The NMEA 0183 Protocol

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The material presented in this document has been compiled from various unofficial sources. It is neither a complete nor error-free description of the NMEA 0183 standard. In particular, it does not cover the new sentences and the high-speed interface defined in version 3.x.


1. What is the NMEA 0183 Standard?

The National Marine Electronics Association (NMEA) is a non-profit association of manufacturers, distributors, dealers, educational institutions, and others interested in peripheral marine electronics occupations. The NMEA 0183 standard defines an electrical interface and data protocol for communications between marine instrumentation.

NMEA 0183 is a voluntary industry standard, first released in March of 1983. It has been updated from time to time; the latest release, currently (August 2001) Version 3.0, July 2001, is available from the NMEA office (Warning: the price for non-members is 250 US$).

P O Box 3435
New Bern NC 28564-3435
USA
www.nmea.org

NMEA has also established a working group to develop a new standard for data communications among shipboard electronic devices. The new standard, NMEA 2000, is a bi-directional, multi-transmitter, multi-receiver serial data network. It is multi-master and self-configuring, and there is no central controller. The NMEA began a beta testing period in January 2000 with eleven manufacturers. A release version of NMEA 2000 is expected in 2001.
2. Electrical Interface

NMEA 0183 devices are designated as either talkers or listeners (with some devices being both), employing an asynchronous serial interface with the following parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud rate</td>
<td>4800</td>
</tr>
<tr>
<td>Number of data bits</td>
<td>8 (bit 7 is 0)</td>
</tr>
<tr>
<td>Stop bits</td>
<td>1 (or more)</td>
</tr>
<tr>
<td>Parity</td>
<td>none</td>
</tr>
<tr>
<td>Handshake</td>
<td>none</td>
</tr>
</tbody>
</table>

NMEA 0183 allows a single talker and several listeners on one circuit. The recommended interconnect wiring is a shielded twisted pair, with the shield grounded only at the talker. The standard does not specify the use of a particular connector. Note: The new 0183-HS standard (HS = high speed) introduced in version 3.0 uses a 3-wire interface and a baud rate of 38400. This type of interface is not discussed here.

It is recommended that the talker output comply with EIA RS-422, a differential system with two signal lines, "A" and "B". Differential drive signals have no reference to ground and are more immune to noise. However, a single-ended line at TTL level is accepted as well. The voltages on the A line correspond to those on the TTL single wire, while the B voltages are inverted (when output A is at +5 V, output B is at 0 V, and vice versa. This is the unipolar RS-422 operation. In bipolar mode ±5 V are used).

In either case, the recommended receive circuit uses an opto-isolator with suitable protection circuitry. The input should be isolated from the receiver's ground. In practice, the single wire, or the RS-422 "A" wire may be directly connected to a computer's RS-232 input. In fact even many of the latest products, like hand-held GPS receivers, do not have a RS-422 differential output, but just a single line with TTL or 5 V CMOS compatible signal level.

3. General Sentence Format

All data is transmitted in the form of sentences. Only printable ASCII characters are allowed, plus CR (carriage return) and LF (line feed). Each sentence starts with a "$" sign and ends with <CR><LF>. There are three basic kinds of sentences: talker sentences, proprietary sentences and query sentences.

**Talker Sentences.** The general format for a talker sentence is:

```
$ttsss,d1,d2,....<CR><LF>
```

The first two letters following the "$" are the talker identifier. The next three characters (sss) are the sentence identifier, followed by a number of data fields separated by commas, followed by an optional checksum, and terminated by carriage return/line feed. The data fields are uniquely defined for each sentence type. An example talker sentence is:

```
$HCHDM,238,M<CR><LF>
```

where "HC" specifies the talker as being a magnetic compass, the "HDM" specifies the magnetic heading message follows. The "238" is the heading value, and "M" designates the heading value as magnetic.

A sentence may contain up to 80 characters plus "$" and CR/LF. If data for a field is not available, the field is omitted, but the delimiting commas are still sent, with no space between them. The checksum field consists of a "*" and two hex digits representing the exclusive OR of all characters between, but not including, the "$" and "*".

