Les Trames NMEA

1 - PREAMBULE

NMEA - National Marine & Electronics Association, est une Association à but non lucratif fondée par un groupement de professionnels de l'industrie de l'électronique des périphériques marine, conjointement avec des fabricants, des distributeurs, des revendeurs, des institutions d'enseignements. Leur but entre autre, harmoniser et standardiser les équipements de la marine.

NMEA est à l'origine de nombreux standards et en particulier du Standard NMEA-0183 qui nous intêresse le plus.

Dans ce qui suit, le Standard NMEA est défini "**simplement**" et uniquement pour la compréhension de ce topo, comme étant le **protocole de transmission des données** entre les instruments et équipements électroniques liés au GPS.

La dernière version de ce standard nous précise **"Habot"**, est la **version 2000** (Hé oui, nous n'utilisons pas encore la dernière version). Celle ci, apporte surtout un nouveau média (les Bus CAN, que vous connaissez sans le savoir puisqu'ils équipent vos véhicules depuis plusieurs années déjà), mais pas de changements majeurs dans les dialogues. Nous nous intéresserons donc plus particulièrement à la **version NMEA-0183**, utilisée dans nos appareils actuels.

Les prochains développements seront basés sur la FAQ (en anglais de Peter Bennet), le développement de Glenn Baddeley et quelques autres sources citée en fin d'article). Citons immédiatement, le site de Christian Couderc : **Voilelec** qui est, à notre sens, une référence pour les aspects 'marins' & électroniques du protocole (et en français).

2 - DEFINITION DU STANDARD NMEA-0183

Sous ce standard, toutes les données sont transmises sous la forme des caractères **ASCII**, tous imprimables, ainsi que les caratères **[CR]** Retour Charriot et **[LF]** Retour à la ligne, à la vitesse de transmission de **4800** bauds (7bits, parité ... , ... stop).

Les données sont tranmises sous forme de trames (sentences, phrases).

Il y a une transmission de toutes les trames en paquet, toutes les secondes d'horloge interne du GPS soit une fréquence de 1Hz.

Chaque trame commence par le caractère **$**

Suivi par un groupe de 2 lettres pour l'identifiant du récepteur.(non limitatif) citons:

- **GP** pour Global Positioning System.
- **LC** Loran-C receiver.
- **OM** Omega Navigation receiver.
- **II** Integrated Instrumentation (eg. AutoHelm Seatalk system).

*(Pour certains fabricants propriétaires comme par exemple : **Garmin**, l'indication P pour propriétaire est suivie du code 3 lettres du fabricant garmin = $PGRM, puis ensuite l'identifiant de trame et le format des données sont libres pour ce fabriquant). Des exemples complets sont proposés dans les liens ci-dessous.*

Puis un groupe de 3 lettres pour l'indentifiant de la trame.

- **GGA** : pour GPS Fix et Date.
- **GLL** : pour Positionnement Géographique Longitude-Latitude.
- **GSA** : pour DOP et satellites actifs.
- **GSV** : pour Satellites visibles.
- **VTG** : pour Direction (cap) et vitesse de déplacement (en noeuds et Km/h).
- **RMC**: pour données minimales exploitables spécifiques.

Suivent ensuite un certain nombre de **champs** (fields) séparés par une "**virgule**". Le rôle de la virgule est d'être le séparateur de champs, qui permet la déconcaténation des données dans le programme de traitement des données, calculateur, navigateur.

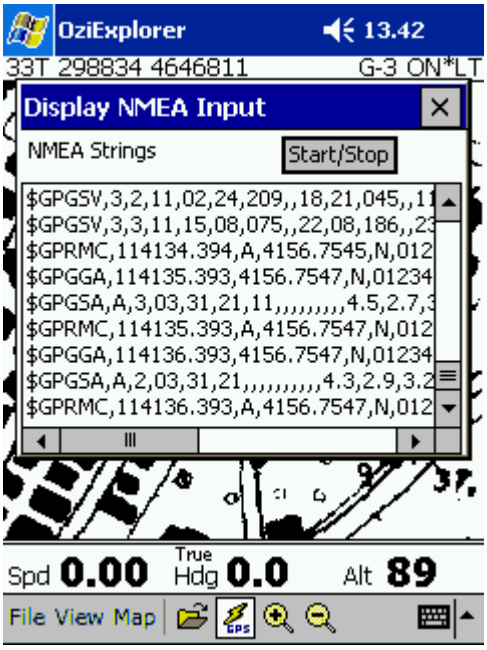
Et enfin un champs optionnel dit checksum précédé du signe * , qui représente le **OR** exclusif de tous les caractères compris entre $ et * (sauf les bornes $ et *), certaines trames exigent le checksum.

Suit la fermeture de la séquence avec un **[CR][LF].**

Un total de **82 caractères** maximum pour une trame.

Et on passe à la trame suivante.

Comme indiqué, le Standard NMEA ne se borne pas qu'à ces 5 trames ci-dessus, et dans les liens vous trouverez accès à la documentation complète du Standard.



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3 -La trame : GGA

Données d'acquisition du FIX - GPS.

$GPGGA,123519,4807.038,N,01131.324,E,1,08,0.9,545.4,M,46.9,M, , *42

123519 = Acquisition du FIX à 12:35:19 UTC
4807.038,N = Latitude 48°07.038' N
01131.324,E = Longitude 11°31.324' E
1 = Fix qualification : (0 = non valide, 1 = Fix GPS, 2 = Fix DGPS)
08 = Nombre de satellites en pousuite.
0.9 = DOP (Horizontal dilution of position) Dilution horizontale.
545.4,M = Altitude, en Metres, au dessus du MSL (mean see level) niveau moyen des Océans.
46.9,M = Correction de la hauteur de la géoïde en Metres par raport à l'ellipsoîde WGS84 (MSL).
(Champ vide) = nombre de secondes écoulées depuis la dernière mise à jour DGPS.
(Champ vide) = Identification de la station DGPS.
***42** = Checksum
Non représentés **CR et LF.**

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4 - La trame : GLL

Position Géographique - Longitude / Latitude - GPS

$GPGLL,4916.45,N,12311.12,W,225444,A

4916.46,N = Latitude 49°6.45' Nord.
12311.12,W = Longitude 123°11.12' West (ouest)
225444 = Acquisition du Fix à 22:54:44 UTC
A = Données valides
Pas de checksum
Non représentés **CR et LF**

---

5 - La Trame : GSA

Satellites actifs - DOP dilution de précision -GPS

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

A= Sélection Automatique 2D ou 3D du FIX (M=Manuel)
3 = Fix 3D
04,05... = PRNs (N° d'Id) des satellites utilisés pour le FIX (maximum 12 satellites)
2.5 = PDOP (dilution de précision)
1.3 = Dilution de précision horizontale(HDOP)
2.1 = Dilution de précision verticale (VDOP)
***39** = Checksum
Non représentés **CR et LF**

Note : La DOP, dilution de précision est une indication de l'effet de la géométrie des satellites sur la précision du Fix.

