NMEA Revealed

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NMEA 0183 is a proprietary protocol issued by the National Marine Electronics Association for use in boat navigation and control systems. Because early GPS sensors were designed for compatibility with these systems, GPS reporting protocols are often a small subset of NMEA 0183 or mutated from such as subset. AIS, the Marine Automatic Identification system, also uses NMEA0183-like packet formats.

This document is a list of NMEA 0183 sentences with field descriptions. It is primarily intended to help people understand GPS reports, but also exists because the author finds life-critical protocols with only closed/proprietary documentation deeply offensive.

The master of this document is in asciidoc format at the GPSD project website; you are probably seeing it as a web page. You may encounter versions of it, in plain ASCII, that do not have a revision number and do not list an editor. These are older and should be considered obsolescent.

Sources and Applicable Standards

This collection may originally have been redacted from the document cited as [BETKE]; see the list of sources at the end of this document. The official NMEA 0183 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 appears there is an international standard, IEC 61162-1, published in 2000, that is essentially NMEA 0183. [IEC61162-1] says it "is closely aligned with NMEA 0183 version 2.30". Unfortunately, it costs money and is not redistributable.

This collection of sentences 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, GNS, 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.
- Sentence PASHR from [PASHR].
- Satellite IDs: PRN vs NMEA-ID.
- Error status indications.

Relationship to NMEA 2000

Recently the National Marine Electronics Association has attempted to replace NMEA 0183 with a very differently structured protocol named NMEA 2000. It is binary rather than textual, a profile or interpretation of the Controller Area Network (CAN) protocol used in automotive networking. Unlike NMEA 0183 it is frame-based and cannot be transmitted over serial links.

While newer marine electronics uses this protocol, general-purpose GPSes have not adopted it. Thus we do not attempt to document NMEA 2000 here; see [CANBUS], [NMEA2000], and [KEVERSOFT] instead.

NMEA version timeline

NMEA 2.00	January 1992
NMEA 2.01	August 1994
NMEA 2.10	October 1995
NMEA 2.20	January 1997
NMEA 2.30	March 1998
NMEA 3.00	July 2000
NMEA 3.01	January 2002
NMEA 4.00	November 2008
NMEA 4.10	July 2012

No version earlier than 2.00 is listed or archived on the NMEA website.

The NMEA 4.00 standard states, provocatively, that it is "in theory" backwards compatible to 2.00, and that versions before 2.00 are not forward-compatible [ANON].

NMEA 0183 physical protocol layer

The NMEA specification requires a physical-level protocol compatible with RS422 at 4800bps, 8N1 or 7N2. It is RS422 rather than RS232 because NMEA expects many navigational devices to feed a common serial bus. The data encoding is ASCII with the high data bit not used and zeroed.

Consumer-grade GPS sensors normally report over an RS232 port or a USB port emulating an RS232 serial device; some use Bluetooth. Baud rate is variable, with 9600 probably the most common. Most devices use 8N1; there are rare exceptions that use 7N2 (San Jose Navigation) or even 8O1 (Trimble).

Sentence Mixes and NMEA Variations

Most GPS sensors emit only RMC, GSA, GSV, GLL, VTG, and (rarely) ZDA. Newer ones conforming to NMEA 3.x may emit GBS as well. Other NMEA sentences are usually only emitted by high-end maritime navigation systems.

The form of VTG is incompatibly variable with NMEA version. See the detailed description of that sentence for details.

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 F = RTK Float mode M = Manual Input Mode N = Data Not Valid P = Precise (4.00 and later) R = RTK Integer mode S = Simulated Mode

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].

In NMEA 3.0, the GBS sentence reports a complete set of error estimates. Note however that many receivers claiming to emit "3.0" or "3.01" don't actually ship this sentence.

NMEA Encoding Conventions

Data is transmitted in serial async, 1 start-bit, 8 data-bits, 1 stop-bit, no parity. Data-bits are in least-significant-bit order. The standard specifies 4800 as the speed, but this is no longer common. The most-signifacant-bit is always zero.

An NMEA sentence consists of a start delimiter, followed by a comma-separated sequence of fields, followed by the character '*' (ASCII 42), the checksum and an end-of-line marker.

The start delimiter is normally '$' (ASCII 36). Packets of AIVDM/AIVDO data, which are otherwise formatted like NMEA, use '!'. Up to 4.00 these are the only permitted start characters [ANON].

The first field of a sentence is called the "tag" and normally consists of a two-letter talker ID followed by a three-letter type code.

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.

In NMEA 3.01 (and possibly some earlier versions), the character "^" (HEX 5E) is reserved as an introducer for two-character hex escapes using 0-9 and A-F, expressing an ISO 8859-1 (Latin-1) character [ANON].

The Checksum is mandatory, and the last field in a sentence. It is the 8-bit XOR of all characters in the sentence, excluding the "$", "I", or "*" characters; but including all "," and "^". It is encoded as two hexadecimal characters (0-9, A-F), the most-significant-nibble being sent first.

Sentences are terminated by a <CR><LF> sequence.

