Appendix E - **The NMEA FAQ**

Version 6.1 Sept. 15, 1997
(NMEA URL updated)

Additions, corrections, and comments should be emailed to the author,
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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

P.O. Box 3435

New Bern NC, 28564-3435
U.S.A.
Phone: 919-638-2626
Fax: 919-638-4885
email: nmea@coastalnet.com
web page: http://www4.coastalnet.com/nmea/default.html

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 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

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)

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 "M" 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

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

ftp://sundae.triumf.ca/pub/peter/index.html
This site is mirrored in Germany at:

ftp://ftp-i2.informatik.rwth-aachen.de/pub/arnd/GPS/peter/index.html

7.1 Acknowlegments

I would like to thank the following for their contributions or corrections to this document:
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*****
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.

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, extend-
ing to the destination waypoint from the origin waypoint for the active navigation leg of the journey.

```
$--BOD,x.x,T,x.x,M,c--c,c--c*hh<CR><LF>
       | | | | |   |
       | | | | |   +--------Origin waypoint ID
       | | | | +-------------Destination waypoint ID
       | | | +---------------\degrees Magnetic
       | | +------------------/Bearing
       | +---------------------\degrees True
       +------------------------/Bearing
```

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.

```
$--BWC,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
    |       |  |  +--------------\degrees True
    |       |  +-----------------/Bearing
    |       +--------------------\E/W East or West
    +---------------------------/longitude

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



$--BWR,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
    |       |  |  +--------------\degrees True
    |       |  +-----------------/Bearing
    |       +--------------------\E/W East or West
    +---------------------------/longitude

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

*****
Dear Net Reader,
The following is an article I wrote on the subject NMEA 0183 interfacing for MAINSHEET, the Catalina and Capri Owners association magazine. It appeared in the May, 1991 issue. You may distribute it freely but please make note of where it came from when you do.

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UNDERSTANDING MARINE ELECTRONICS INTERFACING: the Promise, the Problems

by Wayne Simpson, Technical Editor
International Catalina 27 Association

The coming of the microprocessor to marine electronics has brought with it a promise and a curse. The promise is that two or more devices can share information and so become more valuable and convenient to use. The curse is that not all marine hardware is compatible. To make matters worse, marine electronics manufac turers often make it difficult for the consumer to tell whether any two devices will work together until bought and wired togeth er. Sometimes the result is a happy event. At other times, it can be an exercise in frustration.

An interface is the boundary at which two independent sys tems communicate and interact. When you connect an interface cable from your loran to your autopilot, the wire is like the string between two cans in a play telephone. The wire carries the conversation, but it is the interfaces at each end that do the talking. If the two devices speak the same language and can understand the same words, then they can communicate. Otherwise, they can't. There is a standard for communications in the marine electronics industry, and most manufacturers claim to abide by it, at least in part. Unfortunately this is not always enough.

NMEA 0183: The Marine Interface Standard

In 1980, a group of professionals from the industry met to develop a standard "language" for marine interfaces. The result was the National Marine Electronics Association (NMEA) 0180 standard. It addressed one problem, that of making lorans and autopilots work together, and it was a success. In the following years this standard, revised, broadened, then totally revamped to take into account the wide range of electronics appearing on boats, led to the current NMEA 0183 standard used on almost all equipment today.

The NMEA 0183 standard calls for data communication in the form of coded "sentences." Each sentence begins with the charac ter "$" and ends with a carriage return and line feed (<CR><LF>). These last two characters are "control" characters and are not normally printed (for this reason they are customarily shown enclosed in brackets). Between the beginning and end of each sentence are "fields" of data, each field separated by a comma. The first field in any sentence (field 0) begins with the two letter talker mnemonic code ("talkers" are devices that send out information, "listeners" take it in) followed by the three letter code for the sentence. Data follows in the standard format for that sentence. Here's an example:

```
 field #:    0     1     2   3      4
sentence: $LCGLL,4001.74,N,07409.43,W<CR><LF>
```

What is being said here? Lets look at it field by field. The sentence begins with the start character "$." Next comes the talker identifier and sentence format code. LC stands for Loran-C, GLL for present position in Lat/Lon. Field 1 contains the set's current latitude. Field 2 is either N or S for North or South. Field 3 is the set's current longitude. Field 4 is W or E for West or East. Thus, this sentence reads "Loran-C present position in Lat/Lon: 40 degrees 1.74 minutes North, 74 degrees 9.43 minutes West." A carriage return and line feed close the sentence. The GLL sentence is always displayed in this format. Each type of sentence, and there are many, has its own specific standard format (for a brief catalog of formats, see sidebar: Deciphering the Code).

Standard sentences, each in a standard format. This is how NMEA 0183 is intended to work. But compliance with the standard is voluntary. It is up to the manufacturers to decide how they will implement the standard, and to what extent they will comply with it. Because the standard is so broad, there is often more than one way to express the same information, and this can cause problems. There are many different sentences, and few if any talker devices say them all, or adhere strictly to the standard format of those they do. Does your autopilot need information in a form that your loran isn't sending out? How can you tell?

Don't count on there being an adequate explanation in the manuals, because often it isn't there. The owners manual for my loran describes the workings of the interface this way. "The extra connector on the rear panel is a serial data output inter face which can provide loran data to an autopilot, track plotter, or fishfinder. The serial data is in NMEA 0183 format and is transmitted continuously." That's it; the manual makes no other mention of the interface anywhere. Other manuals I have seen are about as descriptive. In a follow-up bulletin nearly a year after I bought it the manufacturer of my loran mentioned what sentences the data output sent (there were four) and what the pin assignments for the output connector were. This section was labeled "for techies only." These interfaces are touted in adver tising copy, but it's clear the manufacturers don't really expect you to use them. In the end, you probably will have to call the manufacturer for a proper explanation of their interface, and ask specifically whether they have tested the devices you have in mind for compatibility.

So far we've discussed only software incompatibilities, but there can be physical ones, too. NMEA 0183 specifies no standard connector, and no two manufacturers seem to use the same one. Usually, the owner will have to buy plugs from the manufacturers and make his own cable.

A Case History

Two years ago, when I bought my West Marine Vector I loran, I had no intentions of ever using the interface. Why would you want to interface your electronics, anyway? Here's one example. A loran can tell you where you are, what direction to steer to get to your destination, and how far off your intended course track you are. By itself, however, it can't steer the boat. An autopi lot can steer, but on it's own can't compensate for currents or leeway. An autopilot interfaced with a loran can do all these things, and then some. Here's another example. The more you use the magic box, the more you realize the information it gives should be displayed in the cockpit, where the helmsman can have instant access to it. But the cockpit can be a harsh location for electronics and most lorans aren't truly waterproof. A loran "repeater," which echoes steering information on a remote dis play, can provide useful steering information in the cockpit while leaving the loran below in the nav station, safe from sun and spray.

An integrated pilot/navigator system would have been nice, but LEGACY, our 1977 Catalina 27, already had an autopilot, an old style Autohelm 800. It worked perfectly well and I wasn't going to replace it just to have one with an interface. A loran repeater would be handy too, but those available commercially cost as much as a second loran. I toyed with the idea of building a repeater but in the end dismissed the whole thing as not being worth the time, effort, or cost.

Two things happened last summer that changed my opinion on interfacing. First, the old Autohelm failed, and the cost to fix it was almost as much as a new digital autopilot. I went for the new pilot, settling on a Navico Tillerpilot 5000 largely because Autohelm had changed their mounting dimensions and would have required me to change my setup. Navico's dimensions were always very close the old Autohelm's, and would fit without modifica tions.

The new pilot worked well all by itself, but an item on Navico's option list caught my eye. It was a digital hand pro grammer that made the TP5000 a much better pilot. It displayed present heading from the pilot's internal fluxgate compass, allowed you to make course changes in degrees rather than beeps, had an off-course alarm and let you program the pilot's response parameters to better tune them to the boat and conditions. Also at the time, if you bought a pilot and programmer and sent the receipts to Navico, they would send you the loran interface box (which normally cost's $150 at discount) for free.

Second, while at a marine warehouse sale, I came across a KVH model LRX+ loran repeater. It was complete with the warranty card and instruction booklet. It's price was $100, 1/3 the usual discount price. It was NMEA 0183 compatible, and so was my loran. It even had a sheet with a listing of all the lorans the LRX+ had successfully interfaced with. The Vector was there, right at the bottom of the list. Why not?

I took it down to my boat, hooked it up to the NMEA inter face on the back of my loran, programmed a course to a nearby buoy, and waited for the repeater's display to come to life. It did, and showed a bearing that was 12 degrees off! Something in the back of my mind reminded me that the magnetic variation in my area was 12 degrees. The repeater was displaying bearing in de grees true rather than magnetic. Every time I wanted to get a steering course off the display, I would have to do a calculation in my head. The "curse" had visited me.

I was now in the position of having to figure out what the problem was with the repeater. I had no knowledge of the NMEA standard or how it worked, so I called KVH. They said that what ever the loran was sending out over the interface was reported on the display. I called West Marine to find out what the Vector was sending out. They told me that both true and magnetic bearings were sent, and that it was up to the repeater to differentiate between them. I asked KVH for more help, and they offered to upgrade the repeater's software to a newer version at no charge. I sent the repeater off to KVH Industries in Middletown, RI.

While the repeater was away, I took a sample of the Vector's data output using my PC. The procedure is described in the side bar: Listening In, Speaking Out. Here's what I got:

```
$LCGLL,4004.22,N,07409.78,W
$LCBWC,,4001.80,N,07403.66,W,117,T,129,M,005.2,N,011
$LCAPA,V,A,1.00,R,N,V,V,117,T,011
$LCVTG,,,271,M,02.3,N,,
```

The pattern of four sentences repeated itself every two seconds. Close inspection of this string revealed the problem. In order to work with a wide variety of lorans, the KVH repeater's program accepts data from several different sentences, two of which, BWC (bearing to waypoint along great circle) and APA (autopilot format A), appear in the above sample. Look closely at the APA sentence. Data fields 8 and 9 display the bearing and whether it represents degrees true or magnetic. The standard format for APA is degrees magnetic, in this example it is degrees true. There was a bug in the Vector's software.

Why couldn't the repeater see that the bearing was in de grees true and disregard it? Most of these programs are "comma counters." They recognise a sentence of interest from the ad dress, then count commas until they get to the field in which they expect to find data they need. They don't look at the fields telling whether the information is true, magnetic, east, or west.

The people at KVH felt confident that the software upgrade would cure this condition but when the repeater came back, my problem was still there. I called West. The problem was their doing in the first place, maybe they would fix it. Unfortunately for me, the Vector I was made obsolete by the Vector II the previous year. West planned no more software upgrades for the Vector I, and it would be prohibitively expensive for them to rewrite the software in response to this one complaint. I could, perhaps, install the Vector II software (which corrected this bug) but then I would lose some of the features the Vector I had that the Vector II lacked. I decided it wasn't worth it.

There was still some confusion over exactly what data fields the repeater was looking at. To find out, I wrote a loran simula tor program for my computer (see sidebar). I coded the data in each of the three fields that displayed bearing, giving each a different value, and was able to prove that the repeater was looking at the APA sentence for it's bearing to display.

Once again, I called KVH. Rob Solomon, one of KVH's technical people who had stayed with me throughout this ordeal, was certain the new software didn't look at APA for bearing. He wanted to look further into the problem, but was unsure when he would be able to find the time to do so. It was early February, war had just broken out in the Persian Gulf and KVH was in the midst of delivering 15,000 of it's DataScopes to Desert Storm personnel. He promised to look at the LRX+'s software when things quieted down. Oddly enough, he called back in an hour with the LRX+'s program listing in hand. He told me absolutely that the new software did not look at APA for bearing. Back to the drawing board...

I went home that night and ran my simulator again. There was no mistake. I wrote a letter to Rob at KVH. In it I included everything I knew about the problem, a sample of the Vector's data output, the listing of my simulator program, and the version number of the software EPROM ("Erasable Programmable Read Only Memory," the chip which stores the software) installed in my repeater. I sent it off by FAX the following day. A few days later, I called Rob to see if he had gotten the letter. He had, but had not yet read it. When he did, he saw that I hadn't been given the software he asked for. He sent a new EPROM chip in the mail (the right one, this time) for me to put in myself. I did, and it worked as promised. My problem was solved, but only after five months had passed and I had spent many hours on testing and investigation.

I had better luck regarding the autopilot. Late last summer, wisened by my experience with the repeater (I had just begun the process of sorting out it's troubles), I called West Marine and spoke to Dave Wells, their technical support person for the Vector. I was determined to find out whether the loran/autopilot interface would work before I bought it. He told me the Vector and the Navico pilot were compatible. He had tested them himself. I bought the programmer and sent away for the junction box. When it arrived, the manual informed me that my pilot would require a software upgrade from the factory in order to work properly with my loran (sound familiar?). It was by then late fall and I would not be needing the pilot for months, so I sent it off to Navico's Largo, FL plant. When it came back, I hooked the loran, pilot, programmer and junction box together in my study to see what would happen. The system worked as advertised. This time, the "promise" was fulfilled.

Conclusions and Recommendations

My story has a happy ending. Come spring, I will be installing my new toys and enjoying them all summer. Others who try this may not be so fortunate. The NMEA system can work, but there is no guarantee in any particular case that it will. My repeater adventure shows what sort of problems you can have, and to what lengths you may have to go in order to solve them.

My recommendations are these: Do your homework before you buy. If you are buying from a supplier who will do the installation for you, make sure he will guarantee the satisfactory operation of the interface. If you will do the installation yourself, try to arrange for a full credit return in the event the interfaces prove to be incompatible. Call the manufacturers and ask questions. Take the time to understand what the NMEA 0183 standard is and how it works.

If you find that you've been stuck anyway all is not completely lost. A company called Maricom Electronics, at 2911 River Drive, Thunderbolt, GA 31404 (phone (912) 354-4542) markets what it calls a "Universal Marine Interface." For just under $400, this box claims to take data in any format that any talker might emit and put it into a form any listener will understand. In the absence of less extreme solutions, this may be worth trying.

