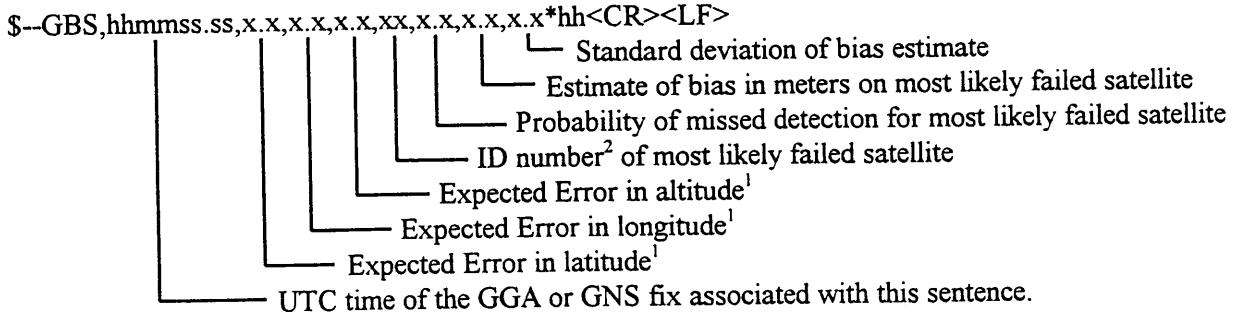
GBS - GNSS Satellite Fault Detection

This message is used to support Receiver Autonomous Integrity Monitoring (RAIM). Given that a GNSS receiver is tracking enough satellites to perform integrity checks of the positioning quality of the position solution a message is needed to report the output of this process to other systems to advise the system user. With the RAIM in the GNSS receiver, the receiver can isolate faults to individual satellites and not use them in its position and velocity calculations. Also, the GNSS receiver can still track the satellite and easily judge when it is back within tolerance. This message shall be used for reporting this RAIM information. To perform this integrity function, the GNSS receiver must have at least two observables in addition to the minimum required for navigation. Normally these observables take the form of additional redundant satellites.

If only GPS, GLONASS, etc. is used for the reported position solution the talker ID is GP, GL, etc. and the errors pertain to the individual system. If satellites from multiple systems are used to obtain the reported position solution the talker ID is GN and the errors pertain to the combined solution.

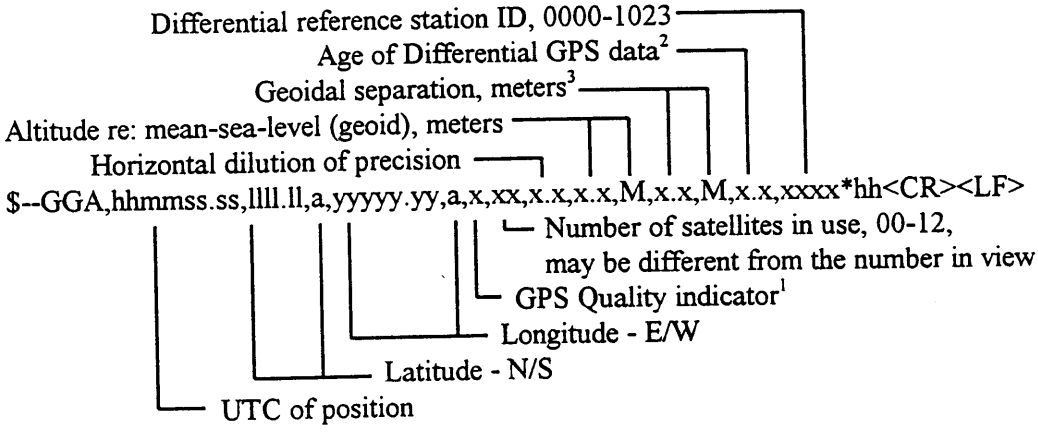


Notes:

1) Expected error in meters due to bias, with noise = 0
2) Satellite ID numbers. 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 WAAS system has reserved numbers 33-64 to identify its satellites.
   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 GLONASS 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.