**Proprietary Sentences.** The standard allows individual manufacturers to define proprietary sentence formats. These sentences start with "SP", then a 3 letter manufacturer ID, followed by whatever data the manufacturer wishes, following the general format of the standard sentences. Some proprietary sentences, mainly from Garmin, Inc., are listed in chapter 6.
Query sentences. A query sentence is a means for a listener to request a particular sentence from a talker. The general format is:

```
$t t l Q, s s s, [C R ][L F ]
```

The first two characters of the address field are the talker identifier of the requester and the next two characters are the talker identifier of the device being queried (listener). The fifth character is always a "Q" defining the message as a query. The next field (sss) contains the three letter mnemonic of the sentence being requested. An example query sentence is:

```
$C C G P Q, G G A<C R><L F >
```

where the "CC" device (computer) is requesting from the "GP" device (a GPS unit) the "GGA" sentence. The GPS will then transmit this sentence once per second until a different query is requested.

4. Talker Identifiers

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>AG</td>
<td>Autopilot - General</td>
</tr>
<tr>
<td>AP</td>
<td>Autopilot - Magnetic</td>
</tr>
<tr>
<td>CD</td>
<td>Communications – Digital Selective Calling (DSC)</td>
</tr>
<tr>
<td>CR</td>
<td>Communications – Receiver / Beacon Receiver</td>
</tr>
<tr>
<td>CS</td>
<td>Communications – Satellite</td>
</tr>
<tr>
<td>CT</td>
<td>Communications – Radio-Telephone (MF/HF)</td>
</tr>
<tr>
<td>CV</td>
<td>Communications – Radio-Telephone (VHF)</td>
</tr>
<tr>
<td>CX</td>
<td>Communications – Scanning Receiver</td>
</tr>
<tr>
<td>DF</td>
<td>Direction Finder</td>
</tr>
<tr>
<td>EC</td>
<td>Electronic Chart Display &amp; Information System (ECDIS)</td>
</tr>
<tr>
<td>EP</td>
<td>Emergency Position Indicating Beacon (EPIRB)</td>
</tr>
<tr>
<td>ER</td>
<td>Engine Room Monitoring Systems</td>
</tr>
<tr>
<td>GP</td>
<td>Global Positioning System (GPS)</td>
</tr>
<tr>
<td>HC</td>
<td>Heading – Magnetic Compass</td>
</tr>
<tr>
<td>HE</td>
<td>Heading – North Seeking Gyro</td>
</tr>
<tr>
<td>HN</td>
<td>Heading – Non North Seeking Gyro</td>
</tr>
<tr>
<td>II</td>
<td>Integrated Instrumentation</td>
</tr>
<tr>
<td>IN</td>
<td>Integrated Navigation</td>
</tr>
<tr>
<td>LC</td>
<td>Loran C</td>
</tr>
<tr>
<td>P</td>
<td>Proprietary Code</td>
</tr>
<tr>
<td>RA</td>
<td>RADAR and/or ARPA</td>
</tr>
<tr>
<td>SD</td>
<td>Sounder, Depth</td>
</tr>
<tr>
<td>SN</td>
<td>Electronic Positioning System, other/general</td>
</tr>
<tr>
<td>SS</td>
<td>Sounder, Scanning</td>
</tr>
<tr>
<td>TI</td>
<td>Turn Rate Indicator</td>
</tr>
<tr>
<td>VD</td>
<td>Velocity Sensor, Doppler, other/general</td>
</tr>
<tr>
<td>DM</td>
<td>Velocity Sensor, Speed Log, Water, Magnetic</td>
</tr>
<tr>
<td>VW</td>
<td>Velocity Sensor, Speed Log, Water, Mechanical</td>
</tr>
<tr>
<td>WI</td>
<td>Weather Instruments</td>
</tr>
<tr>
<td>YX</td>
<td>Transducer</td>
</tr>
<tr>
<td>ZA</td>
<td>Timekeeper – Atomic Clock</td>
</tr>
<tr>
<td>ZC</td>
<td>Timekeeper – Chronometer</td>
</tr>
<tr>
<td>ZQ</td>
<td>Timekeeper – Quartz</td>
</tr>
<tr>
<td>ZV</td>
<td>Timekeeper – Radio Update, WWV or WWVH</td>
</tr>
</tbody>
</table>
5. Sentence Identifiers and Formats

