     S = Simulated Mode
     N = Data Not Valid

This field may be empty. In pre-2.3 versions it is omitted. [NTUM] says
that according to the NMEA specification, it dominates the Status field --
the Status field will be set to "A" (data valid) for Mode Indicators A
and D, and to "V" (data invalid) for all other values of the Mode
Indicator. This is confirmed by [IEC].

Where a numeric latitude or longitude is given, the two digits
immediately to the left of the decimal point are whole minutes, to the
right are decimals of minutes, and the remaining digits to the left of
the whole minutes are whole degrees.

Eg. 4533.35 is 45 degrees and 33.35 minutes. ".35" of a minute is
exactly 21 seconds.

Eg. 16708.033 is 167 degrees and 8.033 minutes. ".033" of a minute is
about 2 seconds.

According to [UNMEA], the NMEA standard requires that a field (such as
altitude, latitude, or longitude) must be left empty when the GPS has
no valid data for it. However, many receivers violate this. It's
common, for example, to see latitude/longitude/altitude figures filled
with zeros when the GPS has no valid data.

The physical-level protocol is RS232C-compatible (actually RS422),
4800bps, 8N1 or 7N2 (the latter is rare but does occur; the FV18 from
San Jose Navigation uses it, for example). The data is all
ASCII, the high bit is not used.

It appears there is an international standard, IEC 61162-1, published
in 2000, that is essentially NMEA 0183. [IEC] says "is closely
aligned with NMEA 0183 version 2.30". Unfortunately, it costs money
and is not redistributable.

Here are the NMEA-standard sentences. The names are listed without the
"talker ID", a two-character prefix that identifies the type of the
transmitting unit. By far the most common talker ID is "GP",

identifying a generic GPS, but all of the following
are well known:

GP	Global Positioning System receiver
LC	Loran-C receiver
II	Integrated Instrumentation
IN	Integrated Navigation
EC	Electronic Chart Display & Information System (ECDIS)
CD	Digital Selective Calling (DSC)

LC - LORAN-C is a marine navigation system run by the U.S. government, which is planning to shut it down in favor of GPS. Some non-LORAN devices emit GLL but use this talker ID for backward-compatibility reasons, so it may outlast the actual LORAN system.

II - II is emitted by the NMEA interface of a widely-used line of marine-navigation electronics called the AutoHelm Seatalk system, made by Raytheon; see also [SEATALK].

IN -- Some Garmin GPS units use an IN talker ID.

EC -- ECDIS is a specialized geographical information system intended to support professional maritime navigation. NMEA talker units meeting the ECDIS standard use this prefix. Some of these emit GLL.

CD -- Modern marine VHF radios have a set of logic collectively known as Digital Selective Calling (DSC). These radios typically take data from a local position indicating device. This data is used in conjunction with a unique (FCC assigned) ID to cause your radio to broadcast your position data to others. Conversely, these radios are capable of recieving position data of other stations and emitting sentences indicating other station positions. This lets you plot the position of other vessels on a chart, for instance. There has been at least one instance of a DSC enabled radio overloading (mis-using) the LC talker prefix for this purpose. Otherwise they use the CD prefix. A vessel's nav system is likely to have both CD and some other position indicating talker on its bus(es).

Until the U.S. Coast Guard terminated the Omega Navigation System in 1997, another common talker prefix was "OM" for an Omega Navigation System receiver.

Here is a more complete list of talker ID prefixes. Most are not relevant to GPS systems.

AG	Autopilot - General
AP	Autopilot - Magnetic
CC	Computer - Programmed Calculator (outdated)
CD	Communications - Digital Selective Calling (DSC)
CM	Computer - Memory Data (outdated)
CS	Communications - Satellite
CT	Communications - Radio-Telephone (MF/HF)
CV	Communications - Radio-Telephone (VHF)
CX	Communications - Scanning Receiver
DE	DECCA Navigation (outdated)
DF	Direction Finder
EC	Electronic Chart Display & Information System (ECDIS)
EP	Emergency Position Indicating Beacon (EPIRB)
ER	Engine Room Monitoring Systems
GP	Global Positioning System (GPS)
HC	Heading - Magnetic Compass
HE	Heading - North Seeking Gyro
HN	Heading - Non North Seeking Gyro
II	Integrated Instrumentation
IN	Integrated Navigation
LA	Loran A (outdated)
LC	Loran C
MP	Microwave Positioning System (outdated)

```
OM        OMEGA Navigation System (outdated)
OS        Distress Alarm System (outdated)

RA        RADAR and/or ARPA

SD        Sounder, Depth
SN        Electronic Positioning System, other/general
SS        Sounder, Scanning

TI        Turn Rate Indicator
TR      TRANSIT Navigation System

VD        Velocity Sensor, Doppler, other/general
DM        Velocity Sensor, Speed Log, Water, Magnetic
VW        Velocity Sensor, Speed Log, Water, Mechanical

WI        Weather Instruments

YC        Transducer - Temperature (outdated)
YD        Transducer - Displacement, Angular or Linear (outdated)
YF        Transducer - Frequency (outdated)
YL        Transducer - Level (outdated)
YP        Transducer - Pressure (outdated)
YR        Transducer - Flow Rate (outdated)
YT        Transducer - Tachometer (outdated)
YV        Transducer - Volume (outdated)
YX      Transducer

ZA        Timekeeper - Atomic Clock
ZC        Timekeeper - Chronometer
ZQ        Timekeeper - Quartz
ZV        Timekeeper - Radio Update, WWV or WWVH
```

AAM - Waypoint Arrival Alarm

This sentence 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.

```
        1 2 3   4 5    6
        | | |   | |    |
 $--AAM,A,A,x.x,N,c--c*hh<CR><LF>
```

Field Number:
1) Status, BOOLEAN, A = Arrival circle entered
2) Status, BOOLEAN, A = perpendicular passed at waypoint
3) Arrival circle radius
4) Units of radius, nautical miles
5) Waypoint ID
6) Checksum

Example: GPAAM,A,A,0.10,N,WPTNME*43

WPTNME is the waypoint name.