GGA - Global Positioning System Fix Data

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



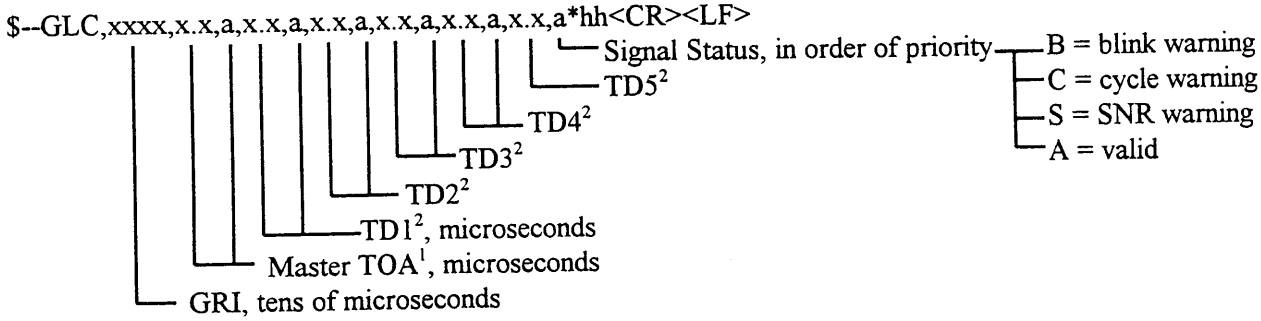
Notes:

1) GPS Quality Indicator:
   0 = Fix not available or invalid
   1 = GPS SPS Mode, fix valid
   2 = Differential GPS, SPS Mode, fix valid
   3 = GPS PPS Mode, fix valid
   4 = Real Time Kinematic. System used in RTK mode with fixed integers
   5 = Float RTK. Satellite system used in RTK mode, floating integers
   6 = Estimated (dead reckoning) Mode
   7 = Manual Input Mode
   8 = Simulator Mode

   The GPS Quality Indicator field shall not be a null field.
2) Time in seconds since last SC104 Type 1 or 9 update, null field when DGPS is not used
3) Geoidal Separation: the difference between the WGS-84 earth ellipsoid surface and mean-sea-level (geoid) surface, "-" = mean-sea-level surface below WGS-84 ellipsoid surface.

GLC - Geographic Position - Loran-C

Loran-C GRI, status and Time Difference (TD) lines of position for present vessel position.

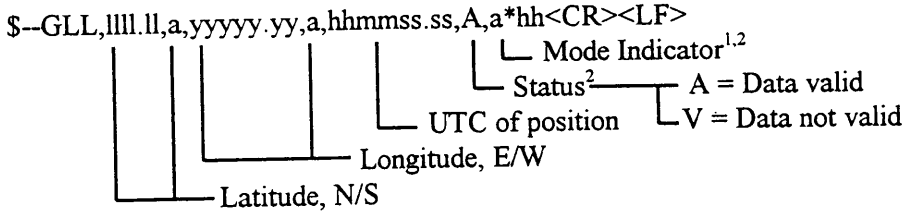


Notes:

1) Master TOA provides for direct ranging operation. It may be the actual range to the Master in microseconds or be offset and track the arrival of the Master signal.
2) Time difference numbers in microseconds are in the Loran-C Coding Delay order with null fields used when values are unavailable.

GLL - Geographic Position - Latitude/Longitude

Latitude and Longitude of vessel position, time of position fix and status.



Notes:

1) Positioning system Mode Indicator:
   A = Autonomous mode
   D = Differential mode
   E = Estimated (dead reckoning) mode
   M = Manual input mode
   S = Simulator mode
   N = Data not valid

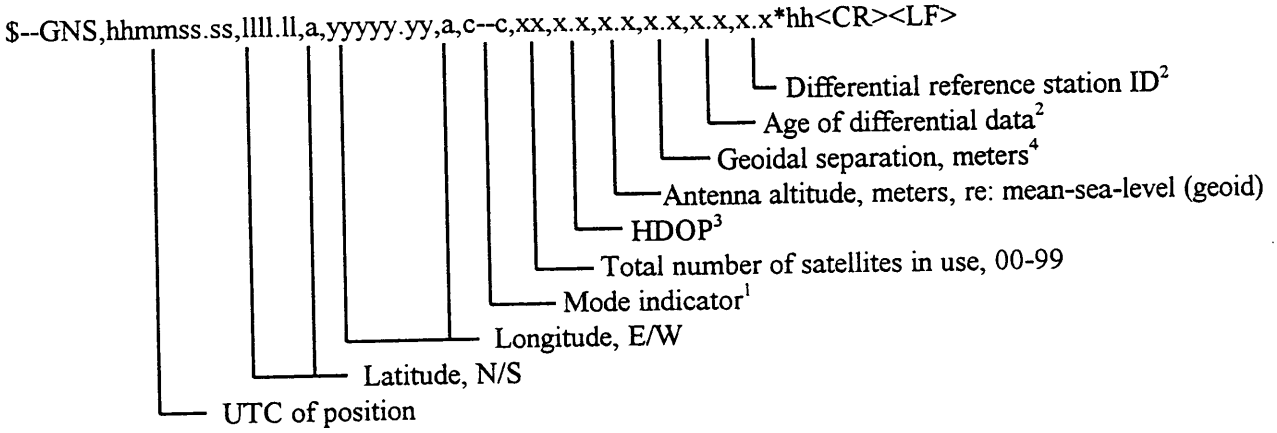
2) The positioning system Mode Indicator field supplements the positioning system Status field, the Status field shall be set to V = Invalid for all values of Indicator mode except for A= Autonomous and D = Differential. The positioning system Mode Indicator and Status fields shall not be null fields.