6 - La trame : GSV

Satellites en vue - GPS

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

2 = Nombre de trames GSV avec les données complètes.
1 = Trame 1 de 2 trames (jusqu'à 3 trames)
08 = Nombre de satellites visibles (SV).
01 = N° d'identification du 1er Satellite.
40 = Elevation en degrés du 1er Satellite.
083 = Azimuth en degrés du 1er Satellite.
46 = Force du signal du 1er Satellite (Plus grand=meilleur)

(***Cette séquence se répète jusqu'à 4 satellites par trames.***
On peut donc avoir jusqu'à 3 trames GSV dans une transmision (12 satellites).)
***75** = cheksum
non représentés les **CR et LF**

Ce qui vous explique la **limitation à 12 satellites** de nos petits appareils.

7 -La trame : VTG

Cap (direction) et vitesse sol GPS

$GPVTG,054.7,T,034.4,M,005.5,N,010.2,K

054.7,T = cap réel en Degrés , T (True track made good)
034.4,M = cap vrai magnétique en Degrés (Magnetic track made good)
005.5,N = Vitesse du déplacement par rapport au sol en Noeuds (N)
010.2,K = Vitesse du déplacement par rapport au sol en Kilomètres heure. (K)
non représentés **CR et LF**

8 - La Trame RMC

Données minimales recommandées de spécification GPS

$GPRMC,225446,A,4916.45,N,12311.12,W,000.5,054.7,191194,020.3,E*68

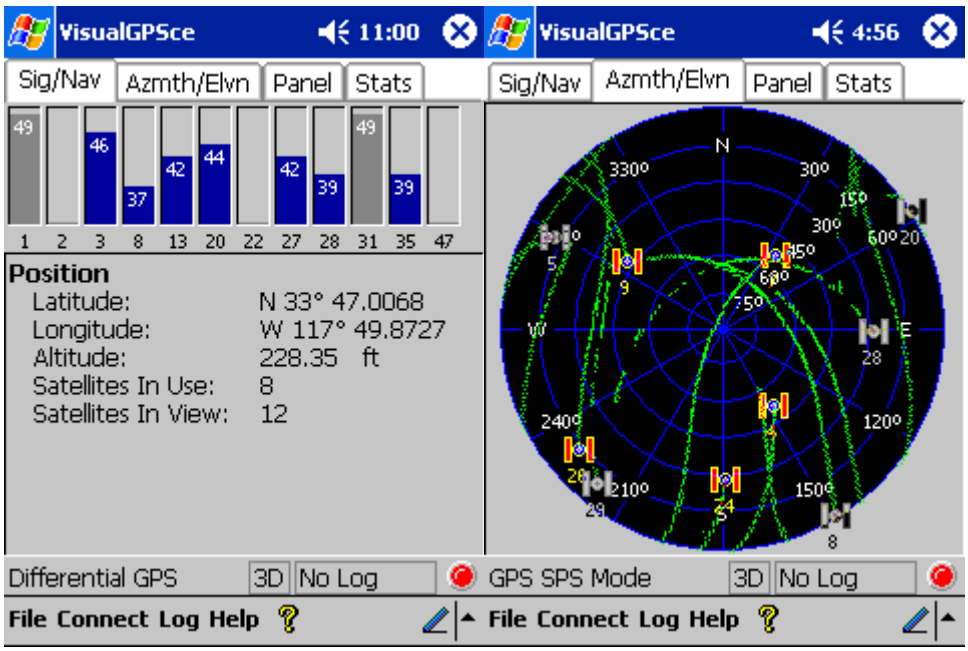
225446 = Heure du Fix 22:54:46 UTC
A = Alerte du logigiel de navigation (A = OK, V = warning (alerte)
4916.45,N = Latitude 49°16.45' North
12311.12,W = Longitude 123°11.12' West
000.5 = vitesse sol, Knots
054.7 = cap (vrai)
191194 = Date du fix 19 Novembre 1994
020.3,E = Déclinaison Magnetique 20.3 deg Est
***68** = checksum obligatoire
Non représentés **CR et LF**

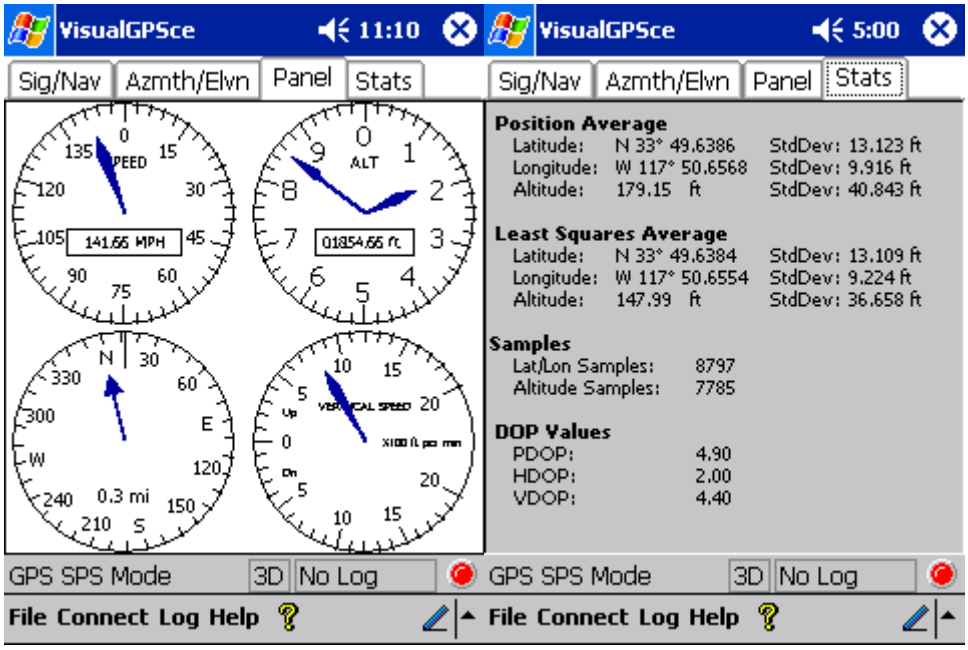
Ces données "minimales" , sont le plus souvent utilisées dans les programmes de navigation-GPS simples.

9 - Comment visualiser les trames.

Quelques logiciels gratuits de traitement et visualisation.

