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Introduction

Why Interface

Interfacing allows the user to access and network data, such as navigational information, using an NMEA display connected to your instrument system. For example your GPS may be at the chart table, but you require its information to steer by on deck, the FFDs could show that information if interfaced with the GPS receiver.

The NMEA display can also provide network information to other instruments; speed and heading to your Transit SatNav, wind direction to your autopilot, heading to your Radar etc. However, this only works if your instruments all understand each other, which is where NMEA comes in.

What is NMEA

NMEA are the initials of an American trade association, the National Marine Electronics Association, who have produced a number of standard specifications for the interconnection of marine electronic instruments.

These standards specify the electrical signals and the format of data to be transferred, allowing devices like position fixers, autopilots, chart plotters and radar produced by different manufacturers to be interconnected.

Introduction

The NMEA display

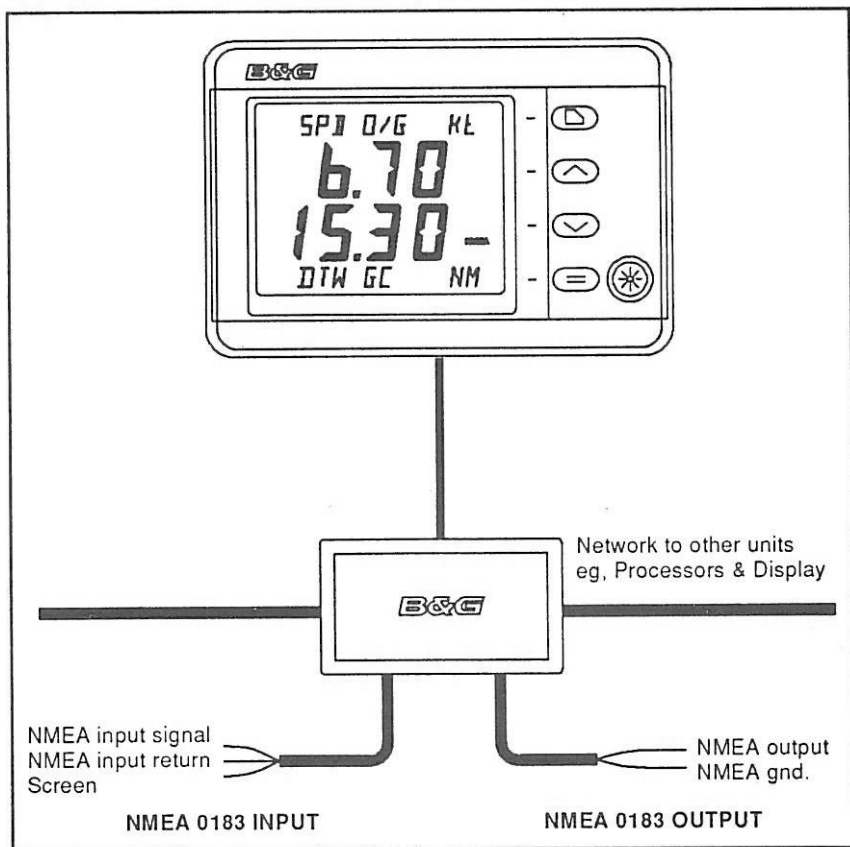
The NMEA display unit is designed to comply with the latest and most comprehensive of the standards, the NMEA 0183 standard. There is one NMEA input and one output giving the user the ability to connect a number of devices.

The NMEA display unit is a full function display (FFD) with an integral NMEA interface. The unit connects directly to the system network and has additional connections for NMEA input and output. The unit can be used with the Hydra, HS 921 and Hercules 690 instrument systems and with the Hydra and HS pilots. See system diagram.

Note: The NMEA display is essentially, identical in operation and ability to any standard FFD.

Introduction

System diagram



NMEA functions and FFD display

Depending on the type of device connected to the NMEA display, the following functions can be displayed by any FFD:

	FUNCTION	MENU
• Bearing waypoint to waypoint,true	(BRG W-W *T)	WAYPOINT
• Bearing waypoint to waypoint,magnetic	(BRG W-W *M)	WAYPOINT
• Bearing to waypoint, true, rhumb	(BTW RMB T)	WAYPOINT
• Bearing to waypoint, magnetic, rhumb	(BTW RMB M)	WAYPOINT
• Bearing to waypoint, true, great circle	(BTW GC T)	WAYPOINT
• Bearing to waypoint, magnetic, great circle	(BTW GC M)	WAYPOINT
• Course to steer, magnetic, tidal corrected	(CTS *M)	WAYPOINT
• Distance to waypoint,rhumb, NM	(DTW RMB NM)	WAYPOINT
• Distance to waypoint, great circle, NM	(DTW GC NM)	WAYPOINT
• Distance to next waypoint, great circle, NM	(NEXT WPT NM)	WAYPOINT
• Course over ground, true	(CRSE O/G T)	WAYPOINT
• Course over ground, magnetic	(CRSE O/G M)	WAYPOINT
• Speed over ground in knots	(SPD O/G KT)	WAYPOINT
• Velocity made good to waypoint in knots	(VMG WPT KT)	WAYPOINT
• Time to waypoint	(ETA WPT HR)	WAYPOINT
• Cross track error and sense	(CROSS TR NM)	WAYPOINT
• Tidal set, magnetic	(TIDE SET *M)	NAVIGATE
• Tidal drift, knots	(TIDE RTE KT)	NAVIGATE
• Local time, hrs, mins, secs	(LOC TIME HR)	TIME
• Distance to layline, left or right	(LAYLINE)	PERFORM

Note: It may be necessary to wait a while after the NMEA device has been switched on before the menus are complete.

NMEA functions and FFD display

NMEA functions can be displayed on an FFD in the same manner as any other FFD function, see appropriate Hydra, HS 921 or Hercules 690 Owner Manuals.

The NMEA functions are to be found under the MENU, as shown on page 6.

Only those functions that are received at the NMEA input will appear in the display menu. These functions can be shown on any of the FFDs or 20/20 CD displays.

*Note: If after approximately one minute the required data is not received for a selected function, the NMEA display and FFD will display **OFF** to indicate there is no data.*

NMEA functions and FFD display

Magnetic variation

Some position fixers only provide course over ground, true via the NMEA as opposed to magnetic, since the NMEA display also requires heading, magnetic from the instrument system, the course over ground must be converted to magnetic for correct tidal calculation.

Local magnetic variation is entered by selecting the CALBRATE option on the TIDE SET function. The entered value should be positive for West variation and negative for East.

Selecting compatible equipment

When selecting equipment to interface with the NMEA display it is most important to check that the equipment is fully NMEA 0183 compatible and that the required data can be transmitted and/or received by it.

The 0183 standard defines data sentences which are identified by three letter mnemonics. The tables supplied on pages 10 and 11 list the sentences and their mnemonics that are input and output by the NMEA display unit.

The NMEA specification section gives detailed information on the data and format concerning the NMEA data stream sentences.

Note: If you have any doubt about equipment compatibility then please consult your local B&G distributor.

Selecting compatible equipment

NMEA 0183 input sentence summary

MNEMONIC	DESCRIPTION
APA	Autopilot format A
APB	Autopilot format B
BEC	Bearing and distance to waypoint, great circle, dead reckoned
BER	Bearing and distance to waypoint, rhumb, dead reckoned
BOD	Bearing to destination waypoint from origin waypoint, true and magnetic
BWC	Bearing and distance to waypoint, great circle, measured
BWR	Bearing and distance to waypoint, rhumb, measured
BWW	Bearing waypoint to waypoint, true and magnetic
GDP	Latitude and longitude, present position dead reckoned
GLL	Latitude and longitude, present position
GLP	Latitude and longitude, present position, Loran C
RMA	Recommended minimum implementation sentence, Loran C specific
RMB	Recommended minimum implementation sentence, Generic navigation information
RMC	Recommended minimum, implementation sentence, GPS, transit specific
VTG	Actual track and ground speed
WCV	Waypoint closure velocity
WDC	Next waypoint distance, great circle
WDR	Next waypoint distance, rhumb
XTE	Cross track error, measured
XTR	Cross track error, dead reckoned
ZDL	Distance and time to layline
ZLZ	Local time zone
ZTG	Time to waypoint

Selecting compatible equipment

NMEA 0183 output sentence summary

MNEMONIC	DESCRIPTION
DBT	Depth below transducer
GLL	Latitude and longitude, present position
HDM	Present heading, magnetic
MTA	Air temperature, Celsius
MTW	Water temperature, Celsius
MWD	Surface wind direction and velocity
VHW	Heading and water speed
VLW	Log mileage, water referenced
VPW	Velocity parallel to true wind, device measured
VWR	Wind relative bearing and velocity
VWT	Wind true bearing and velocity
XTE	Measured cross track error

Note: Sentences are only output if data is available.