ALM - GPS Almanac Data

This sentence expresses orbital data for a specified GPS satellite.

```
        1   2   3  4   5  6    7  8    9    10     11     12     13     14  15   16
        |   |   |  |   |  |    |  |    |    |      |      |      |      |   |    |
 $--ALM,x.x,x.x,xx,x.x,hh,hhhh,hh,hhhh,hhhh,hhhhhh,hhhhhh,hhhhhh,hhhhhh,hhh,hhh,*hh<CR><LF>
```

Field Number:
1) Total number of messages
2) Message Number
3) Satellite PRN number (01 to 32)
4) GPS Week Number :
   Date and time in GPS is computed as number of weeks from 6 January 1980 plus number of seconds into the week.
5) SV health, bits 17-24 of each almanac page
6) Eccentricity
7) Almanac Reference Time

 8) Inclination Angle
 9) Rate of Right Ascension
10) Root of semi-major axis
11) Argument of perigee
12) Longitude of ascension node
13) Mean anomaly
14) F0 Clock Parameter
15) F1 Clock Parameter
16) Checksum

Example: $GPALM,1,1,15,1159,00,441d,4e,16be,fd5e,a10c9f,4a2da4,686e81,58cbe1,0a4,001*5B

APA - Autopilot Sentence "A"

This sentence 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.

```
        1 2  3   4 5 6 7  8  9 10    11
        | |  |   | | | |  |  | |     |
 $--APA,A,A,x.xx,L,N,A,A,xxx,M,c---c*hh<CR><LF>
```

Field Number:
 1) Status
    V = LORAN-C Blink or SNR warning
    V = general warning flag or other navigation systems when a reliable
        fix is not available
 2) Status
    V = Loran-C Cycle Lock warning flag
    A = OK or not used

 3) Cross Track Error Magnitude
 4) Direction to steer, L or R
 5) Cross Track Units (Nautic miles or kilometers)
 6) Status
    A = Arrival Circle Entered
 7) Status
    A = Perpendicular passed at waypoint
 8) Bearing origin to destination
 9) M = Magnetic, T = True
10) Destination Waypoint ID
11) checksum

Example: $GPAPA,A,A,0.10,R,N,V,V,011,M,DEST,011,M*82

APB - Autopilot Sentence "B"

This is a fixed form of the APA sentence with some ambiguities removed.

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.

```
                                        13    15
        1 2 3   4 5 6 7 8   9 10   11  12|   14|
        | | |   | | | | |   | |    |   | |   | |
 $--APB,A,A,x.x,a,N,A,A,x.x,a,c--c,x.x,a,x.x,a*hh<CR><LF>
```

Field Number:
 1) Status
    V = LORAN-C Blink or SNR warning
    V = general warning flag or other navigation systems when a reliable
        fix is not available
 2) Status

```
    V = Loran-C Cycle Lock warning flag
    A = OK or not used
  3) Cross Track Error Magnitude
  4) Direction to steer, L or R
  5) Cross Track Units, N = Nautical Miles
  6) Status
    A = Arrival Circle Entered
  7) Status
    A = Perpendicular passed at waypoint
  8) Bearing origin to destination
  9) M = Magnetic, T = True
 10) Destination Waypoint ID
 11) Bearing, present position to Destination
 12) M = Magnetic, T = True
 13) Heading to steer to destination waypoint
 14) M = Magnetic, T = True
 15) Checksum

Example: $GPAPB,A,A,0.10,R,N,V,V,011,M,DEST,011,M,011,M*82

--------------------------------------------------------------------------------

 BOD - Bearing - Waypoint to Waypoint

        1   2 3   4 5    6    7
        |   | |   | |    |    |
 $--BOD,x.x,T,x.x,M,c--c,c--c*hh<CR><LF>

 Field Number:
  1) Bearing Degrees, TRUE
  2) T = True
  3) Bearing Degrees, Magnetic
  4) M = Magnetic
  5) TO Waypoint
  6) FROM Waypoint
  7) Checksum

Example 1: $GPBOD,099.3,T,105.6,M,POINTB,*01

Waypoint ID: "POINTB" Bearing 99.3 True, 105.6 Magnetic This sentence
is transmitted in the GOTO mode, without an active route on your
GPS. WARNING: this is the bearing from the moment you press enter in
the GOTO page to the destination waypoint and is NOT updated
dynamically! To update the information, (current bearing to waypoint),
you will have to press enter in the GOTO page again.

Example 2: $GPBOD,097.0,T,103.2,M,POINTB,POINTA*52

This sentence is transmitted when a route is active. It contains the
active leg information: origin waypoint "POINTA" and destination
waypoint "POINTB", bearing between the two points 97.0 True, 103.2
Magnetic. It does NOT display the bearing from current location to
destination waypoint! WARNING Again this information does not change
until you are on the next leg of the route. (The bearing from POINTA
to POINTB does not change during the time you are on this leg.)

--------------------------------------------------------------------------------

 BWC - Bearing & Distance to Waypoint - Geat Circle
                                                          12
        1         2       3 4        5 6   7 8   9 10  11|    13 14
        |         |       | |        | |   | |   | |   | |    |   |
 $--BEC,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x.x,T,x.x,M,x.x,N,c--c,m,*hh<CR><LF>

 Field Number:
  1) UTCTime
  2) Waypoint Latitude
  3) N = North, S = South
  4) Waypoint Longitude
  5) E = East, W = West
  6) Bearing, True
  7) T = True
  8) Bearing, Magnetic
  9) M = Magnetic
 10) Nautical Miles
 11) N = Nautical Miles
 12) Waypoint ID
```

13) FAA mode indicator (NMEA 2.3 and later, optional)
14) Checksum

Example 1: $GPBWC,081837,,,,,,T,,M,,N,*13

Example 2: GPBWC,220516,5130.02,N,00046.34,W,213.8,T,218.0,M,0004.6,N,EGLM*11

BWC - Bearing and Distance to Waypoint - Great Circle

```
         1          2     3    4     5  6  7  8  9  10 11 12  13
         |          |     |    |     |  |  |  |  |  |  |  |   |
 $--BWC,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x.x,T,x.x,M,x.x,N,nnn,*hh<CR><LF>
```

Field number:
1) UTC time of fix
2) Latitude of waypoint
3) N or S
4) Longitude of waypoint
5) W or E
6) Bearing to waypoint, degrees true
7) T indicating true bearing
8) Bearing to waypoint, degrees magnetic
9) M indicating magnetic
10) Distance to waypoint, Nautical miles
11) N indicating nautical miles
12) Waypoint ID
13) Checksum

Example 1: $GPBWC,225444,4917.24,N,12309.57,W,051.9,T,031.6,M,001.3,N,004*29

Example 2: $GPBWC,220516,5130.02,N,00046.34,W,213.8,T,218.0,M,0004.6,N,EGLM*11

BWR - Bearing and Distance to Waypoint - Rhumb Line

```
                                                        11
        1         2       3 4        5 6   7 8   9 10  | 12   13
        |         |       | |        | |   | |   | |   | |    |
 $--BWR,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x.x,T,x.x,M,x.x,N,c--c*hh<CR><LF>
```

Field Number:
1) UTCTime
2) Waypoint Latitude
3) N = North, S = South
4) Waypoint Longitude
5) E = East, W = West
6) Bearing, True
7) T = True
8) Bearing, Magnetic
9) M = Magnetic
10) Nautical Miles
11) N = Nautical Miles
12) Waypoint ID
13) Checksum

BWW - Bearing - Waypoint to Waypoint

```
        1   2 3   4 5    6    7
        |   | |   | |    |    |
 $--BWW,x.x,T,x.x,M,c--c,c--c*hh<CR><LF>
```