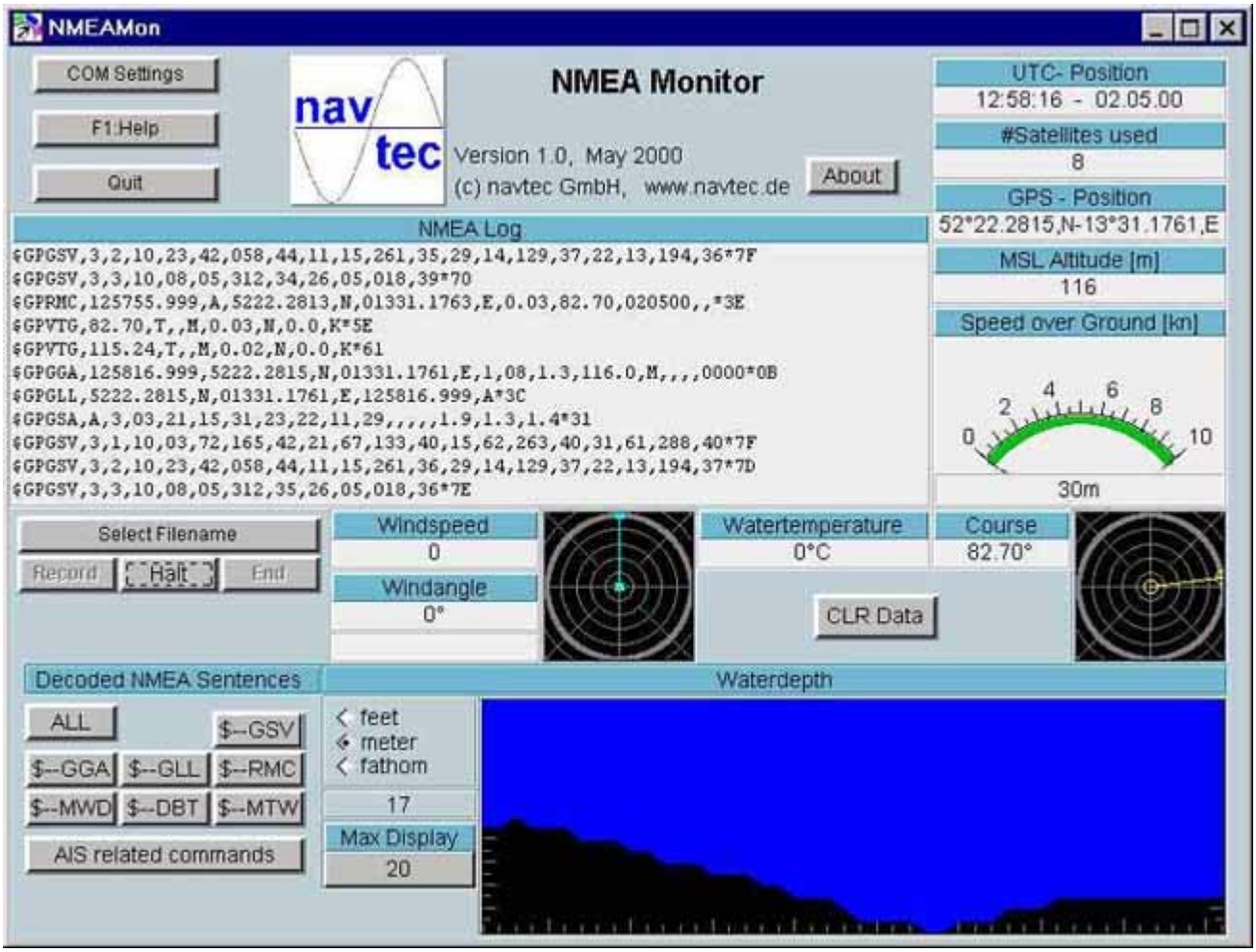
VisualGPS-ce : Lien





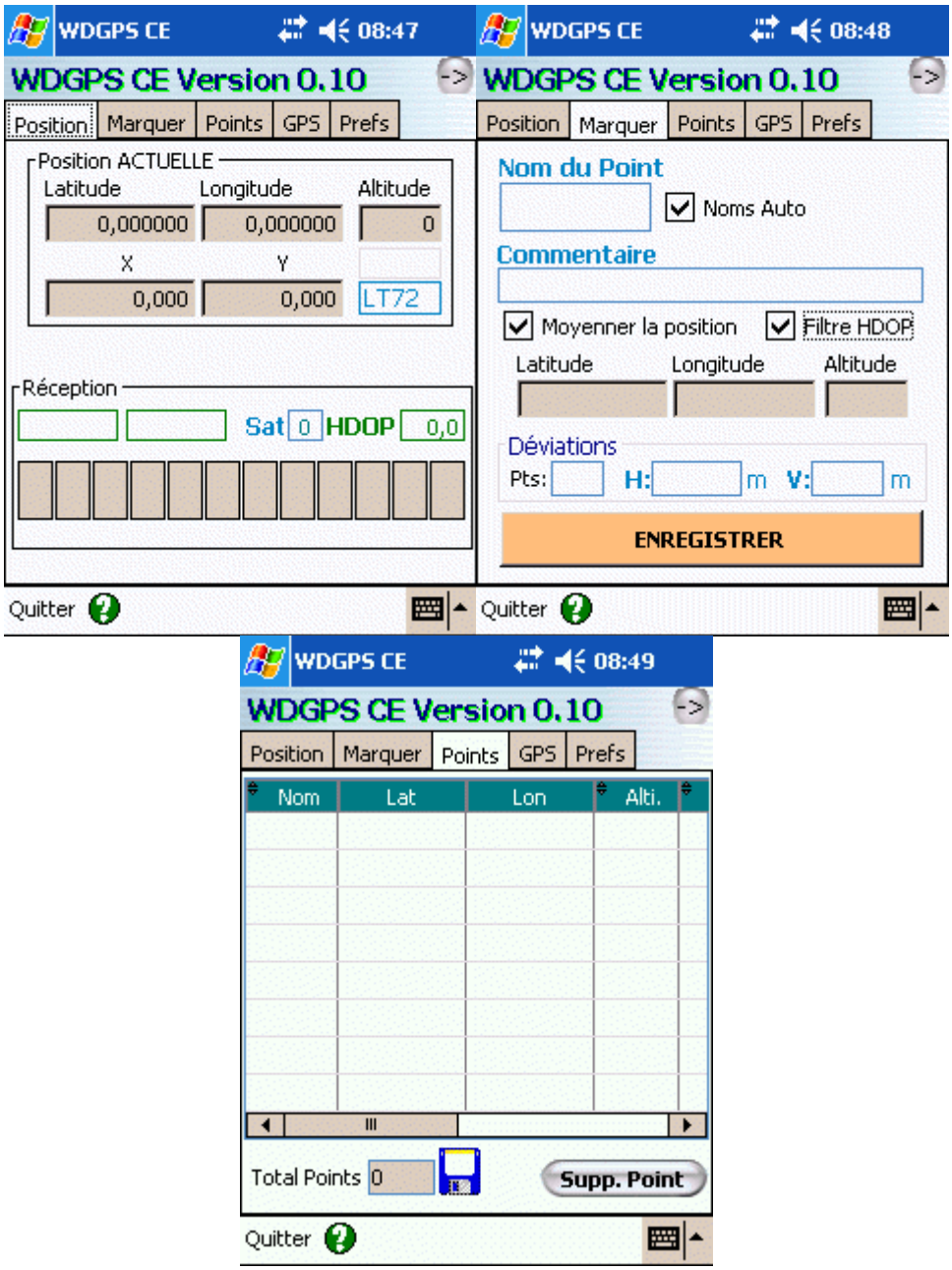
VisualGPS PC : Lien .