AAM  Waypoint Arrival Alarm

1 2 3 4 5 6
| | | | | |
$--AAM,A,A,x.x,N,c--c*hh

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

ALM  GPS Almanac Data

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,hhhhh,hhhhhhh,hhhhhhh,hhhhhhhhh,hhhhhhhhh,hhhhhhhhhhh,h,*,hh

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

APA  Autopilot Sentence "A"

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

1) Status
   V = LORAN-C Blink or SNR warning
   A = 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 kilometres)
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
The NMEA 0183 Protocol

**APB Autopilot Sentence "B"**

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

1) Status
   V = LORAN-C Blink or SNR warning
   A = 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

**ASD Autopilot System Data**

Format unknown

**BEC Bearing & Distance to Waypoint – Dead Reckoning**

```
1 2 3 4 5 6 7 8 9 10 11 12
| | | | | | | | | | | | |
$--BEC,hhmmss.ss,llll.ll,a,yyyy.yy,a,x.x,T,x.x,M,x.x,N,c--c*hh$
```

1) Time (UTC)
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
**BOD**  Bearing – Waypoint to Waypoint

```
1  2  3  4  5  6  7
|   |   |   |   |   |
$--BOD,x.x,T,x.x,M,c--c,c--c*hh
```

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

**BWC**  Bearing and Distance to Waypoint – Latitude, N/S, Longitude, E/W, UTC, Status

```
1         2       3 4        5 6   7 8   9 10  | 12   13
|         |       | |        | |   | |   | |   | |    |
$--BWC,hhmss.ss,llll.ll,a,yyyy.yy,a,x.x,T,x.x,M,x.x,N,c--c*hh
```

1) Time (UTC)
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

**BWR**  Bearing and Distance to Waypoint – Rhumb Line Latitude, N/S, Longitude, E/W, UTC, Status

```
1         2       3 4        5 6   7 8   9 10  | 12   13
|         |       | |        | |   | |   | |   | |    |
$--BWR,hhmss.ss,llll.ll,a,yyyy.yy,a,x.x,T,x.x,M,x.x,N,c--c*hh
```

1) Time (UTC)
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  
|   | |   | |    |    |  
$--BWW,x.x,T,x.x,M,c--c,c--c*hh$

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  
|   | |   | |   | |   |  
$--DBK,x.x,f,x.x,M,x.x,F*hh$

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  
|   | |   | |   | |   |  
$--DBS,x.x,f,x.x,M,x.x,F*hh$

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  
|   | |   | |   | |   |  
$--DBT,x.x,f,x.x,M,x.x,F*hh$

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

**DCN  Decca Position**

obsolete
DPT  Heading – Deviation & Variation

1  2  3
|   |   |
$-$DPT,x.x,x.x*hh

1) Depth, meters
2) Offset from transducer;
   positive means distance from transducer to water line,
   negative means distance from transducer to keel
3) Checksum

DSC  Digital Selective Calling Information

Format unknown

DSE  Extended DSC

Format unknown

DSI  DSC Transponder Initiate

Format unknown

DSR  DSC Transponder Response

Format unknown

DTM  Datum Reference

Format unknown

FSI  Frequency Set Information

1  2  3 4 5
|   |   |   |
$-$FSI,xxxxxx,xxxxxx,c,x*hh

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

GBS  GPS Satellite Fault Detection

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

$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,M,x.x,M,x.x,xxxx*hh

1) Time (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
7) Number of satellites in view, 00 - 12
8) Horizontal Dilution of precision
9) Antenna Altitude above/below mean-sea-level (geoid)
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

$--GLC,xxxx,x.x,a,x.x,a,x.x,a.x,x,a,x.x,a,x.x,a*hh

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

$--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A*hh

1) Latitude
2) N or S (North or South)
3) Longitude
4) E or W (East or West)
5) Time (UTC)
6) Status A - Data Valid, V - Data Invalid
7) Checksum
GRS   GPS Range Residuals

Format unknown

GST   GPS Pseudorange Noise Statistics

Format unknown

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

1) Selection mode
2) Mode
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 in meters
16) HDOP in meters
17) VDOP in meters
18) Checksum

GSV   Satellites in view

1  2  3  4  5  6  7          n
 | | | | | | |          |
$--GSV,x,x,x,x,x,x,x,...*hh