Have a problem to solve, or a solution to share? Send your comments and queries to the address above. If you require a quick answer, please include a self addressed, stamped envelope. Your submissions on computer disk (IBM format, any size) will make my job easier, but your paper submissions are, as always, welcomed and appreciated. Until next time...

SIDEBAR A:

NMEA 0183: DECIPHERING THE CODE

The "language" of NMEA 0183 is extensive but not difficult to understand. The ground rules are these: maximum sentence length is 80 characters including the starting "$," the terminating <CR><LF>, and everything in between. Minimum number of data fields is two, including the address field (talker identifier and sentence format). If data for any field is unavailable, a "null" field, two commas with nothing between them (",,") can be sent instead.

Here is a sampling of two letter talker identifier codes. There are others, for everything from satellite communications to atomic clocks, but these are some of the most familiar to the recreational sailor.

LC Loran-C
GP GPS
TR Transit SATNAV
AP Autopilot (magnetic)
HC Magnetic heading compass
RA Radar
SD Depth sounder
VW Mechanical speed log

Now for some of the more common sentences that might be spoken by your LORAN, SATNAV, or GPS. This is not a complete listing, but should illustrate how the system works. In the following examples, the character "#" will denote some number (0-9). Remember that each of these sentences would be preceded by the start character "$" and the two letter talker ID. Each also would be followed by the sentence terminator, <CR><LF>.

Geographic Location in Lat/Lon
field #: 0   1   2 3   4
sentence: GLL,####.##,N,#####.##,W
1, Lat (deg, min, hundredths); 2, North or South; 3, Lon; 4, West or East.

Geographic Location in Time Differences
field #: 0   1   2   3   4   5
sentence: GTD,#####.#,#####.#,#####.#,#####.#,#####.#
1-5, TD's for secondaries 1 through 5, respectively.

Bearing to Dest wpt from Origin wpt
field #: 0   1 2 3 4 5   6
sentence: BOD,###,T,###,M,####,####
1-2, brg,True; 3-4, brg, Mag; 5, dest wpt; 6, org wpt.

Vector Track and Speed Over Ground (SOG)
field #: 0   1 2 3 4 5   6 7   8
sentence: VTG,###,T,###,M,##.#,N,##.#,K
1-2, brg, True; 3-4, brg, Mag; 5-6, speed, kNots; 7-8, speed, Kilometers/hr.

Cross Track Error
field #: 0 1 2 3   4 5
sentence: XTE,A,A,#.##,L,N
1, blink/SNR (A=valid, V=invalid); 2, cycle lock (A/V); 3-5, dist off, Left or Right, Nautical miles or Kilometers.

Autopilot (format A)
field #: 0 1 2 3   4 5 6 7 8 9 10
sentence: APA,A,A,#.##,L,N,A,A,###,M,####
1, blink/SNR (A/V); 2 cycle lock (A/V); 3-5, dist off, Left or Right, Nautical miles or Kilometers; 6-7, arrival circle, arrival perpendicular (A/V); 8-9, brg, Magnetic; 10, dest wpt.

Bearing to Waypoint along Great Circle
fld: 0   1   2   3 4   5 6 7 8 9 10 11 12
sen: BWC,HHMMSS,####.##,N,#####.##,W,###,T,###,M,###.#,N,####
1, Hours, Minutes, Seconds of universal time code; 2-3, Lat, N/S; 4-5, Lon, W/E; 6-7, brg, True; 8-9, brg, Mag; 10-12, range, Nautical miles or Kilometers, dest wpt.

BWR: Bearing to Waypoint, Rhumbline, BPI: Bearing to Point of Interest, all follow data field format of BWC.

For a full explanation of the NMEA 0183 standard, you can write or call the NMEA. For a fee, they will send you the their 36 page booklet "NMEA 0183 Standard for Interfacing Marine Elec tronic Navigational Devices." The address is: National Marine Electronics Association, PO Box 3435, New Bern, North Carolina, 28564-3435. Cost is $75.00 (new address and cost, Nov. 1994) Phone: (919) 637-7759, Fax (919)637-8136

Sidebar B:

LISTENING IN, SPEAKING OUT:
Using your Home Computer to Monitor NMEA Communications

The data that comes out of your loran or other NMEA equipped gear is in the same format as that from your personal computer. It is possible, and very easy to take a look at what your talkers are saying, and to speak to your listeners in a form they can understand.

To listen in, you need a PC equipped with a serial (RS-232) interface and modem program (such as HAYES SmartCom or CTRM). If your program has a data capture feature, you can read data from the line into a file for later use.

To make the connection, connect the NMEA signal line (line A, output, etc) to the RS-232 "receive data" line (#2 on 9 pin or #3 on 25 pin connectors), and the NMEA ground line (line B, return, etc) to the RS-232 "signal ground" (#5 on 9 pin or #7 on 25 pin connectors).

The statistics for NMEA 0183 are as follows: 4800 baud, 8 data bits, 1 stop bit, no parity. Set your modem program for these parameters. Switch on your loran (or other talker), start the modem program, and the data should come pouring in.

One note of caution regarding radionavigation receivers: they are very sensitive to the kind of RF interference computers, fluorescent lights, TV's and other such things cause. Your re ceiver may not be able to lock on to it's transmitters with these things operating nearby, and you may have to set up the receiver in another room and connect it with a long cable for it to work properly.

Speaking to your listeners is only slightly more complicat ed. You need to send the data strings over and over again at a repetition rate of once every few seconds (but no faster than once every second). For this, I wrote a short simulator program in BASIC that does the job, and allows me to program in the text I want to send. The connection is different, also. This time you will have to connect the NMEA signal line to RS-232 "transmit data" (#3 on 9 pin or #2 on 25 pin connectors), and NMEA ground to RS-232 signal ground (as before). In addition, you probably will have to bring the RS-232 "data set ready" (DSR) terminal to a low voltage. You can do this by inserting a jumper between "data terminal ready" (DTR, normally #4 on 9 pin or #20 on 25 pin) and DSR (#6 on 9 or 25 pin setups).

Here is the text of my NMEA 0183 simulator program:

```
5   REM LORAN SIMULATOR PROGRAM - Wayne Simpson, 1991
10  OPEN "com2:4800,n,8,1,RS" FOR OUTPUT AS#1
15  REM setup RS-232 to parameters and disable request to send
100 A$="$LCGLL,4004.22,N,07409.78,W"
110 B$="$LCBWC,,4001.80,N,07403.66,W,100,T,200,M,005.2,N,011"
120 C$="$LCAPA,V,A,0.25,R,N,V,V,300,T,011"
130 D$="$LCVTG,,,268,M,02.1,N,,"
140 E$=""
200 PRINT A$    'print GLL statement to screen
205 PRINT#1,A$  'send GLL over interface
210 PRINT B$    'BWC to screen
215 PRINT#1,B$  'BWC to interface
220 PRINT C$    'APA to screen
225 PRINT#1,C$  'APA to interface
230 PRINT D$    'VTG to scren
```

```
235 PRINT#1,D$  'VTG to interface
240 PRINT E$    'empty line to screen
245 PRINT#1,E$  'empty line to interface
300 FOR I=1 TO 12000
310 NEXT
320 GOTO 200
330 REM line 300 provides the 2 second rep rate
340 REM line 320 repeats the transmission over and over
350 REM use ctrl-brk keystroke to terminate transmission
```

Load this program into your computer, substitute into the A$-E$ variables whatever it is you want to say, and run it. You are now speaking NMEA, and can do a fair job of troubleshooting interface problems this way.