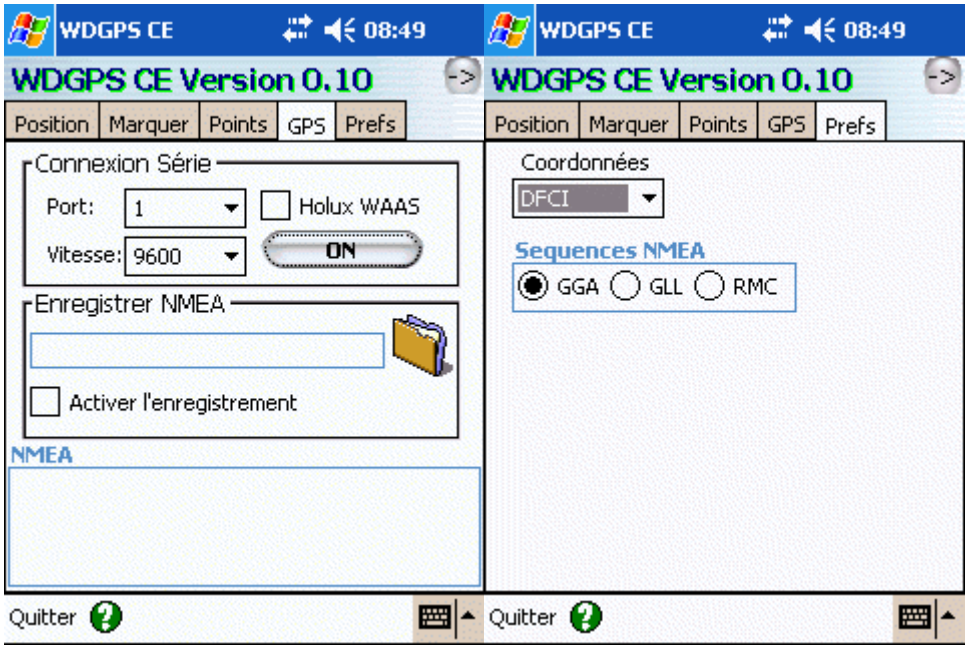
NAVTEC NMEA Monitor : Lien



WDGPS : Lien

WDGPS pour PPC : [Lien]





TomTom : Dont le driver enregistre les trames NMEA, qu'il est possible de récupérer et de visualiser avec un éditeur.

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10 - Liens Intéressants

- Site de Christian Couderc Voilelec
- Le site de l'Association NMEA
- Topic de Boris Analyse Flux NMEA
- Topic d'Hibernatus Activation signal VTG
- Harware explained en Anglais GpsPassion
- NMEA-0183 and GPS Information Par Peter Bennett
- Toujours de Peter Bennett La F.A.Q. Le texte
- De Glenn Baddeley GPS - NMEA sentence information
- Topic de Geideon Coyote besoin de vos tests.
- les posts des membres dans le Forum.
  [*] Lien Donné par Alinus dans Cette Discussion

The NMEA FAQ
Version 6.6 Jan 30, 2008

Additions, corrections, and comments should be emailed to the author,
Peter Bennett peterbb4@interchange.ubc.ca
Contents:

1. What is NMEA?

The National Marine Electronics Association is dedicated to the education and advancement of the marine electronics industry and the market which it serves.

It is a non-profit association composed of manufacturers, distributors, dealers, educational institutions, and others interested in peripheral marine electronics occupations
(quoted from a promo in "NMEA News")

1.1 What is an NMEA standard?

For the purposes of this article, an NMEA standard defines an electrical interface and data protocol for communications between marine instrumentation. (They may also have standards for other things.)

1.2 NMEA Address

NMEA
7 Riggs Avenue
Severna Park, MD 21146

Beth Kahr
President
Phone: 410-975-9425
email: director@nmea.org
Visit us at www.nmea.org

2. Electrical Interface

These standards allow 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 standards do not specify the use of any particular connector.

The NMEA-0180 and 0182 standards say that the talker output may be RS-232, or from a TTL buffer, capable of delivering 10 mA at 4 V. A sample circuit shows an open collector TTL buffer with a 680 ohm resistor to +12 V, and a diode to prevent the output voltage from rising above +5.7 V.

NMEA-0183 accepts this, but recommends that the talker output comply with EIA-422. This is a differential system, having two signal lines, A and B. The voltages on the "A" line correspond to those on the older TTL single wire, while the "B" voltages are reversed (while "A" is at +5, "B" is at ground, and vice versa)

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 EIA-422 "A" wire may be directly connected to a computer's RS-232 input.

3. NMEA-0180 and NMEA 0182

NMEA-0180 and 0182 are very limited, and just deal with communcations from a Loran-C (or other navigation receiver, although the standards specifically mention Loran), and an autopilot.

From the information I have, it appears that 0180 and 0182 are identical. I suspect that equipment claiming to use NMEA-0180 will use the "simple" format described below, while those using NMEA-0182 will use the "complex" format. (but this is really just a guess... corrections??)

3.1 "Simple" data format

The simple format consists of a single data byte transmitted at intervals of 0.8 to 5 seconds, at 1200 baud with odd parity. Bits 5 - 0 give the cross-track error in units of 0.1 uS or 0.01 nautical mile. The error is given in offset binary, with a count of 1 representing full scale right error, 32 (hex 20) for on course, and 63 (hex 3f) full scale left error. Bit 6 is a 1 if the data is valid, and bit 7 is 0 to indicate the simple data format.