Field Number:
1) Bearing Degrees, TRUE
2) T = True
3) Bearing Degrees, Magnetic
4) M = Magnetic
5) TO Waypoint
6) FROM Waypoint
7) Checksum

DBK - Depth Below Keel

```
       1   2 3   4 5   6 7
       |   | |   | |   | |
$--DBK,x.x,f,x.x,M,x.x,F*hh<CR><LF>
```

Field Number:
1) Depth, feet
2) f = feet
3) Depth, meters
4) M = meters
5) Depth, Fathoms
6) F = Fathoms
7) Checksum

DBS - Depth Below Surface

```
       1   2 3   4 5   6 7
       |   | |   | |   | |
$--DBS,x.x,f,x.x,M,x.x,F*hh<CR><LF>
```

Field Number:
1) Depth, feet
2) f = feet
3) Depth, meters
4) M = meters
5) Depth, Fathoms
6) F = Fathoms
7) Checksum

DBT - Depth below transducer

```
       1   2 3   4 5   6 7
       |   | |   | |   | |
$--DBT,x.x,f,x.x,M,x.x,F*hh<CR><LF>
```

Field Number:
1) Depth, feet
2) f = feet
3) Depth, meters
4) M = meters
5) Depth, Fathoms
6) F = Fathoms
7) Checksum

DCN - Decca Position

```
                                    11  13      16
       1  2  3   4 5  6   7 8  9   10| 12| 14  15| 17
       |  |  |   | |  |   | |  |   | | | | |   | | |
$--DCN,xx,cc,x.x,A,cc,x.x,A,cc,x.x,A,A,A,A,x.x,N,x*hh<CR><LF>
```

Field Number:
1) Decca chain identifier
2) Red Zone Identifier
3) Red Line Of Position
4) Red Master Line Status
5) Green Zone Identifier
6) Green Line Of Position
7) Green Master Line Status
8) Purple Zone Identifier
9) Purple Line Of Position
10) Purple Master Line Status
11) Red Line Navigation Use
12) Green Line Navigation Use
13) Purple Line Navigation Use
14) Position Uncertainity
15) N = Nautical Miles
16) Fix Data Basis
    1 = Normal Pattern
    2 = Lane Identification Pattern
    3 = Lane Identification Transmissions
17) Checksum

(The DCN sentence is obsolete as of 3.01)

DPT - Depth of Water

```
       1   2   3
       |   |   |
$--DPT,x.x,x.x*hh<CR><LF>
```

Field Number:
 1) Depth, meters
 2) Offset from transducer,
    positive means distance from tansducer to water line
    negative means distance from transducer to keel
 3) Checksum

This sentence was incorrectly titled "Heading - Deviation & Variation"
in [NMEA2000]. It's documented at
<http://www.humminbird.com/normal.asp?id=853>

DTM - Datum Reference

```
         1  2  3   4  5   6  7  8    9
         |  |  |   |  |   |  |  |    |
$ --DTM,ref,x,llll,c,llll,c,aaa,ref*hh<CR><LF>
```

Field Number:
 1) Local datum code.
 2) Local datum subcode. May be blank.
 3) Latitude offset (minutes)
 4) N or S
 5) Longitude offset (minutes)
 6) E or W
 7) Altitude offset in meters
 8) Datum name. What's usually seen here is "W84", the standard
    WGS84 datum used by GPS.
 9) Checksum.

FSI - Frequency Set Information

```
       1      2      3 4 5
       |      |      | | |
$--FSI,xxxxxx,xxxxxx,c,x*hh<CR><LF>
```

Field Number:
 1) Transmitting Frequency
 2) Receiving Frequency
 3) Communications Mode (NMEA Syntax 2)
 4) Power Level
 5) Checksum

GBS - GPS Satellite Fault Detection

```
           1      2   3   4   5   6   7   8   9
           |      |   |   |   |   |   |   |   |
$--GBS,hhmmss.ss,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>
```

Field Number:
 1) UTC time of the GGA or GNS fix associated with this sentence
 2) Expected error in latitude (meters)
 3) Expected error in longitude (meters)
 4) Expected error in altitude (meters)
 5) PRN of most likely failed satellite
 6) Probability of missed detection for most likely failed satellite
 7) Estimate of bias in meters on most likely failed satellite
 8) Standard deviation of bias estimate
 9) Checksum

Note: Source [MX521] describes a proprietary extension of GBS with

a 9th data field.

GGA - Global Positioning System Fix Data
Time, Position and fix related data for a GPS receiver.

```
        1         2       3 4        5 6 7  8   9  10 |  12 13  14   15
        |         |       | |        | | |  |   |   | |   | |   |    |
 $--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
```

 Field Number:
  1) Universal Time Coordinated (UTC)
  2) Latitude
  3) N or S (North or South)
  4) Longitude
  5) E or W (East or West)
  6) GPS Quality Indicator,
     0 - fix not available,
     1 - GPS fix,
     2 - Differential GPS fix
     (values above 2 are 2.3 features)
     3 = PPS fix
     4 = Real Time Kinematic
     5 = Float RTK
     6 = estimated (dead reckoning)
     7 = Manual input mode
     8 = Simulation mode
  7) Number of satellites in view, 00 - 12
  8) Horizontal Dilution of precision (meters)
  9) Antenna Altitude above/below mean-sea-level (geoid) (in meters)
 10) Units of antenna altitude, meters
 11) Geoidal separation, the difference between the WGS-84 earth
     ellipsoid and mean-sea-level (geoid), "-" means mean-sea-level
     below ellipsoid
 12) Units of geoidal separation, meters
 13) Age of differential GPS data, time in seconds since last SC104
     type 1 or 9 update, null field when DGPS is not used
 14) Differential reference station ID, 0000-1023
 15) Checksum

 GLC - Geographic Position, Loran-C

```
                                          12    14
        1    2   3 4   5 6   7 8   9 10  11|   13|
        |    |   | |   | |   | |   | |   | |   | |
 $--GLC,xxxx,x.x,a,x.x,a,x.x,a.x,x,a,x.x,a,x.x,a*hh<CR><LF>
```

 Field Number:
  1) GRI Microseconds/10
  2) Master TOA Microseconds
  3) Master TOA Signal Status
  4) Time Difference 1 Microseconds
  5) Time Difference 1 Signal Status
  6) Time Difference 2 Microseconds
  7) Time Difference 2 Signal Status
  8) Time Difference 3 Microseconds
  9) Time Difference 3 Signal Status
 10) Time Difference 4 Microseconds
 11) Time Difference 4 Signal Status
 12) Time Difference 5 Microseconds
 13) Time Difference 5 Signal Status
 14) Checksum

 GLL - Geographic Position - Latitude/Longitude

```
         1       2 3        4 5         6 7   8
         |       | |        | |         | |   |
 $--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,a,m,*hh<CR><LF>
```