Maximum sentence length, including the $ and <CR><LF> is 82 bytes.

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.

Dates and times

NMEA devices report date and time in UTC, aka GMT, aka Zulu time (as opposed to local time). But the way this report is computed results in some odd bugs and inaccuracies.

Date and time in GPS is represented as number of weeks from the start of zero second of 6 January 1980, plus number of seconds into the week. GPS time is not leap-second corrected, though satellites also broadcast a current leap-second correction which may be updated on three-month boundaries according to rotational bulletins issued by the International Earth Rotation and Reference Systems Service (IERS).

The leap-second correction is only included in the multiplexed satellite subframe broadcast, once every 12.5 minutes. While the satellites do notify GPSes of upcoming leap-seconds, this notification is not necessarily processed correctly on consumer-grade devices, and may not be available at all when a GPS receiver has just cold-booted. Thus, reported UTC time may be slightly inaccurate between a cold boot or leap second and the following subframe broadcast.

GPS date and time are subject to a rollover problem in the 10-bit week number counter, which will re-zero every 1024 weeks (roughly every 19.6 years). The first rollover since GPS went live in 1980 was in Aug-1999, followed by Apr-2019, the next will be in Nov-2038 (the 32-bit and POSIX issues will probably be more important by then). The new "CNAV" data format extends the week number to 13 bits, with the first rollover occurring in Jan-2137, but this is only used with some newly added GPS signals, and is unlikely to be usable in most consumer-grade receivers currently.

For accurate time reporting, therefore, a GPS requires a supplemental time references sufficient to identify the current rollover period, e.g. accurate to within 512 weeks. Many NMEA GPSes have a wired-in assumption about the UTC time of the last rollover and will thus report incorrect times outside the rollover period they were designed in.

For these reasons, NMEA GPSes should not be considered high-quality references for absolute time. Some do, however, emit pulse-per-second RS232 signals which can be used to improve the precision of an external clock. See [PPS] for discussion.

Error status indications

The NMEA sentences in the normal GPS inventory return four kinds of validity flags: Mode, Status, the Active/Void bit, and in later versions the FAA indicator mode. The FAA mode field is legally required and orthogonal to the others. Here's how the first three used in various sentences:

	GPRMC	GPGLL	GPGGA	GPGSA
Returns A/V	Yes	Yes	No	No
Returns mode	No	No	No	Yes
Returns status	No	Yes	Yes	No

The "Navigation receiver warning" is 'A' for Active and 'V' for Void. (or warning). You will see it when either there is no satellite lock, or to indicate a valid fix that has a DOP too high, or which fails an elevation test. In the latter case the visible satellites are below some fixed elevation of the horizon (usually 15%, but some GNSS receivers make this adjustable) making position unreliable due to poor geometry and more variable signal lag induced by lengthened atmosphere transit.

Mode is associated with the GSA sentence associated with the last fix. It reports whether the fix was no good, sufficient for 2D, or sufficient for 3D (values 1, 2, and 3).

Status will be 0 when the sample from which the reporting sentence was generated does not have a valid fix, 1 when it has a valid (normal-precision) fix, and 2 when the fig is DGPS corrected (reducing the base error).

In addition, some sentences may use empty fields to signify invalid data. It is not clear whether NMEA 0183 allows this, but real-world software must cope.

Table 1. FAA Mode Indicator

A	Autonomous mode
D	Differential mode
E	Estimated (dead reckoning) mode
M	Manual input mode
S	Simulator mode
N	Data not valid

Talker IDs

NMEA sentences do not identify the individual device that issued them; the format was originally designed for shipboard multidrop networks on which it’s possible only to broadcast to all devices, not address a specific one.

NMEA sentences do, however, include a "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:

Table 2. Common talker IDs

BD	BeiDou (China)
CD	Digital Selective Calling (DSC)
EC	Electronic Chart Display & Information System (ECDIS)
GA	Galileo Positioning System
GB	BeiDou (China)
GL	GLONASS, according to IEIC 61162-1
GN	Combination of multiple satellite systems (NMEA 1083)
GP	Global Positioning System receiver
II	Integrated Instrumentation
IN	Integrated Navigation
LC	Loran-C receiver (obsolete)
QZ	QZSS regional GPS augmentation system (Japan)
GI	NavIC (IRNSS) (India)
Pxxx	Proprietary (Vendor specific)

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.

II — II is emitted by the NMEA interfaces of several widely-used lines of marine-navigation electronics. One is the AutoHelm system by Raymarine; see also [SEATALK] for the native protocol of these devices.

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

CD — Modern marine VHF radios use conventions 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 receiving 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 (misusing) 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).

LC — Loran-C is a marine navigation system formerly run by many governments (USA, Canada, Russia, etc.). It was shut down in most countries by the end of 2010. Norway and France shutdown their's in 2015. Some non-Loran devices emit GLL but use this talker ID for backward-compatibility reasons, so it outlasted the actual Loran-C system.

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.

Note that talker IDs made obsolete by newer revisions of the standards may still be emitted by older devices. Support for them may be present in the GPSD project.