GNS -GNSS Fix Data

Fix data for single or combined satellite navigation systems (GNSS). This sentence provides fix data for GPS, GLONASS, possible future satellite systems, and systems combining these. This sentence could be used with the talker identification of GP for GPS, GL for GLONASS, GN for GNSS combined systems, as well as future identifiers. Some fields may be null fields for certain applications, as described below.

If a GNSS receiver is capable simultaneously of producing a position using combined satellite systems, as well as a position using only one of the satellite systems, then separate $GPGNS, $GLGNS, etc. messages may be used to report the data calculated from the individual systems.

If a GNSS receiver is set up to use more than one satellite system, but for some reason one or more of the systems are not available, then it may continue to report the positions using $GNGNS, and use the mode indicator to show which satellite systems are being used.



Notes:

1) Mode Indicator. A variable length valid character field type with the first two characters currently defined. The first character indicates the use of GPS satellites, the second character indicates the use of GLONASS satellites. If another satellite system is added to the standard, the mode indicator will be extended to three characters, new satellite systems shall always be added on the right, so the order of characters in the Mode Indicator is: GPS, GLONASS, other satellite systems in the future. The characters shall take one of the following values:

   N = No fix. Satellite system not used in position fix, or fix not valid
   A = Autonomous. Satellite system used in non-differential mode in position fix
   D = Differential. Satellite system used in differential mode in position fix
   P = Precise. Satellite system used in precision mode. Precision mode is defined as: no deliberate degradation (such as Selective Availability) and higher resolution code (P-code) is used to compute position fix
   R = Real Time Kinematic. Satellite system used in RTK mode with fixed integers
   F = Float RTK. Satellite system used in real time kinematic mode with floating integers
   E = Estimated (dead reckoning) Mode
   M = Manual Input Mode
   S = Simulator Mode

   The Mode Indicator shall not be a null field.

2) Age of differential data and Differential Reference Station ID:

Notes:

1) Satellite information may require the transmission of multiple messages. The first field specifies the total number of messages, minimum value 1. The second field identifies the order of this message (message number), minimum value 1.
2) A variable number of "Satellite ID-Elevation-Azimuth-SNR" sets are allowed up to a maximum of four sets per message. Null fields are not required for unused sets when less than four sets are transmitted.
3) Satellite ID numbers. 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 WAAS system has reserved numbers 33-64 to identify its satellites.
   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 GLONASS 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.

*HDG - Heading, Deviation & Variation

Heading (magnetic sensor reading), which if corrected for deviation, will produce Magnetic heading, which if offset by variation will provide True heading.

```
$--HDG,x.x,x.x,a,x.x,a*hh<CR><LF>
        |   |   |   |
        |   |   |   └── Magnetic variation, degrees, E/W[2,3]
        |   |   └────── Magnetic deviation, degrees E/W[1,3]
        |   └────────── Magnetic sensor heading, degrees
```

Notes:

1. To obtain Magnetic Heading:
   Add Easterly deviation (E) to Magnetic Sensor Reading
   Subtract Westerly deviation (W) from Magnetic Sensor Reading
2. To obtain True Heading:
   Add Easterly variation (E) to Magnetic Heading
   Subtract Westerly variation (W) from Magnetic Heading
3. Variation and deviation fields shall be null fields if unknown.