3.2 "Complex" data format

The complex format consists of a data block of 37 bytes of (mostly) readable ASCII text giving cross-track error, bearing to waypoint, present Lat/Long, and a binary status byte. The data block shall be sent at intervals of 2 to 8 sec. All bytes in the complex format have bit 7 = 1 to distinguish them from the simple format. It is permissible for a sending device to send both simple and complex data, and even to send a "simple" data byte in the middle of a "complex" data block.

Byte	Data
1	$

```
 2          M                  | device
 3          P                  | address

 4          K = kilometres     | cross track
            N = nautical miles | error
            U = microseconds   | units

 5 - 8      0 - 9 or .          cross track error value
 9          L or R              cross track error position

10          T or M              True or Magnetic bearing
11 - 13     0 - 9               bearing to next waypoint

14 - 23     12D34'56"N or       present latitude
            12D34.56'N
24 - 34     123D45'56"W or      present longitude
            123D45.67"W

35          non-ASCII status byte
            bit 0 = 1 for manual cycle lock
                1 = 1     low SNR
                2 = 1     cycle jump
                3 = 1     blink
                4 = 1     arrival alarm
                5 = 1     discontinuity of TDs
                6 = 1 always
 36         "NUL" character (hex 80)(reserved status byte)
 37         "ETX" character (hex 83)
 Any unavailable data is filled with "NUL" bytes.
```

4. NMEA-0183

4.1 General Sentence Format

Under the NMEA-0183 standard, all characters used are printable ASCII text (plus carriage return and line feed). NMEA-0183 data is sent at 4800 baud.

The data is transmitted in the form of "sentences". Each sentence starts with a "$", a two letter "talker ID", a three letter "sentence ID", followed by a number of data fields separated by commas, and terminated by an optional checksum, and a carriage return/line feed. A sentence may contain up to 82 characters including the "$" and CR/LF.

If data for a field is not available, the field is simply omitted, but the commas that would delimit it are still sent, with no space between them.

Since some fields are variable width, or may be omitted as above, the receiver should locate desired data fields by counting commas, rather than by character position within the sentence.

The optional checksum field consists of a "*" and two hex digits representing the exclusive OR of all characters between, but not including, the "$" and "*". A checksum is required on some sentences.

The standard allows individual manufacturers to define proprietary sentence formats. These sentences start with "$P", then a 3 letter manufacturer ID, followed by whatever data the manufacturer wishes, following the general format of the standard sentences.

Some common talker IDs are:

GP	Global Positioning System receiver
LC	Loran-C receiver
OM	Omega Navigation receiver
II	Integrated Instrumentation (eg. AutoHelm Seatalk system)

4.2 Sentences sent by specific equipment

This section lists the sentence types used by various equipment. The format and data included in each sentence type is given in section 4.3.

Eagle AccuNav
Standard: RMB, RMC, GLL, APB
Proprietary: PSLIB
It also pretends it's a Loran, sending LCGLL, as well as GPGLL

Garmin 12XL, NMEA-0183 V 1.5
Standard: RMB, RMC, WPL
Proprietary: PGRMM (map datum), PGRMZ (altitude), PSLIB (DGPS ctrl)

Garmin 12XL, NMEA-0183 V 2.0
Standard: GGA, GSA, GSV, RMB, RMC, RTE, WPL
Proprietary: PGRME (estimated error) PGRMM, PSLIB

Garmin GPS-38, NMEA-0183 V. 1.5 mode
Standard: GLL, RMB, RMC, WPL, BOD, XTE, VTG, BWC
Proprietary: PGRMM (map datum), PGRMZ (altitude), PSLIB (dgps ctrl)

Garmin GPS-38, NMEA-0183 V. 2.0 mode
Standard: GLL, RMB, RMC, WPL, BOD, GSA, GSV, RTE, GGA
Proprietary: PGRME (estimated error), PGRMM, PGRMZ, PSLIB

Garmin GPS-45 (and probably GPS-40 and GPS-90)
Standard: BOD, GLL, RTE, RMB, RMC, GGA, GSA, GSV
Proprietary: PGRME, PGRMM, PGRMZ

Garmin GPS-65 (and probably GPS-75)
Standard: BWC, GLL, RMB, RMC, R00, WPL, XTE, VTG
Proprietary: PGRMM, PGRMZ, PSLIB

Lowrance Global Map 100
Standard: GLL, RMC, RMB, APB, GGA, GSV
Proprietary: PSLIB

Magellan Trailblazer
Standard: APB, BWC, GGA, GLL, RMB, RMC, VTG

Trimble Ensign XL
Standard: APA, BWC, BWR, GGA, GLL, RMB

Trimble Flightmate Pro and Scoutmaster
Standard: APA, APB, BWC, GGA, GLL, GSA, GSV, RMB, RMC, VTG, WCV, XTE, ZTC

Autohelm Seatalk
Autohelm Seatalk is a proprietary bus for communications between various intruments. Some of the instruments can act as NMEA-0183 talkers or listeners. Data received from an external NMEA-0183 device will, if Seatalk understands the sentence, be re-transmitted, but not necessarily in the same sentence type.

The specific sentences sent will depend on the data available on the Seatalk bus (i.e. sentences containing wind

speed and direction will only be sent if the system includes a wind instrument) Note that NMEA data can only be sent to, or received from, a SeaTalk system using AutoHelm's NMEA<->SeaTalk interface box, or those instruments that provide an NMEA-0183 interface. SeaTalk itself is not compatible with NMEA, and cannot be read with a normal PC serial port.

Seatalk output:
Standard: APB, BPI, BWC, VWR, VHW, DBT, GLL, HDM, HDT, HCS, MTW, VTG

Seatalk input:
Standard: APA, APB, RMB, XTE, XTR, BPI, BWR, BWC, BER, BEC,WDR, WDC, BOD, WCV, VHW, VWR, DBT

4.3 Sample Sentences Dissected

4.3.1 Standard Sentences

A talker typically sends a group of sentences at intervals determined by the unit's update rate, but generally not more often than once per second.

Characters following the "*" are a checksum. Checksums are optional for most sentences, according to the standard.

APB - Autopilot format B
APB,A,A,0.10,R,N,V,V,011,M,DEST,011,M,011,M

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

(note: some pilots, Roberston in particular, misinterpret "bearing from origin to destination" as "bearing from present position to destination". This apparently results in poor performance if the boat is sufficiently off-course that the two bearings are different.)