Table 3. Big list of talker IDs

AB	Independent AIS Base Station
AD	Dependent AIS Base Station
AG	Autopilot - General
AP	Autopilot - Magnetic
BD	BeiDou (China)
BN	Bridge navigational watch alarm system
CC	Computer - Programmed Calculator (obsolete)
CD	Communications - Digital Selective Calling (DSC)
CM	Computer - Memory Data (obsolete)
CS	Communications - Satellite
CT	Communications - Radio-Telephone (MF/HF)
CV	Communications - Radio-Telephone (VHF)
CX	Communications - Scanning Receiver
DE	DECCA Navigation (obsolete)
DF	Direction Finder
DM	Velocity Sensor, Speed Log, Water, Magnetic
DU	Duplex repeater station
EC	Electronic Chart Display & Information System (ECDIS)
EP	Emergency Position Indicating Beacon (EPIRB)
ER	Engine Room Monitoring Systems
GA	Galileo Positioning System
GB	BeiDou (China)
GL	GLONASS, according to IEIC 61162-1
GN	Mixed GPS and GLONASS data, according to IEIC 61162-1
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 (obsolete)
LC	Loran C (obsolete)
MP	Microwave Positioning System (obsolete)
NL	Navigation light controller
OM	OMEGA Navigation System (obsolete)
OS	Distress Alarm System (obsolete)
P	Vendor specific
QZ	QZSS regional GPS augmentation system (Japan)
RA	RADAR and/or ARPA
SD	Depth Sounder
SN	Electronic Positioning System, other/general
SS	Scanning Sounder
ST	Skytraq debug output
TI	Turn Rate Indicator
TR	TRANSIT Navigation System
U#	'#' is a digit 0 … 9; User Configured
UP	Microprocessor controller
VD	Velocity Sensor, Doppler, other/general
VW	Velocity Sensor, Speed Log, Water, Mechanical
WI	Weather Instruments
YC	Transducer - Temperature (obsolete)
YD	Transducer - Displacement, Angular or Linear (obsolete)
YF	Transducer - Frequency (obsolete)
YL	Transducer - Level (obsolete)
YP	Transducer - Pressure (obsolete)
YR	Transducer - Flow Rate (obsolete)
YT	Transducer - Tachometer (obsolete)
YV	Transducer - Volume (obsolete)
YX	Transducer
ZA	Timekeeper - Atomic Clock
ZC	Timekeeper - Chronometer
ZQ	Timekeeper - Quartz
ZV	Timekeeper - Radio Update, WWV or WWVH

The canonical list of Talkers is available at [TALKERS] .

Satellite IDs

Satellites may be identified by one of two different numbers in sentences such as GSV: a PRN number associated with their radio code, or an NMEA-ID.

For satellites 1-32, the GPS constellation, these numbers are the same. For satellites associated with WAAS (Wide Area Augmentation System), EGNOS (European Geostationary Navigation Overlay Service), and MSAS (Multi-functional Satellite Augmentation System), they are different.

Here is a table of NMEA-ID allocations above 32 as of March 2010:

System	Satellite	PRN	NMEA-ID
EGNOS	AOR-E	120	33
EGNOS	Artemis	124	37
EGNOS	IOR-W	126	39
MSAS	MTSAT-1	129	42
EGNOS	IOR-E	131	44
WAAS	AMR	133	46
WAAS	PanAm	135	48
MSAS	MTSAT-2	137	50
WAAS	Anik	138	51

Theoretically, all NMEA emitting devices should emit NMEA-IDs. In practice, some pass through PRNs.

To avoid possible confusion caused by repetition of satellite ID numbers when using multiple satellite systems, the following convention has been adopted:

a. GPS satellites are identified by their PRN numbers, which range from 1 to 32.
b. The numbers 33-64 are reserved for WAAS satellites. The WAAS system PRN numbers are 120-138. The offset from NMEA WAAS SV ID to WAAS PRN number is 87. A WAAS PRN number of 120 minus 87 yields the SV ID of 33. The addition of 87 to the SV ID yields the WAAS PRN number.
c. The numbers 65-96 are reserved for GLONASS satellites. GLONASS satellites are identified by 64+satellite slot number. The slot numbers are 1 through 24 for the full constellation of 24 satellites, this gives a range of 65 through 88. The numbers 89 through 96 are available if slot numbers above 24 are allocated to on-orbit spares.

Other sources such as [SATSTAT] confirm that the NMEA standard assigns NMEA IDs 65-96 to GLONASS. The following table is our best guess of NMEA usage in 2018:

1 - 32	GPS
33 - 54	Various SBAS systems (EGNOS, WAAS, SDCM, GAGAN, MSAS)
55 - 64	not used (might be assigned to further SBAS systems)
65 - 88	GLONASS
89 - 96	GLONASS (future extensions?)
97 - 119	not used
120 - 151	not used (SBAS PRNs occupy this range)
152 - 158	Various SBAS systems (EGNOS, WAAS, SDCM, GAGAN, MSAS)
159 - 172	not used
173 - 182	IMES
193 - 197	QZSS
196 - 200	QZSS (future extensions?)
201 - 235	BeiDou (u-blox, not NMEA)
301 - 336	GALILEO
401 - 437	BeiDou (NMEA)

GLONASS satellite numbers come in two flavors. If a sentence has a GL talker ID, expect the skyviews to be GLONASS-only and in the range 1-32; you must add 64 to get a globally-unique NMEA ID. If the sentence has a GN talker ID, the device emits a multi-constellation skyview with GLONASS IDs already in the 65-96 range.