*HDT - Heading, True

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

```
$--HDT,x.x,T*hh<CR><LF>
        |  |
        |  └── Heading, degrees True
```

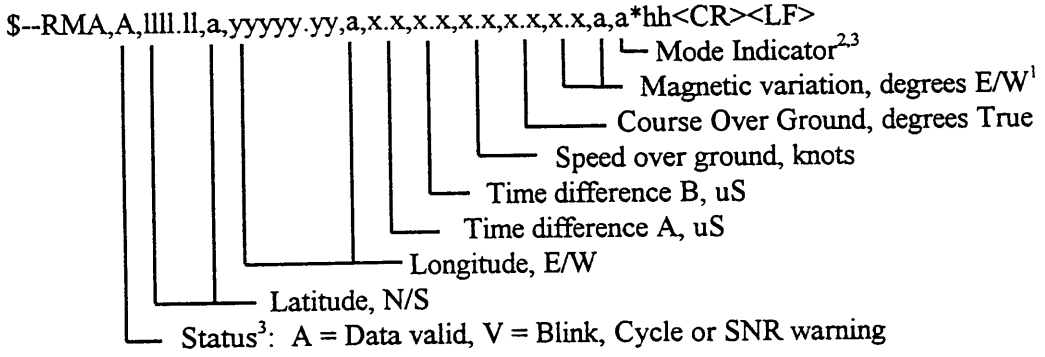
Notes:

1) Reference systems on which the calculation of vessel course and speed is based. The values of course and speed are derived directly from the referenced system and do not additionally include the effects of data in the set and drift fields.

B = Bottom tracking log
M = Manually entered
W = Water referenced
R = radar tracking (of fixed target)
P = Positioning system ground reference

RMA - Recommended Minimum Specific Loran-C Data

Position, course and speed data provided by a Loran-C receiver. Time differences A and B are those used in computing latitude/longitude. This sentence is transmitted at intervals not exceeding 2-seconds and is always accompanied by RMB when a destination waypoint is active. RMA and RMB are the recommended minimum data to be provided by a loran-C receiver. All data fields must be provided, null fields used only when data is temporarily unavailable.



Notes:

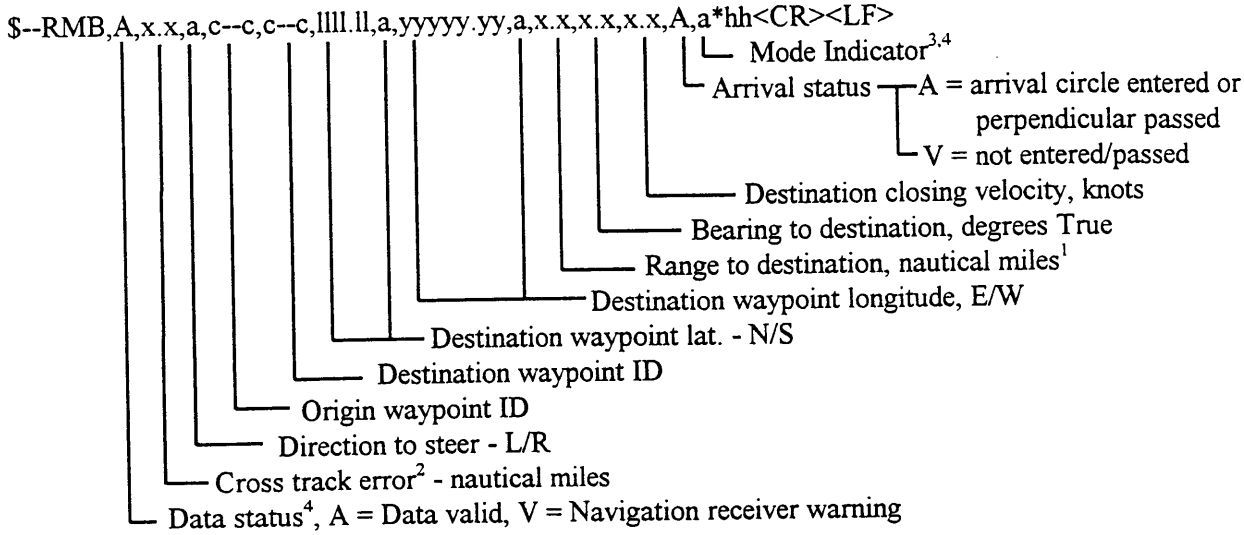
1) Easterly variation (E) subtracts from True course
Westerly variation (W) adds to True course

2) Positioning system Mode Indicator:
A = Autonomous mode
D = Differential mode
E = Estimated (dead reckoning) mode
M = Manual input mode
S = Simulator mode
N = Data not valid

3) The positioning system Mode Indicator field supplements the positioning system Status field, the Status field shall be set to V = Invalid for all values of Indicator mode except for A= Autonomous and D = Differential. The positioning system Mode Indicator and Status fields shall not be null fields.