BOD - Bearing - origin to destination waypoint
BOD,045.,T,023.,M,DEST,START

045.,T	bearing 045 True from "START" to "DEST"
023.,M	breaing 023 Magnetic from "START" to "DEST"
DEST	destination waypoint ID
START	origin waypoint ID

BWC - Bearing and distance to waypoint - great circle
BWC,225444,4917.24,N,12309.57,W,051.9,T,031.6,M,001.3,N,004*29

225444	UTC time of fix 22:54:44
4917.24,N	Latitude of waypoint
12309.57,W	Longitude of waypoint
051.9,T	Bearing to waypoint, degrees true
031.6,M	Bearing to waypoint, degrees magnetic
001.3,N	Distance to waypoint, Nautical miles
004	Waypoint ID

BWR - Bearing and distance to waypoint - rhumb line
(format same as BWC)

```
DBT - Depth below transducer
DBT,0017.6,f,0005.4,M
   0017.6,f     17.6 feet
   0005.4,M     5.4 Metres

GGA - Global Positioning System Fix Data
GGA,123519,4807.038,N,01131.324,E,1,08,0.9,545.4,M,46.9,M, , *42
   123519       Fix taken at 12:35:19 UTC
   4807.038,N   Latitude 48 deg 07.038' N
   01131.324,E  Longitude 11 deg 31.324' E
   1            Fix quality: 0 = invalid
                             1 = GPS fix
                             2 = DGPS fix
   08           Number of satellites being tracked
   0.9          Horizontal dilution of position
   545.4,M      Altitude, Metres, above mean sea level
   46.9,M       Height of geoid (mean sea level) above WGS84
                ellipsoid
   (empty field) time in seconds since last DGPS update
   (empty field) DGPS station ID number

GLL - Geographic position, Latitude and Longitude
GLL,4916.45,N,12311.12,W,225444,A
   4916.46,N    Latitude 49 deg. 16.45 min. North
   12311.12,W   Longitude 123 deg. 11.12 min. West
   225444       Fix taken at 22:54:44 UTC
   A            Data valid
     (Garmin 65 does not include time and status)

GSA - GPS DOP and active satellites
GSA,A,3,04,05,,09,12,,,24,,,,,2.5,1.3,2.1*39
   A            Auto selection of 2D or 3D fix (M = manual)
   3            3D fix
   04,05...     PRNs of satellites used for fix (space for 12)
   2.5          PDOP (dilution of precision)
   1.3          Horizontal dilution of precision (HDOP)
   2.1          Vertical dilution of precision (VDOP)
     DOP is an indication of the effect of satellite geometry on
     the accuracy of the fix.

GSV - Satellites in view
GSV,2,1,08,01,40,083,46,02,17,308,41,12,07,344,39,14,22,228,45*75
   2            Number of sentences for full data
   1            sentence 1 of 2
   08           Number of satellites in view
   01           Satellite PRN number
   40           Elevation, degrees
   083          Azimuth, degrees
   46           Signal strength - higher is better
   <repeat for up to 4 satellites per sentence>
        There my be up to three GSV sentences in a data packet

HDM - Heading, Magnetic
HDM,235.,M
   HDM          Heading, Magnetic
   235.,M       Heading 235 deg. Magnetic
    (HDG, which includes deviation and variation, is recommended
    instead)

HSC - Command heading to steer
HSC,258.,T,236.,M
   258.,T       258 deg. True
   236.,M       136 deg. Magnetic

MTW - Water temperature, Celcius
MTW,11.,C
```

```
   11.,C        11 deg. C

R00 - List of waypoint IDs in currently active route
R00,MINST,CHATN,CHAT1,CHATW,CHATM,CHATE,003,004,005,006,007,,,*05
   (This sentence is produced by a Garmin 65, but is not listed
   in Version 2.0 of the standard.  The standard lists RTE for
   this purpose.)

RMB - Recommended minimum navigation information (sent by nav.
        receiver when a destination waypoint is active)
RMB,A,0.66,L,003,004,4917.24,N,12309.57,W,001.3,052.5,000.5,V*0B
   A            Data status A = OK, V = warning
   0.66,L       Cross-track error (nautical miles, 9.9 max.),
                        steer Left to correct (or R = right)
   003          Origin waypoint ID
   004          Destination waypoint ID
   4917.24,N    Destination waypoint latitude 49 deg. 17.24 min. N
   12309.57,W   Destination waypoint longitude 123 deg. 09.57 min. W
   001.3        Range to destination, nautical miles
   052.5        True bearing to destination
   000.5        Velocity towards destination, knots
   V            Arrival alarm  A = arrived, V = not arrived
   *0B          mandatory checksum

RMC - Recommended minimum specific GPS/Transit data
RMC,225446,A,4916.45,N,12311.12,W,000.5,054.7,191194,020.3,E*68
   225446       Time of fix 22:54:46 UTC
   A            Navigation receiver warning A = OK, V = warning
   4916.45,N    Latitude 49 deg. 16.45 min North
   12311.12,W   Longitude 123 deg. 11.12 min West
   000.5        Speed over ground, Knots
   054.7        Course Made Good, True
   191194       Date of fix  19 November 1994
   020.3,E      Magnetic variation 20.3 deg East
   *68          mandatory checksum

RTE - Waypoints in active route
RTE,2,1,c,0,W3IWI,DRIVWY,32CEDR,32-29,32BKLD,32-I95,32-US1,BW-32,BW-198*69
   2            two sentences for full data
   1            this is sentence 1 of 2
   c            c = complete list of waypoints in this route
                w = first listed waypoint is start of current leg
   0            Route identifier
   W3IWI...     Waypoint identifiers

VHW - Water speed and heading
VHW,259.,T,237.,M,05.00,N,09.26,K
   259.,T       Heading 259 deg. True
   237.,M       Heading 237 deg. Magnetic
   05.00,N      Speed 5 knots through the water
   09.26,K      Speed 9.26 KPH

VWR - Relative wind direction and speed
VWR,148.,L,02.4,N,01.2,M,04.4,K
   148.,L       Wind from 148 deg Left of bow
   02.4,N       Speed 2.4 Knots
   01.2,M       1.2 Metres/Sec
   04.4,K       Speed 4.4 Kilometers/Hr

VTG - Track made good and ground speed
VTG,054.7,T,034.4,M,005.5,N,010.2,K
   054.7,T      True track made good
   034.4,M      Magnetic track made good
   005.5,N      Ground speed, knots
   010.2,K      Ground speed, Kilometers per hour
```

WCV - Waypoint Closure Velocity
WDC - Distance to Waypoint
WDR - Waypoint Distance, Rhumb Line

WPL - waypoint location
WPL,4917.16,N,12310.64,W,003*65
   4917.16,N   Latitude of waypoint
   12310.64,W   Longitude of waypoint
   003   Waypoint ID
     When a route is active, this sentence is sent once for each
     waypoint in the route, in sequence. When all waypoints have
     been reported, GPR00 is sent in the next data set. In any
     group of sentences, only one WPL sentence, or an R00
     sentence, will be sent.