QZSS is a geosynchronous (**not geostationary**) system of three (possibly four) satellites in highly elliptical, inclined, orbits. It is designed to provide coverage in Japan's urban canyons.

BeiDou-1 consists of 4 geostationary satellites operated by China, operational since 2004. Coverage area is the Chinese mainland. gpsd does not support this, as this requires special hardware, and prior arrangements with the operator, who calculates and returns the position fix.

BeiDou-2 (earlier known as COMPASS) is a system of 35 satellites, including 5 geostationary for compatibility with BeiDou-1. As of late 2015, coverage is complete over most of Asia and the West Pacific. It is expected to be fully operational by 2020, by when coverage area is expected to be worldwide.

Note that the PRN system is becoming increasingly fragmented and unworkable. New GPS denote each satellite, and their signals, by their constellation (gnssID), satellite id in that constellation (svId), and signal type (sigId). NMEA, as of version 4, has not adapted.

Obsolete sentences

Note that sentences made obsolete by newer revisions of the standards may still be emitted by devices. Support for them may be present in the GPSD project.

The following NMEA sentences have been designated "obsolete" in a publicly available NMEA document dated 2009.

APA	Autopilot Sentence "A"
BER	Bearing & Distance to Waypoint, Dead Reckoning, Rhumb Line
BPI	Bearing & Distance to Point of Interest
DBK	Depth Below Keel
DBS	Depth Below Surface
DRU	Dual Doppler Auxiliary Data
GDA	Dead Reckoning Positions
GLA	Loran-C Positions
GOA	OMEGA Positions
GXA	TRANSIT Positions
GTD	Geographical Position, Loran-C TDs
GXA	TRANSIT Position
HCC	Compass Heading
HCD	Heading and Deviation
HDM	Heading, Magnetic
HDT	Heading, True
HVD	Magnetic Variation, Automatic
HVM	Magnetic Variation, Manually Set
IMA	Vessel Identification
MDA	Meteorological Composite
MHU	Humidity
MMB	Barometer
MTA	Air Temperature
MWH	Wave Height
MWS	Wind & Sea State
Rnn	Routes
SBK	Loran-C Blink Status
SCY	Loran-C Cycle Lock Status

SCD	Loran-C ECDs
SDB	Loran-C Signal Strength
SGD	Position Accuracy Estimate
SGR	Loran-C Chain Identifier
SIU	Loran-C Stations in Use
SLC	Loran-C Status
SNC	Navigation Calculation Basis
SNU	Loran-C SNR Status
SPS	Loran-C Predicted Signal Strength
SSF	Position Correction Offset
STC	Time Constant
STR	Tracking Reference
SYS	Hybrid System Configuration

NMEA Standard Sentences

Here are the NMEA standard sentences we know about:

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, V = not passed
2. Status, BOOLEAN, A = perpendicular passed at waypoint, V = not passed
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. Sentence Number
3. Satellite PRN number (01 to 32)
4. GPS Week Number
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

Fields 5 through 15 are dumped as raw hex.

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 (Nautical 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 A = Data valid 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. Destination Waypoint
6. origin 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.)

This sentence has been replaced by BWW in NMEA 4.00 (and possibly earlier versions) [ANON].

BWC - Bearing & Distance to Waypoint - Great Circle

```
                                                         12
         1         2       3 4        5 6   7 8   9 10  11|    13 14
         |         |       | |        | |   | |   | |   | |    |   |
  $--BWC,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. UTC Time or observation
2. Waypoint Latitude
3. N = North, S = South
4. Waypoint Longitude
5. E = East, W = West
6. Bearing, degrees True
7. T = True
8. Bearing, degrees Magnetic
9. M = Magnetic
10. Distance, 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

BWR - Bearing and Distance to Waypoint - Rhumb Line

```
                                                       11       14
        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,m*hh<CR><LF>
```

Field Number:

1. UTC Time of observation
2. Waypoint Latitude
3. N = North, S = South
4. Waypoint Longitude
5. E = East, W = West
6. Bearing, degrees True
7. T = True
8. Bearing, degrees Magnetic
9. M = Magnetic
10. Distance, Nautical Miles
11. N = Nautical Miles
12. Waypoint ID
13. FAA mode indicator (NMEA 2.3 and later, optional)
14. Checksum

BWW - Bearing - Waypoint to Waypoint

Bearing calculated at the FROM 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 ID
6. FROM Waypoint ID
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. Water depth, feet
2. f = feet
3. Water depth, meters
4. M = meters
5. Water depth, Fathoms
6. F = Fathoms
7. Checksum

In real-world sensors, sometimes not all three conversions are reported. So you might see something like $SDDBT,,f,22.5,M,,F*cs

Example: $SDDBT,7.8,f,2.4,M,1.3,F*0D

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 Uncertainty
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   4
        |   |   |   |
$--DPT,x.x,x.x,x.x*hh<CR><LF>
```

Field Number:

1. Water depth relative to transducer, meters
2. Offset from transducer, meters positive means distance from transducer to water line negative means distance from transducer to keel
3. Maximum range scale in use (NMEA 3.0 and above)
4. Checksum

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

Example: $INDPT,2.3,0.0*46

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.