1) total number of messages
2) message number
3) satellites in view
4) satellite number
5) elevation in degrees
6) azimuth in degrees to true
7) SNR in dB
more satellite infos like 4)-7)
n) Checksum

GTD   Geographic Location in Time Differences

1   2   3   4   5   6   7
 |   |   |   |   |   |   |
$--GTD,x.x,x.x,x.x,x.x,x.x,x.x.x.x*hh

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

obsolete
### HDG  Heading – Deviation & Variation

1 2 3 4 5 6
|   |   | |   | |
$--HDG,x.x,x.x,a,x.x,a*hh$

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

1 2 3
|   | |
$--HDM,x.x,M*hh$

1) Heading Degrees, magnetic  
2) M = magnetic  
3) Checksum

### HDT  Heading – True

1 2 3
|   | |
$--HDT,x.x,T*hh$

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

### HSC  Heading Steering Command

1 2 3 4 5
|   | |   | |
$--HSC,x.x,T,x.x,M,*hh$

1) Heading Degrees, True  
2) T = True  
3) Heading Degrees, Magnetic  
4) M = Magnetic  
5) Checksum
**LCD**  **Loran-C Signal Data**

<p>| | | | | | | | | | | | | | | |</p>
<table>
<thead>
<tr>
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</tbody>
</table>
$\text{--LCD,xxxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx*hh}$

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**  **MSK Receiver Interface (for DGPS Beacon Receivers)**

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</tr>
</tbody>
</table>
$\text{GPMSK,xxx.x,xx,xxx,xx,N*hh}$

1) Frequency in kHz (283.5 to 325.0)  
2) Frequency Selection  
   M1 = Manual  
   A1 = Automatic (field 1 empty)  
3) MSK bit rate (100 or 200)  
4) Bit Rate Selection  
   M2 = Manual  
   A2 = Automatic (field 3 empty)  
5) Period of output of performance status message, 0 to 100 seconds ($\text{CRMSS}$)  
6) Checksum

**MSS**  **MSK Receiver Signal Status**

Format unknown

**MWD**  **Wind Direction & Speed**

Format unknown

**MTW**  **Water Temperature**

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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>---</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
$\text{--MTW,x.x,C*hh}$

1) Degrees  
2) Unit of Measurement, Celcius  
3) Checksum
### MWV  Wind Speed and Angle

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</thead>
</table>
|$--MWV,x.x,a,x.x,a*hh$

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

obsolete

### OSD  Own Ship Data

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</table>
|$--OSD,x.x,A,x.x,a,x.x,a,x.x,x.x,a*hh$

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

### ROO  Waypoints in Active Route

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</table>
|$--ROO,c---c,c---c,...*hh$

1) waypoint ID  
...  
n) checksum

### RMA  Recommended Minimum Navigation Information

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</thead>
</table>
|$--RMA,A,1ll1.11,a,yyyy.yy,a,x.x,x.x,x.x,x.x,x.x,a*hh$

1) Blink Warning  
2) Latitude  
3) N or S  
4) Longitude  
5) E or W  
6) Time Difference A, µS  
7) Time Difference B, µS  
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**

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</thead>
<tbody>
<tr>
<td>$--RMB,a,x,x,a,cc,cccc,1111.11,a,yyyy.yy,a,x.x,x.x,x.x,A*hh$</td>
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</tbody>
</table>

1) Status, V = Navigation receiver warning  
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) Checksum

### RMC  
**Recommended Minimum Navigation Information**

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</thead>
<tbody>
<tr>
<td>$--RMC,hhmmss.ss,A,1111.11,a,yyyy.yy,a,x.x,x.x,xxxx,x.x,A*hh$</td>
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</table>

1) Time (UTC)  
2) Status, V = Navigation receiver 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) Checksum

### ROT  
**Rate Of Turn**

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<tr>
<td>$--ROT,x.x,A*hh$</td>
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</table>

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

### RPM  
**Revolutions**

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<tbody>
<tr>
<td>$--RPM,a,x,x.x,x.x,x.x,A*hh$</td>
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</tbody>
</table>

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 means data is valid  
6) Checksum
The NMEA 0183 Protocol

**RSA  Rudder Sensor Angle**

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</thead>
</table>

$--RSA,x.x,A,x.x,A*hh$

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**

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</table>

$--RSD,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,a,a*hh$

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

**RTE  Routes**

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<th>n</th>
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</thead>
</table>