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

XTR - Cross-Track Error - Dead Reckoning
XTR,0.67,L,N
   0.67   cross track error distance
   L   Steer left to correct error (or R for right)
   N   Distance units - Nautical miles

4.3.2 Proprietary Sentences

The following are Garmin proprietary sentences. "P" denotes proprietary, "GRM" is Garmin's manufacturer code, and "E" or "Z" indicates the specific sentence type.

$PGRME,15.0,M,45.0,M,25.0,M*22
   15.0,M   Estimated horizontal position error in metres (HPE)
   45.0,M   Estimated vertical error (VPE) in metres
   25.0,M   Overall spherical equivalent position error

$PGRMZ,93,f,3*21
   93,f   Altitude in feet
   3   Position fix dimensions 2 = user altitude
                                        3 = GPS altitude
This sentence shows in feet, regardless of units shown on the display.

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

Proprietary sentences to control a Starlink differential beacon receiver. (I assume Garmin's DBR is made by Starlink)
$PSLIB,,,J*22
$PSLIB,,,K*23
   These two sentences are normally sent together in each group
   of sentences from the GPS.
   The three fields are: Frequency, bit Rate, Request Type. The
   value in the third field may be:
        J = status request
        K = configuration request
        blank = tuning message

   When the GPS receiver is set to change the DBR frequency or
   baud rate, the "J" sentence is replaced (just once) by (for
   example): $PSLIB,320.0,200*59 to set the DBR to 320 KHz, 200

baud.

5. RS-232 connections

Although this is not really related to NMEA, many people want to connect a GPS to a computer, so need to know about the RS-232 serial ports on a computer.

The RS-232 standard defines two classes of devices that may communicate using RS-232 serial data - Data Terminal Equipment (DTE), and Data Communication Equipment (DCE). Computers and terminals are considered DTE, while modems are DCE. The standard defines pinouts for DTE and DCE such that a "straight through" cable (pin 2 to pin 2, 3 to 3, etc) can be used between a DTE and DCE. To connect two DTEs together, you need a "null modem" cable, that swaps pins between the two ends (eg. pin 2 to 3, 3 to 2). Unfortunately, there is sometimes disagreement whether a certain device is DTE or DCE, hence my standard RS-232 disclaimer:

if it doesn't work, swap pins 2 and 3!

The standard RS-232 connector is a 25 conductor DB-25, although many PCs (and some other equipment) now use a 9 pin DE-9 (often incorrectly called DB-9)

Serial Port Connections

Computer (DTE)				Modem
DB-25	DE-9	Signal	Direction	DB-25
2	3	Tx Data	->	2
3	2	Rx Data	<-	3
4	7	Request to send	->	4
5	8	Clear to send	<-	5
6	6	Data Set Ready	<-	6
7	5	signal ground		7
8	1	Data CarrierDetect	<-	8
20	4	Data Terminal Ready	->	20
22	9	Ring Indicator	<-	22

For NMEA-0183 interfacing, we are only concerned with Rx Data, signal ground (and possibly Tx Data, if we want the computer to talk to the GPS)

NMEA-0183 data is sent at 4800 baud.

6. Troubleshooting

First check that the talker (usually GPS or Loran) can send NMEA-0183, and determine what sentences it sends. Also, verify that the listener understands NMEA-0183, and that it understands the sentences the talker is sending. In some cases the same information may be sent in two or more different sentences. If the talker and listener don't both use the same sentences, there will be no communication. It may be possible to change the sentences sent by the talker, to match those understood by the listener.

Next, check that the talker is indeed set to send NMEA-0183 data. Some talkers may have provision to send NMEA-0180 or 0182, or some proprietary format.

A computer, using any convenient terminal program (Telix, Procomm, Windows Terminal, etc.) set to 4800 baud, can be used to monitor the NMEA data, and confirm what sentences are sent, and that the data is in the correct format.
Verify that the wiring is correct - that the talker data output is connected to the listener data input, and that a signal

ground line is connected between the two pieces of equipment.

If you have multiple listeners connected to a single talker, you may be overloading the talker port. Try connecting only one listener at a time.

On any NMEA-0183 circuit, there can _only_ be one talker. If you must have more than one talker, and one of the talker devices can also act as a listener, you may be able to connect things "in series", so a talker-only output is connected to a listener/talker input, and the listener/talker output is connected to other listeners. However, some listener/talker devices may reformat the data, or only pass data they understand. (The Autohelm Seatalk system does this, and claims the data as it's own, starting all output sentences with "$II".)

Particularly with older equipment, the equipment may claim to comply with NMEA-0183, but in fact have an error in the data format. (My Kings 8001 Loran-C claims to send an APB sentence, but gets some of the fields in the wrong order, so my autopilot can't understand it.) This sort of problem can be verified by capturing the NMEA-0183 data on a computer, and comparing the data formats with those given above.

7. About the author

This FAQ was written by:

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I have an Web site containing this file, a GPS FAQ, and other NMEA information files and PC programs for capturing and displaying NMEA data, and related things:

http://vancouver-webpages.com/peter

The full NMEA-0183 standard is available from:

Cindy Ensley
National Marine Electronics Association
P.O. Box 3435
New Bern, North Carolina
28564-3435
Phone (919)637-7759
Fax (919)637-8136

The current version, as of Nov. 94, is 2.1, and the cost is $75.00
The above address is new as of Oct. 94.

TABLE 4 - TALKER IDENTIFIER MNEMONICS
(Address Characters 1 and 2)

TALKER DEVICE		IDENTIFIER
AUTOPILOT:	General	*AG
	Magnetic	AP
COMMUNICATIONS:	Digital Selective Calling (DSC)	*CD
	Satellite	*CS
	Radio-Telephone (MF/HF)	*CT
	Radio-Telephone (VHF)	*CV
	Scanning Receiver	*CX
DECCA Navigation		DE
Direction Finder		*DF
Electronic Chart Display & Information System (ECDIS)		EC
Emergancy Position Indicating Beacon (EPIRB)		*EP
Engineroom Monitoring Systems		ER
Global Positioning System (GPS)		GP
HEADING SENSORS:	Compass, Magnetic	*HC
	Gyro, North Seeking	*HE
	Gyro, Non-North Seeking	HN
Integrated Instrumentation		II
Integrated Navigation		IN
LORAN:	Loran-A	LA
	Loran-C	LC
OMEGA Navigation System		OM
Proprietary Code		P
Radar and/or ARPA		*RA
Sounder, depth		*SD
Electronic positioning system, other/general		TR
Sounder, scanning		SS
Turn Rate Indicator		*TI
TRANSIT Navigation System		TR
VELOCITY SENSORS:	Doppler, other/general	*VD
	Speed Log, Water, Magnetic	VM
	Speed Log, Water, Mechanical	VW
TRANSDUCER		YX
TIMEKEEPERS, TIME/DATE:	Atomic Clock	ZA
	Chronometer	ZC
	Quartz	ZQ
	Radio Update, WWV or WWVH	ZV
Weather Instruments		WI

*
Designated by I.E.C. for use with I.M.O. marine electronic devices. This is the minimum requirement for equipment that is specified by I.M.O. to meet S.O.L.A.S. regulations.