Example: $GPDTM,W84,C*52

FSI - Frequency Set Information

Set (or report) frequency, mode of operation and transmitter power level of a radiotelephone.

```
        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 (0 = standby, 1 = lowest, 9 = highest)
 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*hh<CR><LF>
```

Field Number:

1. UTC time of the GGA or GNS fix associated with this sentence
2. Expected 1-sigma error in latitude (meters)
3. Expected 1-sigma error in longitude (meters)
4. Expected 1-sigma error in altitude (meters)
5. ID of most likely failed satellite (1 to 138)
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. The 8-field version is in NMEA 3.0.

Example: $GPGBS,125027,23.43,M,13.91,M,34.01,M*07

GGA - Global Positioning System Fix Data

This is one of the sentences commonly emitted by GPS units.

Time, Position and fix related data for a GPS receiver.

```
                                                       11
         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. UTC of this position report
2. Latitude
3. N or S (North or South)
4. Longitude
5. E or W (East or West)
6. GPS Quality Indicator (non null)
   - 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 use, 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

Example:

$GNGGA,001043.00,4404.14036,N,12118.85961,W,1,12,0.98,1113.0,M,-21.3,M,,*47

GLC - Geographic Position, Loran-C

This sentence is obsolete over most of its former coverage area. The US/Canadian/Russian Loran-C network was shut down in 2010; it is still as of 2015 in limited use in Europe. Loran-C operations in Norway will cease from 1st Jan 2016. [NORWAY]

```
                                            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

This is one of the sentences commonly emitted by GPS units.

```
        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. UTC of this position
6. Status A - Data Valid, V - Data Invalid
7. FAA mode indicator (NMEA 2.3 and later)
8. Checksum

Example: $GNGLL,4404.14012,N,12118.85993,W,001037.00,A,A*67

GNS - Fix data

```
        1         2       3 4        5 6    7  8   9   10  11  12  13
        |         |       | |        | |    |  |   |   |   |   |   |
 $--GNS,hhmmss.ss,llll.ll,a,yyyyy.yy,a,c--c,xx,x.x,x.x,x.x,x.x,x.x*hh
```

Field Number:

1. UTC of position
2. Latitude
3. N or S (North or South)
4. Longitude
5. E or W (East or West)
6. Mode indicator (non-null)
7. Total number of satellites in use, 00-99
8. Horizontal Dilution of Precision, HDOP
9. Antenna altitude, meters, re:mean-sea-level(geoid).
10. Goeidal separation meters
11. Age of differential data
12. Differential reference station ID
13. Navigational status (optional) S = Safe C = Caution U = Unsafe V = Not valid for navigation
14. Checksum

The Mode indicator is one to four characters, with the first and second defined for GPS and GLONASS. Further characters may be defined. For each system, the character can have a value (table may be incomplete):

- A = Autonomous (non-differential)
- D = Differential mode

- E = Estimated (dead reckoning) Mode
- F = RTK Float
- M = Manual Input Mode
- N = Constellation not in use, or no valid fix
- P = Precise (no degradation, like Selective Availability, and hires)
- R = RTK Integer
- S = Simulator Mode

Example: $GPGNS,112257.00,3844.24011,N,00908.43828,W,AN,03,10.5,,,,*57

GRS - GPS Range Residuals

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

Field Number:

1. UTC 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 MUST match those in the last GSA.

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

Note that the talker ID may be GP, GL, or GN, depending on if the residuals are for GPS-only, GLONASS-only, or combined solution, respectively.

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

Example: $GPGST,182141.000,15.5,15.3,7.2,21.8,0.9,0.5,0.8*54

GSA - GPS DOP and active satellites

This is one of the sentences commonly emitted by GPS units.

```
    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, 2D/3D
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
5. ID of 3rd satellite used for fix
6. ID of 4th satellite used for fix
7. ID of 5th satellite used for fix
8. ID of 6th satellite used for fix
9. ID of 7th satellite used for fix
10. ID of 8th satellite used for fix
11. ID of 9th satellite used for fix
12. ID of 10th satellite used for fix
13. ID of 11th satellite used for fix
14. ID of 12th satellite used for fix
15. PDOP
16. HDOP
17. VDOP
18. Checksum

Example: $GNGSA,A,3,80,71,73,79,69,,,,,,,,1.83,1.09,1.47*17

Note: NMEA 4.1+ systems (in particular u-blox 9) emit an extra field just before the checksum.

```
1 = GPS L1C/A, L2CL, L2CM
2 = GLONASS L1 OF, L2 OF
3 = Galileo E1C, E1B, E5 bl, E5 bQ
4 = BeiDou B1I D1, B1I D2, B2I D1, B2I D12
```

GSV - Satellites in view

This is one of the sentences commonly emitted by GPS units.