RMB - Recommended Minimum Navigation Information

Navigation data from present position to a destination waypoint provided by a Loran-C, OMEGA, GNSS, DECCA, navigation computer or other integrated navigation system. This sentence always accompanies RMA or RMC sentences when a destination is active when provided by a Loran-C or GNSS receiver, other systems may transmit $--RMB without $--RMA or $--RMC.

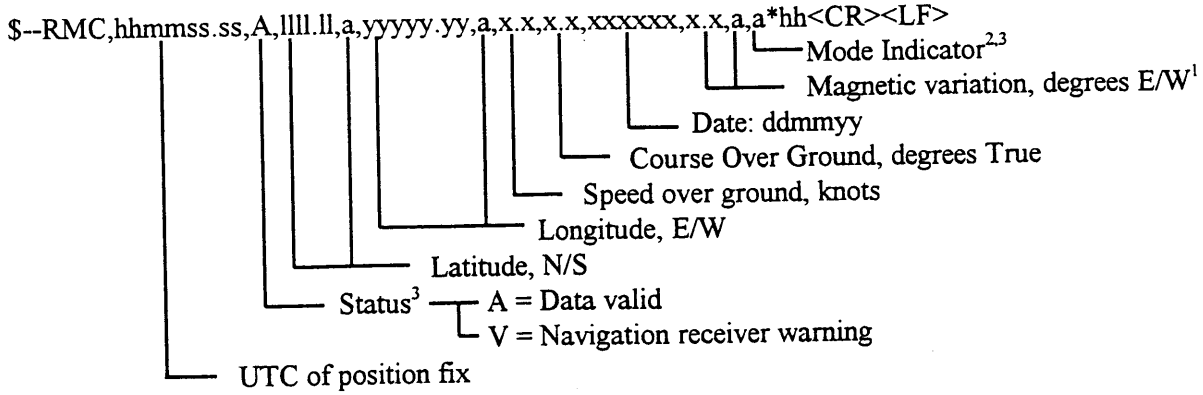


Notes:

1) if range to destination exceeds 999.9 NM, display 999.9
2) if cross track error exceeds 9.99 NM, display 9.99
3) Positioning system Mode Indicator:
   A = Autonomous mode
   D = Differential mode
   E = Estimated (dead reckoning) mode
   M = Manual input mode
   S = Simulator mode
   N = Data not valid
4) The positioning system Mode Indicator field supplements the positioning system Status field, the Status field shall be set to V = Invalid for all values of Indicator mode except for A= Autonomous and D = Differential. The positioning system Mode Indicator and Status fields shall not be null fields.

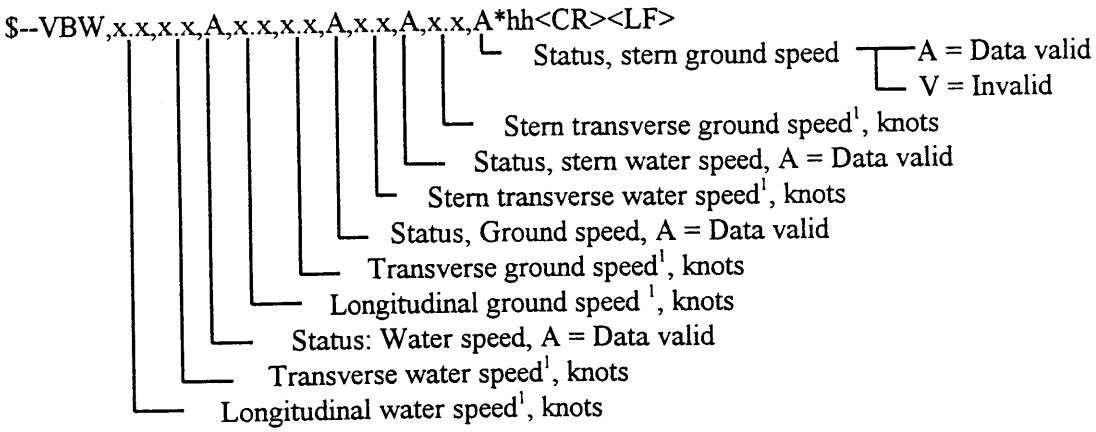
RMC - Recommended Minimum Specific GNSS Data