$--RTE,x.x,x.x,a,c--c,c--c, ..... c--c*hh$

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

**SFI  Scanning Frequency Information**

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</thead>
</table>

$--SFI,x.x,x.x,xxxxxx,c .......... xxxxxx,c*hh$

1) Total Number Of Messages
2) Message Number
3) Frequency 1
4) Mode 1
n) Checksum

**STN  Multiple Data ID**

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</table>

$--STN,x.x,*hh$

1) Talker ID Number
2) Checksum
TLL  Target Latitude and Longitude

Format unknown

TRF  TRANSIT Fix Data

obsolete

TTM  Tracked Target Message

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</thead>
</table>
$--TTM,xx,x.x,x.x,a,x.x,x.x,a,x.x,x.x,a,c--c,a,a*hh$

1) Target Number
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

VBW  Dual Ground/Water Speed

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</table>
$--VBW,x.x,x.x,A,x.x,x.x,A*hh$

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

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</thead>
</table>
$--VDR,x.x,T,x.x,M,x.x,N*hh$

1) Degrees 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

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</thead>
</table>
|$--$VHW,x.x,T,x.x,M,x.x,N,x.x,K*hh

1) Degrees 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 = Kilometres
9) Checksum

VLW  Distance Traveled through Water

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</table>
|$--$VLW,x.x,N,x.x,N*hh

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

VPW  Speed – Measured Parallel to Wind

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</thead>
</table>
|$--$VPW,x.x,N,x.x,M*hh

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

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</thead>
</table>
|$--$VTG,x.x,T,x.x,M,x.x,N,x.x,K*hh

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 = Kilometres Per Hour
9) Checksum
VWR  Relative Wind Speed and Angle

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</thead>
</table>
|$--VWR,x.x,a,x.x,N,x.x,M,x.x,K*hh$

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

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</table>
|$--WCV,x.x,N,c--c*hh$

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

WDC  Distance to Waypoint – Great Circle

Format unknown

WDR  Distance to Waypoint – Rhumb Line

Format unknown

WNC  Distance – Waypoint to Waypoint

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</table>
|$--WNC,x.x,N,x.x,K,c--c,c--c*hh$

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

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</thead>
</table>
|$--WPL,llll.ll,a,yyyy.yy,a,c--c*hh$

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

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
| | | | |
$--XTE,A,A,x.x,a,N,*hh

1) Status
   V = LORAN-C blink or SNR warning
   A = 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) Checksum

XTR  Cross Track Error – Dead Reckoning

1 2 3 4
| | | |
$--XTR,x.x,a,N*hh

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,hhmss.ss,xx,xx,xxxx,xx,xx*hh

1) Local zone minutes description, same sign as local hours
2) Local zone description, 00 to +/- 13 hours
3) Year
4) Month, 01 to 12
5) Day, 01 to 31
6) Time (UTC)
7) Checksum

ZDL  Time and Distance to Variable Point

Format unknown
ZFO  UTC & Time from Origin Waypoint

1  2  3  4
|    |    |    |
$--ZFO,hhmmss.ss,hhmmss.ss,c--c*hh

1) Time (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

1) Time (UTC)
2) Time Remaining
3) Destination Waypoint ID
4) Checksum
6. Some Proprietary Sentences

$PGRMC   Sensor Configuration Information

Garmin proprietary sentence

$PGRMC,A,x.x,hh,x.x,x.x,x.x,x.x,x.x,c,c,2,c*hh

1) Fix mode, A=automatic (only option)
2) Altitude above/below mean sea level, -1500.0 to 18000.0 meters
3) Earth datum index. If the user datum index (96) is specified, fields 5-8 must contain valid values. Otherwise, fields 4-8 must be null.
4) User earth datum semi-major axis, 6360000.0 to 6380000.0 meters (.001 meters resolution)
5) User earth datum inverse flattening factor, 285.0 to 310.0 (10^-9 resolution)
6) User earth datum delta x earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
7) User earth datum delta y earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
8) User earth datum delta z earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
9) Differential mode, A = automatic (output DGPS data when available, non-DGPs otherwise), D = differential exclusively (output only differential fixes)
10) NMEA Baud rate, 1 = 1200, 2 = 2400, 3 = 4800, 4 = 9600
11) Filter mode, 2 = no filtering (only option)
12) PPS mode, 1 = No PPS, 2 = 1 Hz
13) Checksum