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 sentences to be transmitted in this group
2. Sentence number, 1-9 of this GSV message within current group
3. total number of satellites in view (leading zeros sent)
4. satellite ID number (leading zeros sent)
5. elevation in degrees (-90 to 90) (leading zeros sent)
6. azimuth in degrees to true north (000 to 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.

Example: $GLGSV,3,3,09,88,07,028,*51

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. Satellite 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

Example: $GPHDT,274.07,T*03

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

Obsolete.

```
        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

MDA - Meteorological Composite

```
        1    2  3    4  5  6 7 8  9 10 11 12 13 14 15 16 17 18 19 20 21
        |    |  |    |  |  | | |  |  |  |  |  |  |  |  |  |  |  |  |  |
 $--MDA,n.nn,I,n.nnn,B,n.n,C,n.C,n.n,n,n.n,C,n.n,T,n.n,M,n.n,N,n.n,M*hh<CR><LF>
```

Field Number:

1. Barometric pressure, inches of mercury, to the nearest 0.01 inch
2. I = inches of mercury
3. Barometric pressure, bars, to the nearest .001 bar
4. B = bars
5. Air temperature, degrees C, to the nearest 0.1 degree C
6. C = degrees C
7. Water temperature, degrees C (this field left blank by WeatherStation)
8. C = degrees C
9. Relative humidity, percent, to the nearest 0.1 percent
10. Absolute humidity, percent
11. Dew point, degrees C, to the nearest 0.1 degree C
12. C = degrees C
13. Wind direction, degrees True, to the nearest 0.1 degree
14. T = true
15. Wind direction, degrees Magnetic, to the nearest 0.1 degree
16. M = magnetic
17. Wind speed, knots, to the nearest 0.1 knot
18. N = knots
19. Wind speed, meters per second, to the nearest 0.1 m/s
20. M = meters per second
21. Checksum

Obsolete as of 2009.

MSK - Control for a Beacon Receiver

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

Field Number:

1. Beacon frequency to use, 283.5-325.0 kHz
2. Frequency mode, A=auto, M=manual
3. Beacon bit rate (25, 50, 100, 200)
4. Bitrate, A=auto, M=manual
5. Interval for MSS message status (null for no status), seconds

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,283.5-325.0 kHz
4. Beacon data rate, 25, 50, 100, 200 bps
5. Channel number
6. Checksum

Example: $GPMSS,0,0,0.000000,200,*5A

MTW - Mean Temperature of Water

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

Field Number:

1. Temperature, degrees
2. Unit of Measurement, Celsius
3. Checksum

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

Example: $INMTW,17.9,C*1B

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 359 degrees
2. Reference, R = Relative, T = True
3. Wind Speed
4. Wind Speed Units, K/M/
5. Status, A = Data Valid, V = Invalid
6. Checksum

OLN - Omega Lane Numbers

Obsolete.

```
       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, V = Invalid
3. Vessel Course, degrees True
4. Course Reference B/M/W/R/P
5. Vessel Speed
6. Speed Reference B/M/W/R/P
7. Vessel Set, degrees True
8. Vessel drift (speed)
9. Speed Units K/N
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. Status, A = Valid, V = Invalid
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 = Invalid
2. Cross Track error - nautical miles

3. Direction to Steer, Left or Right
4. Origin Waypoint ID
5. Destination 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. V = not entered/passed
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

This is one of the sentences commonly emitted by GPS units.

```
                                                            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 of position
2. Status, A = Valid, V = Warning
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.

Example: $GNRMC,001031.00,A,4404.13993,N,12118.86023,W,0.146,,100117,,,A*7B

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

Example: $HEROT,0.0,A*2B

RPM - Revolutions

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

Field Number:

1. Source, S = Shaft, E = Engine
2. Engine or shaft number
3. Speed, Revolutions per minute
4. Propeller pitch, % of maximum, "-" means astern
5. Status, A = Valid, V = Invalid
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 = valid, V = Invalid
3. Port rudder sensor
4. Status, A = valid, V = Invalid
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,a,a*hh<CR><LF>
```

(Some fields are missing from this description.)

Field Number: 1. Origin 1 range 2. Origin 1 bearing 3. Variable Range Marker 1 4. Bearing Line 1 5. Origin 2 range 6. Origin 2 bearing 7. Variable Range Marker 2 8. Bearing Line 2 9. Cursor Range From Own Ship 10. Cursor Bearing Degrees Clockwise From Zero 11. Range Scale 12. Range Units 13. Display rotation (C = course up, H = heading up, N - North up) 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 RE sentences being transmitted
2. Sentence Number
3. Sentence 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. Route ID
5. Waypoint ID
6. Additional waypoint IDs

More waypoints follow. Last field is a checksum as usual.