 Field Number:
  1) Latitude
  2) N or S (North or South)
  3) Longitude

```
  4) E or W (East or West)
  5) Universal Time Coordinated (UTC)
  6) Status A - Data Valid, V - Data Invalid
  7) FAA mode indicator (NMEA 2.3 and later)
  8) Checksum

Introduced in NMEA 3.0.

------------------------------------------------------------------------------

 GRS - GPS Range Residuals

                1    2  3  4  5  6  7  8  9 10 11 12 13 14  15
                |    |  |  |  |  |  |  |  |  |  |  |  |  |   |
 $ --GST,hhmmss.ss,m,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,*hh<CR><LF>

 Field Number:
  1) TC time of associated GGA fix
  2) 0 = Residuals used in GGA, 1 = residuals calculated after GGA
  3) Satellite 1 residual in meters
  4) Satellite 2 residual in meters
  5) Satellite 3 residual in meters
  6) Satellite 4 residual in meters (blank if unused)
  7) Satellite 5 residual in meters (blank if unused)
  8) Satellite 6 residual in meters (blank if unused)
  9) Satellite 7 residual in meters (blank if unused)
  10) Satellite 8 residual in meters (blank if unused)
  11) Satellite 9 residual in meters (blank if unused)
  12) Satellite 10 residual in meters (blank if unused)
  13) Satellite 11 residual in meters (blank if unused)
  14) Satellite 12 residual in meters (blank if unused)
  15) Checksum

The order of satellites the same as those in the last GSA.

Example: $GPGRS,024603.00,1,-1.8,-2.7,0.3,,,,,,,,,*6C

------------------------------------------------------------------------------

 GST - GPS Pseudorange Noise Statistics

                1    2 3 4 5 6 7 8   9
                |    | | | | | | |   |
 $ --GST,hhmmss.ss,x,x,x,x,x,x,x,*hh<CR><LF>

 Field Number:
  1) TC time of associated GGA fix
  2) Total RMS standard deviation of ranges inputs to the navigation solution
  3) Standard deviation (meters) of semi-major axis of error ellipse
  4) Standard deviation (meters) of semi-minor axis of error ellipse
  5) Orientation of semi-major axis of error ellipse (true north degrees)
  6) Standard deviation (meters) of latitude error
  7) Standard deviation (meters) of longitude error
  8) Standard deviation (meters) of altitude error
  9) Checksum

------------------------------------------------------------------------------

 GSA - GPS DOP and active satellites

          1 2 3                       14 15  16  17  18
          | | |                        |  |   |   |   |
 $--GSA,a,a,x,x,x,x,x,x,x,x,x,x,x,x,x,x,x.x,x.x,x.x*hh<CR><LF>

 Field Number:
  1) Selection mode
                M=Manual, forced to operate in 2D or 3D
                A=Automatic, 3D/2D
  2) Mode (1 = no fix, 2 = 2D fix, 3 = 3D fix)
  3) ID of 1st satellite used for fix
  4) ID of 2nd satellite used for fix
  ...
  14) ID of 12th satellite used for fix
  15) PDOP
  16) HDOP
  17) VDOP
  18) checksum
```

Robin Darroch writes: "As I understand it, DOP is unit-less, and can only be compared meaningfully to other DOP figures. A DOP of 4 indicates twice the likelihood of a given position error compared with a DOP of 2. The DOP is calculated from the expected errors due to current geometry of the satellites used to obtain the fix. The estimated position errors should show a strong correlation with DOP, but be completely different in value as they are measured in distance units (i.e. metres), and they are trying to tell you "you're very probably within x metres of this point" rather than "I'm about twice as sure of my position as I was a couple of minutes ago".

GSV - Satellites in view

These sentences describe the sky position of a UPS satellite in view. Typically they're shipped in a group of 2 or 3.

```
         1 2 3 4 5 6 7     n
         | | | | | | |     |
$--GSV,x,x,x,x,x,x,x,...*hh<CR><LF>
```

Field Number:
1) total number of GSV messages to be transmitted in this group
2) 1-origin number of this GSV message within current group
3) total number of satellites in view (leading zeros sent)
4) satellite PRN number (leading zeros sent)
5) elevation in degrees (00-90) (leading zeros sent)
6) azimuth in degrees to true north (000-359) (leading zeros sent)
7) SNR in dB (00-99) (leading zeros sent)
more satellite info quadruples like 4-7
n) checksum

Example:
```
    $GPGSV,3,1,11,03,03,111,00,04,15,270,00,06,01,010,00,13,06,292,00*74
    $GPGSV,3,2,11,14,25,170,00,16,57,208,39,18,67,296,40,19,40,246,00*74
    $GPGSV,3,3,11,22,42,067,42,24,14,311,43,27,05,244,00,,,,*4D
```

Some GPS receivers may emit more than 12 quadruples (more than three GPGSV sentences), even though NMEA-0813 doesn't allow this. (The extras might be WAAS satellites, for example.) Receivers may also report quads for satellites they aren't tracking, in which case the SNR field will be null; we don't know whether this is formally allowed or not.

GTD - Geographic Location in Time Differences

```
          1   2   3   4   5  6
          |   |   |   |   |  |
$--GTD,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>
```

Field Number:
1) time difference
2) time difference
3) time difference
4) time difference
5) time difference
n) checksum

GXA - TRANSIT Position - Latitude/Longitude
Location and time of TRANSIT fix at waypoint

```
        1         2       3 4        5 6    7 8
        |         |       | |        | |    | |
$--GXA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,c--c,X*hh<CR><LF>
```

Field Number:
1) UTC of position fix
2) Latitude
3) East or West
4) Longitude
5) North or South

6) Waypoint ID
7) Satelite number
8) Checksum

(The GXA sentence is obsolete as of 3.01.)

HDG - Heading - Deviation & Variation

```
       1   2   3 4   5 6
       |   |   | |   | |
$--HDG,x.x,x.x,a,x.x,a*hh<CR><LF>
```

Field Number:
1) Magnetic Sensor heading in degrees
2) Magnetic Deviation, degrees
3) Magnetic Deviation direction, E = Easterly, W = Westerly
4) Magnetic Variation degrees
5) Magnetic Variation direction, E = Easterly, W = Westerly
6) Checksum

HDM - Heading - Magnetic

Vessel heading in degrees with respect to magnetic north produced by
any device or system producing magnetic heading.

```
       1   2 3
       |   | |
$--HDM,x.x,M*hh<CR><LF>
```

Field Number:
1) Heading Degrees, magnetic
2) M = magnetic
3) Checksum

HDT - Heading - True

Actual vessel heading in degrees true produced by any device or system
producing true heading.

```
       1   2 3
       |   | |
$--HDT,x.x,T*hh<CR><LF>
```

Field Number:
1) Heading Degrees, true
2) T = True
3) Checksum

HFB - Trawl Headrope to Footrope and Bottom

```
        1  2  3  4 5
        |  |  |  | |
$--HFB,x.x,M,y.y,M*hh<CR><LF>
```

Field Number:
1) Distance from headrope to footrope
2) Meters (0-100)
3) Distance from headrope to bottom
4) Meters (0-100)
5) Checksum

From [GLOBALSAT]. Shown with a "@II" leader rather than "$GP".