Time, date, position, course and speed data provided by a GNSS navigation receiver. This sentence is transmitted at intervals not exceeding 2-seconds and is always accompanied by RMB when a destination waypoint is active. RMC and RMB are the recommended minimum data to be provided by a GNSS receiver. All data fields must be provided, null fields used only when data is temporarily unavailable.



*VBW - Dual Ground/Water Speed

Water referenced and ground referenced speed data.

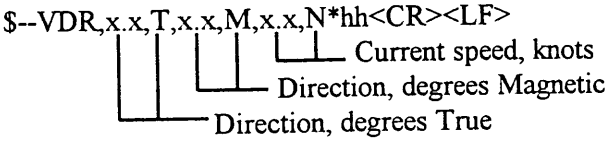


Notes:

1) Transverse speed: "-" = port, Longitudinal speed: "-" = astern

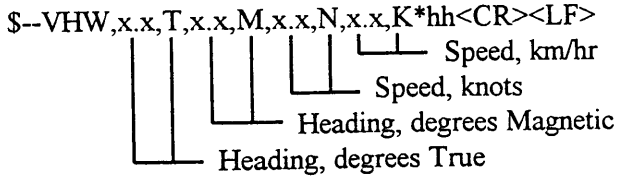
VDR - Set and Drift

The direction towards which a current flows (Set) and speed (Drift) of a current.



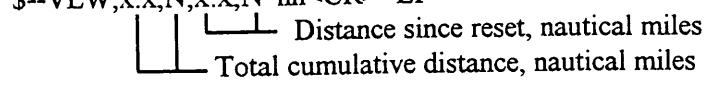
VHW - Water Speed and Heading

The compass heading to which the vessel points and the speed of the vessel relative to the water.



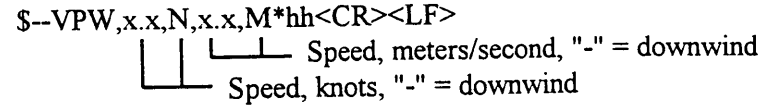
VLW - Distance Traveled through the Water

The distance traveled, relative to the water.



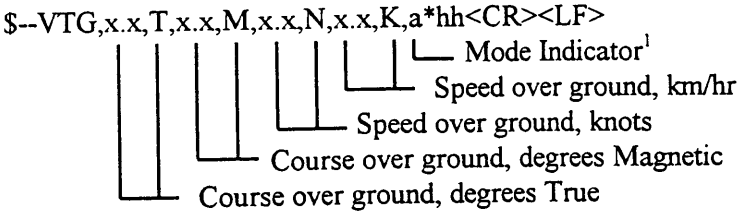
VPW - Speed - Measured Parallel to Wind

The component of the vessel's velocity vector parallel to the direction of the true wind direction. Sometimes called "speed made good to windward" or "velocity made good to windward".



VTG - Course Over Ground and Ground Speed

The actual course and speed relative to the ground.



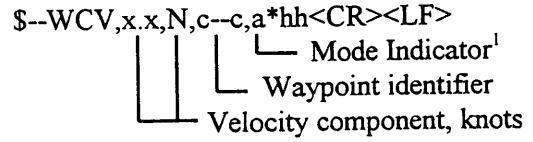
Notes:

1) Positioning system Mode Indicator:
A = Autonomous mode
D = Differential mode
E = Estimated (dead reckoning) mode
M = Manual input mode
S = Simulator mode
N = Data not valid

The positioning system Mode Indicator field shall not be a null field.

WCV - Waypoint Closure Velocity

The component of the velocity vector in the direction of the waypoint, from present position. Sometimes called "speed made good" or "velocity made good".



Notes:

1) Positioning system Mode Indicator:
A = Autonomous mode
D = Differential mode
E = Estimated (dead reckoning) mode
M = Manual input mode
S = Simulator mode
N = Data not valid

The positioning system Mode Indicator field shall not be a null field.

WNC - Distance - Waypoint to Waypoint

Distance between two specified waypoints.