$PGRME   Estimated Position Error

Garmin proprietary sentence

$PGRME,x.x,M,x.x,M,x.x,M*hh

1) Estimated horizontal position error (HPE)
2) Unit, metres
3) Estimated vertical error (VPE)
4) Unit, metres
5) Overall spherical equivalent position error
6) Unit, metres
7) Checksum
**$PGRMF  Position Fix Sentence**

Garmin proprietary sentence

```
$PGRMF,x.x,x.x,ddmmyy,hhmmss,x.x,ddmm.mmmm,c,dddmm.mmmm,c,c,c,x.x,x.x,c,c*hh
```

1) GPS week number (0 - 1023)
2) GPS seconds (0 - 604799)
3) UTC date of position fix
4) UTC time of position fix
5) GPS leap second count
6) Latitude
7) N or S
8) Longitude
9) E or W
10) Mode
   M = manual
   A = automatic
11) Fix type
   0 = no fix
   1 = 2D fix
   2 = 3D fix
12) Speed over ground, 0 to 999 kilometers/hour
13) Course over ground, 0 to 359 degrees, true
14) Position dilution of precision, 0 to 9 (rounded to nearest integer value)
15) Time dilution of precision, 0 to 9 (rounded to nearest integer value)
16) Checksum

**$PGRMI  Sensor Initialisation Information**

Garmin proprietary sentence

```
$PGRMI,ddmm.mmm,N,ddmm.mmm,E,ddmm.mmm,E,ddmmyy,hhmmss*hh
```

1) Latitude
2) N or S
3) Longitude
4) E or W
5) Current UTC date
6) Current UTC time
7) Checksum

**$PGRMM  Map Datum**

Garmin proprietary sentence

```
$PGRMM,c---c*hh
```

1) Currently active horizontal datum (WGS-84, NAD27 Canada, ED50, a.s.o)
2) Checksum
**$PGRMO**  Output Sentence Enable/Disable

Garmin proprietary sentence

```
1  2  3
|   |   |
$PGRMO,cccc,c*hh
```

1) Target sentence description (e.g., PGRMT, GPGSV, etc.)
2) Target sentence mode
   0 = disable specified sentence
   1 = enable specified sentence
   2 = disable all
   3 = enable all output sentences (except GPALM)
3) Checksum

**$PGRMT**  Sensor Status Information

Garmin proprietary sentence

```
1  2  3  4  5  6  7  8  9  10
|   |   |   |   |   |   |   |   |   |
$PGRMT,c...c,c,c,c,c,c,x.x,c*hh
```

1) Product, model and software version
   e.g. "GPS25VEE] 1.10"
2) Rom checksum test
   P = pass
   F = fail
3) Receiver failure discrete
   P = pass
   F = fail
4) Stored data lost
   R = retained
   L = lost
5) Real time clock lost
   R = retained
   L = lost
6) Oscillator drift discrete
   P = pass
   F = excessive drift detected
7) Data collection discrete
   C = collecting
   null if not collecting
8) Board temperature in degrees C
9) Board configuration data
   R = retained
   L = lost
10) Checksum

**$PGRMV**  3D Velocity

Garmin proprietary sentence

```
1  2  3  4
|   |   |   |
$PGRMV,x.x,x.x,x.x*x*hh
```

1) True east velocity, -999.9 to 9999.9 meters/second
2) True north velocity, -999.9 to 9999.9 meters/second
3) Up velocity, -999.9 to 9999.9 meters/second
4) Checksum
**$PGRMZ  Altitude Information**

Garmin proprietary sentence

```
|   |   |   |
$PGRMZ,x.x,f,h*hh
```

1) Altitude  
2) Unit, feet  
3) Position fix dimensions  
   2 user altitude  
   3 GPS altitude  
4) Checksum

**$PSLIB  Differential GPS Beacon Receiver Control**

Starlink, Inc. proprietary sentence, used by Garmin and others

```
|   |   |   |
$PSLIB,x.x,x.x,c*hh
```

1) Frequency  
2) Bit rate  
3) Request type  
   J = status request  
   K = configuration request  
   blank = tuning message  
4) Checksum
7. Manufacturer Codes

Note: This list is out-of-date, but perhaps still useful.