HSC - Heading Steering Command

```
       1   2 3   4  5
       |   | |   |  |
```

```
 $--HSC,x.x,T,x.x,M,*hh<CR><LF>

 Field Number:
  1) Heading Degrees, True
  2) T = True
  3) Heading Degrees, Magnetic
  4) M = Magnetic
  5) Checksum
```

[GLOBALSAT] describes a completely different meaning for this sentence, having to do with water temperature sensors. It is unclear which is correct.

```
 ITS - Trawl Door Spread 2 Distance

         1  2 3
         |  | |
 $--ITS,x.x,M*hh<CR><LF>

 Field Number)
  1) Second spread distance
  2) Meters
  3) Checksum.
```

From [GLOBALSAT]. Shown with a "@II" leader rather than "$GP".

```
 LCD - Loran-C Signal Data

        1    2   3   4   5   6   7   8   9   10  11  12  13  14
        |    |   |   |   |   |   |   |   |   |   |   |   |   |
 $--LCD,xxxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx*hh<CR><LF>

 Field Number:
  1) GRI Microseconds/10
  2) Master Relative SNR
  3) Master Relative ECD
  4) Time Difference 1 Microseconds
  5) Time Difference 1 Signal Status
  6) Time Difference 2 Microseconds
  7) Time Difference 2 Signal Status
  8) Time Difference 3 Microseconds
  9) Time Difference 3 Signal Status
 10) Time Difference 4 Microseconds
 11) Time Difference 4 Signal Status
 12) Time Difference 5 Microseconds
 13) Time Difference 5 Signal Status
 14) Checksum
```

```
 MSK - Control for a Beacon Receiver

         1  2  3  4  5   6
         |  |  |  |  |   |
 $--MSK,nnn,m,nnn,m,nnn*hh<CR><LF>

 Field Number:
  1) Frequency to use
  2) Frequency mode, A=auto, M=manual
  3) Beacon bit rate
  4) Bitrate, A=auto, M=manual
  5) Frequency for MSS message status (null for no status)
  6) Checksum
```

```
 MSS - Beacon Receiver Status

         1  2  3  4    5   6
         |  |  |  |    |   |
 $--MSS,nn,nn,fff,bbb,xxx*hh<CR><LF>

 Field Number:
```

1) Signal strength (dB 1uV)
2) Signal to noise ratio (dB)
3) Beacon frequency (kHz)
4) Beacon data rate (BPS)
5) Unknown integer value
6) Checksum

MTW - Mean Temperature of Water

```
       1   2 3
       |   | |
$--MTW,x.x,C*hh<CR><LF>
```

Field Number:
1) Degrees
2) Unit of Measurement, Celcius
3) Checksum

[GLOBALSAT] lists this as "Meteorological Temperature of Water", which is probably incorrect.

MWV - Wind Speed and Angle

```
       1   2 3   4 5
       |   | |   | |
$--MWV,x.x,a,x.x,a*hh<CR><LF>
```

Field Number:
1) Wind Angle, 0 to 360 degrees
2) Reference, R = Relative, T = True
3) Wind Speed
4) Wind Speed Units, K/M/N
5) Status, A = Data Valid
6) Checksum

OLN - Omega Lane Numbers

```
       1          2          3          4
       |--------+ |--------+ |--------+ |
$--OLN,aa,xxx,xxx,aa,xxx,xxx,aa,xxx,xxx*hh<CR><LF>
```

Field Number:
1) Omega Pair 1
2) Omega Pair 1
3) Omega Pair 1
4) Checksum

(The OLN sentence is obsolete as of 2.30)

OSD - Own Ship Data

```
       1   2 3   4 5   6 7   8   9 10
       |   | |   | |   | |   |   | |
$--OSD,x.x,A,x.x,a,x.x,a,x.x,x.x,a*hh<CR><LF>
```

Field Number:
1) Heading, degrees true
2) Status, A = Data Valid
3) Vessel Course, degrees True
4) Course Reference
5) Vessel Speed
6) Speed Reference
7) Vessel Set, degrees True
8) Vessel drift (speed)
9) Speed Units
10) Checksum

R00 - Waypoints in active route

```
       1               n
       |               |
$--R00,c---c,c---c,....*hh<CR><LF>
```

Field Number:
 1) waypoint ID
 ...
 n) checksum

RMA - Recommended Minimum Navigation Information

```
                                                      12
       1 2       3 4        5 6   7   8   9   10  11|
       | |       | |        | |   |   |   |   |   | |
$--RMA,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,x.x,x.x,x.x,a*hh<CR><LF>
```

Field Number:
 1) Blink Warning
 2) Latitude
 3) N or S
 4) Longitude
 5) E or W
 6) Time Difference A, uS
 7) Time Difference B, uS
 8) Speed Over Ground, Knots
 9) Track Made Good, degrees true
10) Magnetic Variation, degrees
11) E or W
12) Checksum

RMB - Recommended Minimum Navigation Information

To be sent by a navigation receiver when a destination waypoint is active.

```
                                                        14
       1 2   3 4    5    6       7 8        9 10  11  12  13|  15
       | |   | |    |    |       | |        | |   |   |   | |   |
$--RMB,A,x.x,a,c--c,c--c,llll.ll,a,yyyyy.yy,a,x.x,x.x,x.x,A,m,*hh<CR><LF>
```

Field Number:
 1) Status, A= Active, V = Void
 2) Cross Track error - nautical miles
 3) Direction to Steer, Left or Right
 4) TO Waypoint ID
 5) FROM Waypoint ID
 6) Destination Waypoint Latitude
 7) N or S
 8) Destination Waypoint Longitude
 9) E or W
10) Range to destination in nautical miles
11) Bearing to destination in degrees True
12) Destination closing velocity in knots
13) Arrival Status, A = Arrival Circle Entered
14) FAA mode indicator (NMEA 2.3 and later)
15) Checksum

Example: $GPRMB,A,0.66,L,003,004,4917.24,N,12309.57,W,001.3,052.5,000.5,V*0B

RMC - Recommended Minimum Navigation Information

```
                                                     12
       1         2 3       4 5        6  7   8   9    10 11|  13
       |         | |       | |        |  |   |   |    |  | |   |
$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxx,x.x,a,m,*hh<CR><LF>
```