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

Example: $GPRTE,1,1,c,0*07

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 sentences 2. Sentence Number 3. Frequency 1 4. Mode 1 5. Additional Frequency, Mode pairs 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 depth sounding 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".

TLB - Target Label

```
        1   2   (3) (4)             5
        |   |    |   |              |
 $--TLB,x.x,c--c,x.x,c--c,...,x.x,c--c*hh<CR><LF>
```

Field Number:

1. Target Number (0-99)
2. Label assigned to target
3. (Target number 2)
4. (Label assigned to target number 2)
5. Checksum

Message can contain target number + label pairs up to maximum NMEA message length. Target number references to target number in TTM (and/or TLL) messages.

TLL - Target Latitude and Longitude

```
        1  2       3 4        5 6    7         8 9 10
        |  |       | |        | |    |         | | |
 $--TLL,xx,llll.ll,a,yyyyy.yy,a,c--c,hhmmss.ss,a,a*hh<CR><LF>
```

Field Number:

1. Target Number (0-99)
2. Target Latitude
3. N=north, S=south

4. Target Longitude
5. E=east, W=west
6. Target name
7. UTC of data
8. Status (L=lost, Q=acquisition, T=tracking)
9. R= reference target; null (,,)= otherwise

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 target (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            16
       1  2   3   4 5   6   7 8   9   10|    12| 14       15  |
       |  |   |   | |   |   | |   |   | |    | | |         |  |
$--TTM,xx,x.x,x.x,a,x.x,x.x,a,x.x,x.x,a,c--c,a,a,hhmmss.ss,a*hh<CR><LF>
```

Field Number:

1. Target Number (0-99)
2. Target Distance
3. Bearing from own ship
4. T = True, R = Relative
5. Target Speed
6. Target Course
7. T = True, R = Relative
8. Distance of closest-point-of-approach
9. Time until closest-point-of-approach "-" means increasing
10. Speed/distance units, K/N
11. Target name
12. Target Status
13. Reference Target
14. UTC of data (NMEA 3 and above)
15. Type, A = Auto, M = Manual, R = Reported (NMEA 3 and above)
16. 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   8  0 10 11
       |   |   | |   |   | |   |  |  |  |
$--VBW,x.x,x.x,A,x.x,x.x,A,x.x,A,x.x,A*hh<CR><LF>
```

Field Number:

1. Longitudinal water speed, "-" means astern, knots
2. Transverse water speed, "-" means port, knots

3. Status, A = Data Valid
4. Longitudinal ground speed, "-" means astern, knots
5. Transverse ground speed, "-" means port, knots
6. Status, A = Data Valid
7. Stern traverse water speed, knots *NMEA 3 and above)
8. Status, stern traverse water speed A = Valid (NMEA 3 and above)
9. Stern traverse ground speed, knots *NMEA 3 and above)
10. Status, stern ground speed A = Valid (NMEA 3 and above)
11. 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. Direction degrees, True
2. T = True
3. Direction degrees Magnetic
4. M = Magnetic
5. Current speed, knots
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. Heading degrees, True
2. T = True
3. Heading degrees, Magnetic
4. M = Magnetic
5. Speed of vessel relative to the water, knots
6. N = Knots
7. Speed of vessel relative to the water, km/hr
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   6  7  8  9
        |   | |   | |   |  |  |  |
 $--VLW,x.x,N,x.x,N,x.x,N,x.x,N*hh<CR><LF>
```

Field Number:

1. Total cumulative water distance, nm
2. N = Nautical Miles
3. Water distance since Reset, nm
4. N = Nautical Miles
5. Total cumulative ground distance, nm (NMEA 3 and above)
6. N = Nautical Miles (NMEA 3 and above)
7. Ground distance since reset, nm (NMEA 3 and above)

8. N = Nautical Miles (NMEA 3 and above)
9. 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, knots
2. N = Knots
3. Speed, "-" means downwind, m/s
4. M = Meters per second
5. Checksum

VTG - Track made good and Ground speed

This is one of the sentences commonly emitted by GPS units.

```
         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. Course over ground, degrees True
2. T = True
3. Course over ground, degrees Magnetic
4. M = Magnetic
5. Speed over ground, knots
6. N = Knots
7. Speed over ground, km/hr
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.

Example: $GPVTG,220.86,T,,M,2.550,N,4.724,K,A*34

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  5
        |   | |    |  |
 $--WCV,x.x,N,c--c,a*hh<CR><LF>
```

Field Number:

1. Velocity, knots
2. N = knots
3. Waypoint ID
4. FAA Mode indicator, not null (NMEA 3 and above)
5. 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 - Transducer Measurement

```
        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

There may be any number of quadruplets like this, each describing a sensor. The last field will be a checksum as usual.