AAR Asian American Resources
ACE Auto-Comm Engineering Corporation
ACR ACR Electronics, Inc.
ACS Arco Solar, Inc.
ACT Advanced Control Technology
AGI Airguide Instrument Company
AHA Autohelm of America
AIP Aiphone Corporation
ALD Alden Electronics, Inc.
AMT Airmar Technology
ANS Antenna Specialists
ANX Analytxy Electronic Systems
ANZ Anschutz of America
APC Apelco
APN American Pioneer, Inc.
APX Ampex, Inc.
AQC Aqua-Chem, Inc.
AQC Aquodynamics, Inc.
AQM Aqua Meter Instrument Company
ASP American Solar Power
ATE Aetna Engineering
ATM Atlantic Marketing Company, Inc.
ATR Airtron
ATV Activation, Inc.
AVN Advanced Navigation, Inc.
AWA Awa New Zealand, Limited
BBL BBL Industries, Inc.
BBR BBR and Associates
BDV Brisson Development, Inc.
BEC Boat Electric Company
BGS Barringer Geoservice
BGT Brookes and Gatehouse, Inc.
BHE BH Electronics
BHR Bahr Technologies, Inc.
BLB Bay Laboratories
BME Bartel Marine Electronics
BNI Neil Brown Instrument Systems
BNS Bowditch Navigation Systems
BRM Mel Barr Company
BRY Byrd Industries
BTH Benthos, Inc.
BTK Baltek Corporation
BTS Boat Sentry, Inc.
BXA Bendix-Avalex, Inc.
CAT Catel
CBN Cybernet Marine Products
CCA Copal Corporation of America
CCC Coastal Communications Company
CCL Coastal Climate Company
CCM Coastal Communications
CDC Cordic Company
CEC Ceco Communications, Inc.
CHI Charles Industries, Limited
CKM Cinkel Marine Electronics Industries
CMA Societe Nouvelle D'EQuipment du Calvados
CMC Coe Manufacturing Company
CME Cushman Electronics, Inc.
CMP C-Map, s.r.l.
CMS Coastal Marine Sales Company
CMV CourseMaster USA, Inc.
CNV Coastal Navigator
CNX Cynex Manufacturing Company
CPL Computrol, Inc.
CPN Compunav
CPS Columbus Positioning, Inc.
CPT CPT, Inc.
CRE Crystal Electronics, Limited
CRO The Caro Group
CRY Crystek Crystals Corporation
CSI Communication Systems International, Inc.
CSM Comsat Maritime Services
CST Cast, Inc.
CSV Combined Services
CTA Current Alternatives
CTB Cetec Benmar
CCT Cell-tech Communications
CME Digital Marine Electronics Corp.
DMI Datamarine International, Inc.
DNS Dornier System GmbH
DNT Del Norte Technology, Inc.
DPS Danaplus, Inc.
DRL R.L. Drake Company
DSC Dynascan Corporation
DYN Dynamote Corporation
DYM Dytek Laboratories, Inc.
EBC Emergency Beacon Corporation
ECT Echotec, Inc.
EEV EEV, Inc.
EFC Efcom Communication Systems
ELD Electronic Devices, Inc.
EMC Electric Motion Company
EMS Electro Marine Systems, Inc.
ENA Energy Analysts, Inc.
ENC Encron, Inc.
EPM Epsco Marine
EPT Eastprint, Inc.
ERC The Ericsson Corporation
ESA European Space Agency
FDN Fluddyne
FHE Fish Hawk Electronics
FJN Jon Fluke Company
FMM First Mate Marine Autopilots
FNT Franklin Net and Twine, Limited
FRC The Fredericks Company
FTG T.G. Faria Corporation
FUJ Fujitsu Ten Corporation of America
FEC Furuno Electric Company (??)
<table>
<thead>
<tr>
<th>Company</th>
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<td>Standard Communications</td>
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8. References


This document describes the protocol used by Magellan's consumer GPS units, including a number of NMEA 0183 proprietary sentences.


This manual explains the interfacing of the SBA-1 DGPS beacon receiver to numerous GPS units as well as the CSI proprietary sentences used.