Field Number:
 1) UTC Time
 2) Status, V=Navigation receiver warning A=Valid
 3) Latitude
 4) N or S
 5) Longitude
 6) E or W

```
  7) Speed over ground, knots
  8) Track made good, degrees true
  9) Date, ddmmyy
 10) Magnetic Variation, degrees
 11) E or W
 12) FAA mode indicator (NMEA 2.3 and later)
 13) Checksum

A status of V means the GPS has a valid fix that is below an internal
quality threshold, e.g. because the dilution of precision is too high
or an elevation mask test failed.
```

```
 ROT - Rate Of Turn

        1   2 3
        |   | |
 $--ROT,x.x,A*hh<CR><LF>

 Field Number:
  1) Rate Of Turn, degrees per minute, "-" means bow turns to port
  2) Status, A means data is valid
  3) Checksum
```

```
 RPM - Revolutions

        1 2 3   4   5 6
        | | |   |   | |
 $--RPM,a,x,x.x,x.x,A*hh<CR><LF>

 Field Number:
  1) Sourse, S = Shaft, E = Engine
  2) Engine or shaft number
  3) Speed, Revolutions per minute
  4) Propeller pitch, % of maximum, "-" means astern
  5) Status, A means data is valid
  6) Checksum
```

```
 RSA - Rudder Sensor Angle

        1   2 3   4 5
        |   | |   | |
 $--RSA,x.x,A,x.x,A*hh<CR><LF>

 Field Number:
  1) Starboard (or single) rudder sensor, "-" means Turn To Port
  2) Status, A means data is valid
  3) Port rudder sensor
  4) Status, A means data is valid
  5) Checksum
```

```
 RSD - RADAR System Data
                                                      14
        1   2   3   4   5   6   7   8   9   10  11 12 13|
        |   |   |   |   |   |   |   |   |   |   |   | | |
 $--RSD,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,a,a*hh<CR><LF>

 Field Number:
  9) Cursor Range From Own Ship
 10) Cursor Bearing Degrees Clockwise From Zero
 11) Range Scale
 12) Range Units
 14) Checksum
```

```
 RTE - Routes

        1   2   3 4 5                       x    n
        |   |   | |   |           |    |
```

```
 $--RTE,x.x,x.x,a,c--c,c--c, ..... c--c*hh<CR><LF>
```

 Field Number:
  1) Total number of messages being transmitted
  2) Message Number
  3) Message mode
     c = complete route, all waypoints
     w = working route, the waypoint you just left, the waypoint you're heading to then all the rest
  4) Waypoint ID
  x) More Waypoints
  n) Checksum

The Garmin 65 and possibly other units report a $GPR00 in the same format.

 SFI - Scanning Frequency Information

```
        1   2   3      4                     x
        |   |   |      |                     |
 $--SFI,x.x,x.x,xxxxxx,c ..........  xxxxxx,c*hh<CR><LF>
```

 Field Number:
  1) Total Number Of Messages
  2) Message Number
  3) Frequency 1
  4) Mode 1
  x) Checksum

 STN - Multiple Data ID

This sentence is transmitted before each individual sentence where there is a need for the Listener to determine the exact source of data in the system. Examples might include dual-frequency depthsounding equipment or equipment that integrates data from a number of sources and produces a single output.

```
        1   2
        |   |
 $--STN,x.x,*hh<CR><LF>
```

 Field Number:
  1) Talker ID Number
  2) Checksum

 TDS - Trawl Door Spread Distance

```
         1  2 3
         |  | |
 $--TDS,x.x,M*hh<CR><LF>
```

 Field Number)
  1) Distance between trawl doors
  2) Meters (0-300)
  3) Checksum.

From [GLOBALSAT]. Shown with a "@II" leader rather than "$GP".

 TFI - Trawl Filling Indicator

```
        1 2 3 4
        | | | |
 $--TFI,x,y,z*hh<CR><LF>
```

 Field number:
  1) Catch sensor #1 (0 = off, 1 = on, 2 = no answer)
  2) Catch sensor #2 (0 = off, 1 = on, 2 = no answer)
  3) Catch sensor #3 (0 = off, 1 = on, 2 = no answer)

From [GLOBALSAT]. Shown with a "@II" leader rather than "$GP".

TPC - Trawl Position Cartesian Coordinates

```
       1 2 3 4  5  6 7
       | | | |  |  | |
$--TPC,x,M,y,P,z.z,M*hh,<CR><LF>
```

Field Number:
1) Horizontal distance from the vessel center line
2) Meters
3) Horizontal distance from the transducer to the trawl along the vessel center line. The value is normally positive assuming the trawl is located behind the vessel.
4) Meters
5) Depth of the trawl below the surface
6) Meters
7) Checksum

From [GLOBALSAT]. Shown with a "@II" leader rather than "$GP".
This entry actually merges their TPC description with another entry labeled (apparently incorrectly) TPT, which differs from the TPT shown below.

TPR - Trawl Position Relative Vessel

```
       1 2 3 4  5  6 7
       | | | |  |  | |
$--TPR,x,M,y,P,z.z,M*hh,<CR><LF>
```

Field Number:
1) Horizontal range relative to target
2) Meters (0-4000)
3) Bearing to target relative to vessel heading. Resolution is one degree.
4) Separator
5) Depth of trawl below the surface
6) Meters (0-2000)
7) Checksum

From [GLOBALSAT]. Shown with a "@II" leader rather than "$GP".

TPT - Trawl Position True

```
       1 2 3 4  5  6 7
       | | | |  |  | |
$--TPT,x,M,y,P,z.z,M*hh,<CR><LF>
```

Field Number:
1) Horizontal range relative to target
2) Meters (0-4000)
3) True bearing to taget (ie. relative north). Resolution is one degree.
4) Separator
5) Depth of trawl below the surface
6) Meters (0-2000)
7) Checksum

From [GLOBALSAT]. Shown with a "@II" leader rather than "$GP".

TRF - TRANSIT Fix Data

```
                                                                  13
       1         2      3       4 5        6 7   8   9   10  11  12|
       |         |      |       | |        | |   |   |   |   |   | |
$--TRF,hhmmss.ss,xxxxxx,llll.ll,a,yyyyy.yy,a,x.x,x.x,x.x,x.x,xxx,A*hh<CR><LF>
```

Field Number:
1) UTC Time
2) Date, ddmmyy
3) Latitude
4) N or S
5) Longitude

6) E or W
7) Elevation Angle
8) Number of iterations
9) Number of Doppler intervals
10) Update distance, nautical miles
11) Satellite ID
12) Data Validity
13) Checksum

(The TRF sentence is obsolete as of 2.3.0)

TTM - Tracked Target Message

```
                                        11     13
       1  2   3   4 5   6   7 8   9   10|    12| 14
       |  |   |   | |   |   | |   |   | |    | | |
$--TTM,xx,x.x,x.x,a,x.x,x.x,a,x.x,x.x,a,c--c,a,a*hh<CR><LF>
```

Field Number:
1) Target Number (0-99)
2) Target Distance
3) Bearing from own ship
4) Bearing Units
5) Target Speed
6) Target Course
7) Course Units
8) Distance of closest-point-of-approach
9) Time until closest-point-of-approach "-" means increasing
10) "-" means increasing
11) Target name
12) Target Status
13) Reference Target
14) Checksum

[GLOBALSAT] gives this in a slightly different form, with 14th and 15th fields conveying time of observation and whether target acquisition was automatic or manual.