6.2 Field Definitions
(continued)

TABLE 5 - APPROVED SENTENCE FORMATTERS

AAM - Waypoint Arrival Alarm

Status of arrival (entering the arrival circle, or passing the perpendicular of the course line) at waypoint c--c.

```
$--AAM,A,A,x.x,N,c--c*hh<CR><LF>
       | |  |  |  |
       | |  |  |  +---------------Waypoint ID
```

```
        | |  |  +------------------Units of radius, nautical miles
        | |  +---------------------Arrival circle radius
        | +------------------------Status: A = perpendicular passed at waypoint
        +--------------------------Status: A = arrival circled entered
```

ALM - GPS Almanac Data

Contains GPS week number, satellite health and the complete almanac data for one satellite. Multiple messages may be transmitted, one for each satellite in the GPS constellation, up to maximum of 32 messages.

```
    $--ALM,x.x,x.x,xx,x.x,hh,hhhh,...
           |   |  |   |  |   |
           |   |  |   |  |   +-------e, eccentricity [3]
           |   |  |   |  +-----------SV health, bits 17-24 of each almanac page [2]
           |   |  |   +--------------GPS week number [1]
           |   |  +------------------Satellite PRN number, 01 to 32
           |   +---------------------Message number
           +-------------------------Total number of messages


       hh,hhhh,hhhh,hhhhhh,hhhhhh,...
       |   |    |     |      |
       |   |    |     |      +--------Omega, argument of perigee [3]
       |   |    |     +---------------SQRT(A), root of semi-major axis [3]
       |   |    +---------------------OMEGADOT, rate of right ascension [3]
       |   +--------------------------(sigma) index i, inclination angle [3]
       +------------------------------t index OA, almanac reference time [3]


       hhhhhh,hhhhhh,hhh,hhh*hh<CR><LF>
         |      |     |   |
         |      |     |   +-----------a index f1, clock parameter [3]
         |      |     +---------------a index f0, clock parameter [3]
         |      +---------------------M index O , mean anomaly [3]
         +--------------------------(OMEGA) index O, longitude of ascension node[3]
```

[1] Variable lengh integer, 4-digits maximum. Converted from (10) most significant binary bits of Subframe 1, Word 3. Reference Table 20-I, ICD-GPS-200, Rev. B.

[2] Reference paragraph 20.3.3.5.1.3, Table 20-VII and Table 20-VIII, ICD-GPS-200, Rev. B.

[3] Reference Table 20-VI, ICD-GPS-200, Rev. B for scaling factors and units.

APB - Autopilot Sentence "B"

Commonly used by autopilots this sentence 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.

```
    $--APB,A,A,x.x,a,N,A,A,x.x,a,c--c,...
           | |  |  | | | |  |  |  |
           | |  |  | | | |  |  |  +---Destination waypoint ID
           | |  |  | | | |  |  +-----\M/T Magnetic or True
           | |  |  | | | |  +--------/Bearing origin to destination
```

```
          | |  |  | | | +------------Status: A = perpendicular passed at waypoint
          | |  |  | | +--------------Status: A = arrival circle entered
          | |  |  | +----------------XTE units, nautical miles
          | |  |  +------------------L/R Direction to steer
          | |  +---------------------Magnitude of XTE (cross-track-error)
          | +------------------------Status: V = Loran-C Cycle Lock warning flag
          |                                   A = OK or not used
          +--------------------------Status: V = Loran-C Blink or SNR warning
                                              V = general warning flag for other
navigation
                                                  systems when a reliable fix is not
available


        x.x,a,x.x,a*hh<CR><LF>
         |  |  |  |
         |  |  |  +-------------------\M/T Magnetic or True
         |  |  +----------------------/Heading-to-steer to destination waypoint
         |  +-------------------------\M/T Magnetic or True
         +----------------------------/Bearing, Present position to destination
```

*ASD - Autopilot System Data

I.M.O. Ref. A342 (IX). Autopilot operating parameters, alarm status commanded course and vessel heading.

(TO BE DETERMINED)

BEC - Bearing & Distance to Waypoint - Dead Reckoning

Time (UTC) and distance & bearing to, and loacation of, a specified waypoint from the dead-reckoned present position.

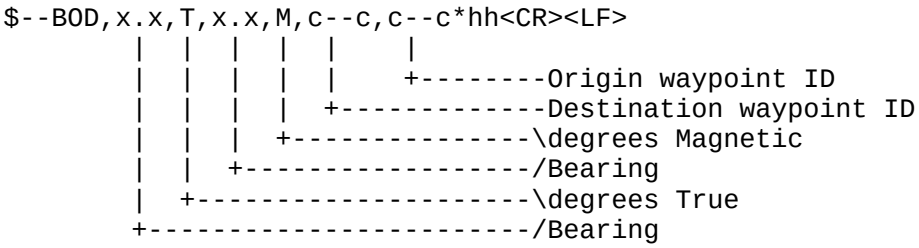
```
    $--BEC,hhmmss.ss,llll.ll,a,...
           |        |      |
           |        |      +-------\N/S North or South
           |        +--------------/Waypoint Latitude
           +-----------------------UTC of observation


        yyyyy.yy,a,x.x,T,x.x,M,x.x,N,...
          |      |  |  |  |  |  |  |
          |      |  |  |  |  |  |  +--\nautical miles
          |      |  |  |  |  |  +-----/Distance
          |      |  |  |  |  +--------\degrees Magnetic
          |      |  |  |  +-----------/Bearing
          |      |  |  +--------------\E/W East or West
          |      |  +-----------------/Waypoint longitude
          |      +--------------------\N/S North or South
          +---------------------------/Waypoint latitude


        c--c*hh<CR><LF>
         |
         +----------------------------Waypoint ID
```

BOD - Bearing - Origin to Destination

Bearing angle of the line, calculated at the origin waypoint, extending to the destination waypoint from the origin waypoint for the active navigation leg of the journey.



BWC - Bearing & Distance to Waypoint - Great Circle
BWR - Bearing & Distance to Waypoint - Rhumb Line

Time (UTC) and distance & bearing to, and location of, a specified waypoint from present position. '$--BWR' data is calculated along the rhumb line from present position rather than along the great circle path.