Example:

$HCXDR,A,171,D,PITCH,A,-37,D,ROLL,G,367,,MAGX,G,2420,,MAGY,G,-8984,,MAGZ*41

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
   - A - Valid
   - 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 = Valid
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

Example: $GPXTE,V,V,,,N,S*43

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

This is one of the sentences commonly emitted by GPS units.

```
        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 subseconds)
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, 00 to 59, 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. UTC of observation
2. Time Remaining
3. Destination Waypoint ID
4. Checksum

Other sentences

There is evidence for the existence of the following NMEA sentences on the Web:

ACK - Alarm Acknowledgement
ADS - Automatic Device Status
AKD - Acknowledge Detail Alarm Condition
ALA - Set Detail Alarm Condition
ASD - Autopilot System Data
BEC - Bearing & Distance to Waypoint - Dead Reckoning
CEK - Configure Encryption Key Command
COP - Configure the Operational Period, Command
CUR - Water Current Layer
DCR - Device Capability Report
DDC - Display Dimming Control
DOR - Door Status Detection
DSC - Digital Selective Calling Information
DSE - Extended DSC
DSI - DSC Transponder Initiate
DSR - DSC Transponder Response
ETL - Engine Telegraph Operation Status
EVE - General Event Message
FIR - Fire Detection
MWD - Wind Direction & Speed
WDR - Distance to Waypoint - Rhumb Line
WDC - Distance to Waypoint - Great Circle
ZDL - Time and Distance to Variable Point

$CDDSC is described in [CDDSC].

Vendor extensions

This list is very incomplete.

PASHR - RT300 proprietary roll and pitch sentence

```
         1           2   3    4      5      6     7     8     9  10 11 12
         |           |   |    |      |      |     |     |     |   | |  |
$PASHR,hhmmss.sss,hhh.hh,T,rrr.rr,ppp.pp,xxx.xx,a.aaa,b.bbb,c.ccc,d,e*hh<CR><LF>
```

Field number:

1. hhmmss.sss - UTC time
2. hhh.hh - Heading in degrees
3. T - flag to indicate that the Heading is True Heading (i.e. to True North)
4. rrr.rr - Roll Angle in degrees
5. ppp.pp - Pitch Angle in degrees
6. xxx.xx - Heave
7. a.aaa - Roll Angle Accuracy Estimate (Stdev) in degrees
8. b.bbb - Pitch Angle Accuracy Estimate (Stdev) in degrees
9. c.ccc - Heading Angle Accuracy Estimate (Stdev) in degrees
10. d - Aiding Status
11. e - IMU Status
12. hh - Checksum

[PASHR] describes this sentence as NMEA, though other sources say it is Ashtech proprietary and describe a different format.

Example:

$PASHR,085335.000,224.19,T,-01.26,+00.83,+00.00,0.101,0.113,0.267,1,0*06

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

PGRMZ - Garmin Altitude

```
        1  2  3  4
        |  |  |  |
$PGRMZ,hhh,f,M*hh<CR><LF>
```

Field Number:

1. Current Altitude Feet
2. f=feet
3. Mode (1 = no fix, 2 = 2D fix, 3 = 3D fix)
4. Checksum

Example: $PGRMZ,2282,f,3*21

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 receivers.

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,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 - u-blox Lat/Long Position Data

```
$PUBX,00,hhmmss.ss,Latitude,N,Longitude,E,AltRef,NavStat,Hacc,Vacc,SOG,COG,Vvel,+ageC,HDOP,VDOP,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 u-blox Antaris chipset.

PUBX 01 - u-blox 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 u-blox Antaris chipset.

PUBX 03 - u-blox 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,

Only emitted by u-blox Antaris chipset.

(There’s no PUBX 02)

PUBX 04 - u-blox 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 u-blox Antaris chipset.

TMVTD - Transas VTS / SML tracking system report

```
$TMVTD,DDMMYY,hhmmss.ss,a,xxxx,c—c,llll.llll,a,yyyyy.yyyy,a,x.x,a,x.x,a,a*hh<CR><LF>
```

'TM' indicates message generated by SML tracking system. 'VTD' is name of the message.

Field Number:

1. Day/month/year (two-digit year, unknown base century)
2. Hour/minute/second to 0.1 sec precision, UTC.
3. 'R' indicates that this is an update for a radar track. No other values are valid
4. Internal unique ID number. Can't be changed even when target is re-identified
5. Target alias. Can be changed when the target identification data is edited. Symbols "$", "*" "," and "." are not allowed to be used within the alias word. This field is variable length, at most 21v characters.
6. Latitude in degrees (two leading digits) and decimal minutes (trailing digits).
7. N or S for North or South latitude.
8. Longitude in degrees (three leading digits) and decimal minutes (trailing digits).
9. E or W for East or West longitude.
10. Target course in decimal degrees.
11. Fixed to T, indicates true course.
12. Target speed in decimal knots.
13. Fixed to N, indicates decimal speed in knots.
14. T or D. T = tracked, D = dropped. Message with status "dropped" is sent only once after target is dropped.
15. NMEA checksum.

Transas is a mnanufacturer of proprietary ECDIS systems.

Described in [MALTESE], actually a Maltese government document.

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- [SATSTAT] "NMEA IDs" https://github.com/mvglasow/satstat/wiki/NMEA-IDs
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