VBW - Dual Ground/Water Speed

```
       1   2   3 4   5   6 7
       |   |   | |   |   | |
$--VBW,x.x,x.x,A,x.x,x.x,A*hh<CR><LF>
```

Field Number:
1) Longitudinal water speed, "-" means astern
2) Transverse water speed, "-" means port
3) Status, A = Data Valid
4) Longitudinal ground speed, "-" means astern
5) Transverse ground speed, "-" means port
6) Status, A = Data Valid
7) Checksum

VDR - Set and Drift

```
       1   2 3   4 5   6 7
       |   | |   | |   | |
$--VDR,x.x,T,x.x,M,x.x,N*hh<CR><LF>
```

Field Number:
1) Degress True
2) T = True
3) Degrees Magnetic
4) M = Magnetic
5) Knots (speed of current)
6) N = Knots
7) Checksum

VHW - Water speed and heading

```
        1   2 3   4 5   6 7   8 9
        |   | |   | |   | |   | |
 $--VHW,x.x,T,x.x,M,x.x,N,x.x,K*hh<CR><LF>
```

 Field Number:
  1) Degress True
  2) T = True
  3) Degrees Magnetic
  4) M = Magnetic
  5) Knots (speed of vessel relative to the water)
  6) N = Knots
  7) Kilometers (speed of vessel relative to the water)
  8) K = Kilometers
  9) Checksum

[GLOBALSAT] describes a different format in which the first three fields are water-temperature measurements. It's not clear which is correct.

 VLW - Distance Traveled through Water

```
        1   2 3   4 5
        |   | |   | |
 $--VLW,x.x,N,x.x,N*hh<CR><LF>
```

 Field Number:
  1) Total cumulative distance
  2) N = Nautical Miles
  3) Distance since Reset
  4) N = Nautical Miles
  5) Checksum

 VPW - Speed - Measured Parallel to Wind

```
        1   2 3   4 5
        |   | |   | |
 $--VPW,x.x,N,x.x,M*hh<CR><LF>
```

 Field Number:
  1) Speed, "-" means downwind
  2) N = Knots
  3) Speed, "-" means downwind
  4) M = Meters per second
  5) Checksum

 VTG - Track made good and Ground speed

```
         1  2  3  4  5       6  7  8 9   10
         |  |  |  |  |       |  |  | |   |
 $--VTG,x.x,T,x.x,M,x.x,N,x.x,K,m,*hh<CR><LF>
```

 Field Number:
  1) Track Degrees
  2) T = True
  3) Track Degrees
  4) M = Magnetic
  5) Speed Knots
  6) N = Knots
  7) Speed Kilometers Per Hour
  8) K = Kilometers Per Hour
  9) FAA mode indicator (NMEA 2.3 and later)
  10) Checksum

Note: in some older versions of NMEA 0183, the sentence looks like this:

```
         1  2  3   4  5
         |  |  |   |  |
 $--VTG,x.x,x,x.x,x.x,*hh<CR><LF>
```

 Field Number:

```
  1) True course over ground (degrees) 000 to 359
  2) Magnetic course over ground 000 to 359
  3) Speed over ground (knots) 00.0 to 99.9
  4) Speed over ground (kilometers) 00.0 to 99.9
  5) Checksum

The two forms can be distinguished by field 2, which will be
the fixed text 'T' in the newer form.  The new form appears
to have been introduced with NMEA 3.01 in 2002.

Some devices, such as those described in [GLOBALSAT], leave the
magnetic-bearing fields 3 and 4 empty.

------------------------------------------------------------------------------

 VWR - Relative Wind Speed and Angle

         1  2  3  4  5  6  7  8 9
         |  |  |  |  |  |  |  | |
 $--VWR,x.x,a,x.x,N,x.x,M,x.x,K*hh<CR><LF>

 Field Number:
  1) Wind direction magnitude in degrees
  2) Wind direction Left/Right of bow
  3) Speed
  4) N = Knots
  5) Speed
  6) M = Meters Per Second
  7) Speed
  8) K = Kilometers Per Hour
  9) Checksum

------------------------------------------------------------------------------

 WCV - Waypoint Closure Velocity

        1   2 3    4
        |   | |    |
 $--WCV,x.x,N,c--c*hh<CR><LF>

 Field Number:
  1) Velocity
  2) N = knots
  3) Waypoint ID
  4) Checksum

------------------------------------------------------------------------------

 WNC - Distance - Waypoint to Waypoint

        1   2 3   4 5    6    7
        |   | |   | |    |    |
 $--WNC,x.x,N,x.x,K,c--c,c--c*hh<CR><LF>

 Field Number:
  1) Distance, Nautical Miles
  2) N = Nautical Miles
  3) Distance, Kilometers
  4) K = Kilometers
  5) TO Waypoint
  6) FROM Waypoint
  7) Checksum

------------------------------------------------------------------------------

 WPL - Waypoint Location

          1       2 3        4 5    6
        |       | |        | |    |
 $--WPL,llll.ll,a,yyyyy.yy,a,c--c*hh<CR><LF>

 Field Number:
  1) Latitude
  2) N or S (North or South)
  3) Longitude
  4) E or W (East or West)
  5) Waypoint name
```

6) Checksum

XDR - Cross Track Error - Dead Reckoning

```
       1 2   3 4                         n
       | |   | |           |
$--XDR,a,x.x,a,c--c, ..... *hh<CR><LF>
```

Field Number:
1) Transducer Type
2) Measurement Data
3) Units of measurement
4) Name of transducer
x) More of the same
n) Checksum

XTE - Cross-Track Error, Measured

```
       1 2 3   4 5 6   7
       | | |   | | |   |
$--XTE,A,A,x.x,a,N,m,*hh<CR><LF>
```

Field Number:
1) Status
   V = LORAN-C Blink or SNR warning
   V = general warning flag or other navigation systems when a reliable
       fix is not available
2) Status
   V = Loran-C Cycle Lock warning flag
   A = OK or not used
3) Cross Track Error Magnitude
4) Direction to steer, L or R
5) Cross Track Units, N = Nautical Miles
6) FAA mode indicator (NMEA 2.3 and later, optional)
7) Checksum

XTR - Cross Track Error - Dead Reckoning

```
       1   2 3 4
       |   | | |
$--XTR,x.x,a,N*hh<CR><LF>
```

Field Number:
1) Magnitude of cross track error
2) Direction to steer, L or R
3) Units, N = Nautical Miles
4) Checksum

ZDA - Time & Date - UTC, day, month, year and local time zone

```
         1         2  3  4    5  6  7
       |         |  |  |    |  |  |
$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>
```

Field Number:
1) UTC time (hours, minutes, seconds, may have fractional subsecond)
2) Day, 01 to 31
3) Month, 01 to 12
4) Year (4 digits)
5) Local zone description, 00 to +- 13 hours
6) Local zone minutes description, apply same sign as local hours
7) Checksum

Example: $GPZDA,160012.71,11,03,2004,-1,00*7D

ZFO - UTC & Time from origin Waypoint

```
       1         2         3    4
       |         |         |    |
$--ZFO,hhmmss.ss,hhmmss.ss,c--c*hh<CR><LF>
```

Field Number:
 1) Universal Time Coordinated (UTC)
 2) Elapsed Time
 3) Origin Waypoint ID
 4) Checksum

ZTG - UTC & Time to Destination Waypoint

```
       1         2         3    4
       |         |         |    |
$--ZTG,hhmmss.ss,hhmmss.ss,c--c*hh<CR><LF>
```

Field Number:
 1) Universal Time Coordinated (UTC)
 2) Time Remaining
 3) Destination Waypoint ID
 4) Checksum

****

Found on the web: (data fields unknown)

ASD - Autopilot System Data
DSC - Digital Selective Calling Information
DSE - Extended DSC
DSI - DSC Transponder Initiate
DSR - DSC Transponder Response
MWD - Wind Direction & Speed
TLL - Target Latitude and Longitude
WDR - Distance to Waypoint - Rhumb Line
WDC - Distance to Waypoint - Great Circle
ZDL - Time and Distance to Variable Point

****

Vendor extensions (this list is very incomplete):

PGRME - Garmin Estimated Error

```
       1  2  3  4  5  6  7
       |  |  |  |  |  |  |
$PGRME,hhh,M,vvv,M,ttt,M*hh<CR><LF>
```

Field Number:
  1) Estimated horizontal position error (HPE),
  2) M=meters
  3) Estimated vertical position error (VPE)
  4) M=meters
  5) Overall spherical equivalent position error
  6) M=meters
  7) Checksum

Example: $PGRME,15.0,M,45.0,M,25.0,M*22

PMGNST - Magellan Status

```
         1   2 3  4    5    6  7    8
         |   | |  |    |    |  |    |
$PMGNST,xx.xx,m,t,nnn,xx.xx,nnn,nn,c
```

Field Number:
 1) Firmware version number?
 2) Mode (1 = no fix, 2 = 2D fix, 3 = 3D fix)
 3) T if we have a fix
 4) numbers change - unknown
 5) time left on the GPS battery in hours
 6) numbers change (freq. compensation?)

  7) PRN number receiving current focus
  8) nmea_checksum

 Only supported on Magellan GPSes.

 PRWIZCH - Rockwell Channel Status

 $PRWIZCH,n,s,n,s,n,s,n,s,n,s,n,s,n,s,n,s,n,s,n,s,n,s,c*hh<CR><LF>

 Fields consist of 12 pairs of a satellite PRN followed by a
 signal quality number in the range 0-7 (0 worst, 7 best).

 Only emitted by the now-obsolete Zodiac (Rockwell) chipset.

 PUBX 00 - uBlox Lat/Long Position Data

$PUBX,00,hhmmss.ss,Latitude,N,Longitude,E,AltRef,NavStat,Hacc,Vacc,SOG,COG,Vvel,+ageC,HDOP,VDO
P,TDOP,GU,RU,DR,*hh<CR><LF>

Example:
$PUBX,00,081350.00,4717.113210,N,00833.915187,E,546.589,G3,2.1,2.0,0.007,77.52,0+.007,,0.92,1.
19,0.77,9,0,0*5F<CR><LF>

Only emitted by uBlox Antaris chipset.

 PUBX 01 - uBlox UTM Position Data

The $PUBX,01 is a UTM (Universal Transverse Mercator projection) version
of the $PUBX,00 sentence.

$PUBX,01,hhmmss.ss,Easting,E,Northing,N,AltMSL,NavStat,Hacc,Vacc,SOG,COG,Vvel,ag+eC,HDOP,VDOP,
TDOP,GU,RU,DR,*hh<CR><LF>

Example:
$PUBX,01,075142.00,467125.245,E,5236949.763,N,498.235,G3,2.1,1.9,0.005,85.63,0.0+00,,0.78,0.90
,0.52,12,0,0*65

Only emitted by uBlox Antaris chipset.

 PUBX 03 - uBlox Satellite Status

 $PUBX,03,GT{,ID,s,AZM,EL,SN,LK},*hh<CR><LF>

Example:
$PUBX,03,11,23,-,,,45,010,29,-,,,46,013,07,-
,,,42,015,08,U,067,31,42,025,10,U,19+5,33,46,026,18,U,326,08,39,026,17,-
,,,32,015,26,U,306,66,48,025,27,U,073,10,36,+026,28,U,089,61,46,024,15,-,,,39,014*0D

Only emitted by uBlox Antaris chipset.

(There's no PUBX 02)

 PUBX 04 - uBlox Time of Day and Clock Information

$PUBX,04,hhmmss.ss,ddmmyy,UTC_TOW,week,reserved,Clk_B,Clk_D,PG,*hh<CR><LF>

Example:
$PUBX,04,073731.00,091202,113851.00,1196,113851.00,1930035,-2660.664,43,*3C<CR><+LF>

Only emitted by uBlox Antaris chipset.

Sources:

[NMEA2000]

The NMEA 0183 protocol
http://nmeatool.nmea2000.de/download/0183.pdf
Probably the ancestor of this document.

[DEPRIEST]
"NMEA data"
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[MX521]
"MX521 GPS/DGPS Sensor Installation Manual"
http://www.mx-marine.com/downloads/MX521_Install_manual_051804.pdf
Used for GBS, GRS.

[ZODIAC]
"Zodiac Serial Data Interface Specification"
http://users.rcn.com/mardor/serial.pdf
Used for PRWIZCH.

[GH79L4N]
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http://www.tecsys.de/db/gps/gh79l1an_intant.pdf
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"GPS - NMEA sentence information"
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[NMEAFAQ]
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[UNMEA]
"Understanding NMEA 0183"
http://pcptpp030.psychologie.uni-regensburg.de/trafficresearch/NMEA0183/
Source for the claim that NMEA requires undefined data fields to
be empty.

[NTUM]
"NemaTalker User Manual"
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Source for the claim that Mode Indicator dominates Status.

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"International Standard IEC 61162-1" (preview)
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[SEATALK]
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http://www.thomasknauf.de/seatalk.htm

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"NMEA (National Marine Electronics Association) 0183 Protocol"
http://www.usglobalsat.com/faq_details/NMEA.htm