NMEA specification

NMEA 0183 input sentences recognised

The following section gives details of the NMEA 0183 input and output sentences recognised by the NMEA display unit. The spaces between characters in the NMEA sentences are included only to improve readability and do not form part of the sentence.

Autopilot format A

\$ aaAPA, A, A, x.xx, L, N, A, A, xxx, M, cccc *ss (CR) (LF)

device identifier

signal validation (SRN 'OR'ed with blink for Loran C)

cycle lock

cross track error

steer left (L) or right (R)

nautical miles

arrival circle

arrival perpendicular

bearing of dest. wpt. from original wpt.

magnetic

destination wpt.

checksum

Data extracted:
Cross track error

NMEA specification

Autopilot format B

\$aaAPB,A,A,x.xx,L,N,A,A,x.xx,M,cccc,xxx,m,xxx,m*ss(CR) (LF)

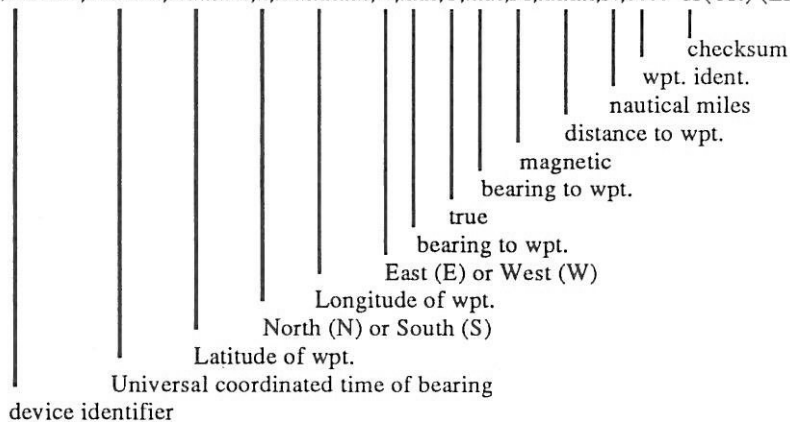
checksum
mag. (M) or true (T)
heading to steer to wpt.
mag. (M) or true (T)
bearing to wpt.
wpt. identifier
magnetic
bearing of dest. wpt from origin wpt.
arrival perpendicular
arrival circle
nautical miles
steer left (L) or right (R)
cross track error
cycle lock
signal validation (SRN ORed with blink for Loran C)
device identifier

Data extracted:
cross track error
bearing to waypoint true or magnetic
bearing waypoint to waypoint magnetic
course to steer, magnetic

NMEA specification

Bearing and distance to waypoint, great circle, dead reckoned

\$aaBEC,xxxxxx,xxxx.xx,n,xxxxxx.xx,w,xxx,T,xxx,M,xxx.x,N,cccc*ss(CR) (LF)



Data extracted:

Bearing to waypoint from dead reckoned position, great circle, magnetic.

Bearing to waypoint from dead reckoned position, great circle, true

Distance to waypoint from dead reckoned position, great circle.

NMEA specification

Bearing and distance to waypoint, rhumb line, dead reckoned

\$aaBER, xxxxxx,xxxx.xx,n,xxxxx.xx,w,xxx,T,xxx,M,xxx.x,N,cccc*ss(CR) (LF)

checksum
wpt. ident.
nautical miles
distance to wpt
magnetic bearing to wpt.
true bearing to wpt.
East (E) or West (W)
Longitude of wpt.
North (N) or South (S)
Latitude of wpt.
Universal coordinated time of bearing
device identifier

Data extracted:

Bearing to waypoint from dead reckoned position, rhumb line, magnetic

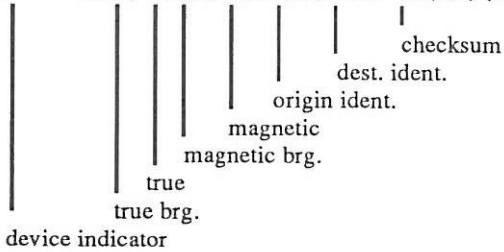
Bearing to waypoint from dead reckoned position, rhumb line, true

Distance to waypoint from dead reckoned position, rhumb line

NMEA specification

Bearing to destination waypoint from origin
waypoint, true or magnetic

\$aaBOD, xxx, T, xxx, M, ccccc, ccccc *ss (CR) (LF)



Data extracted:

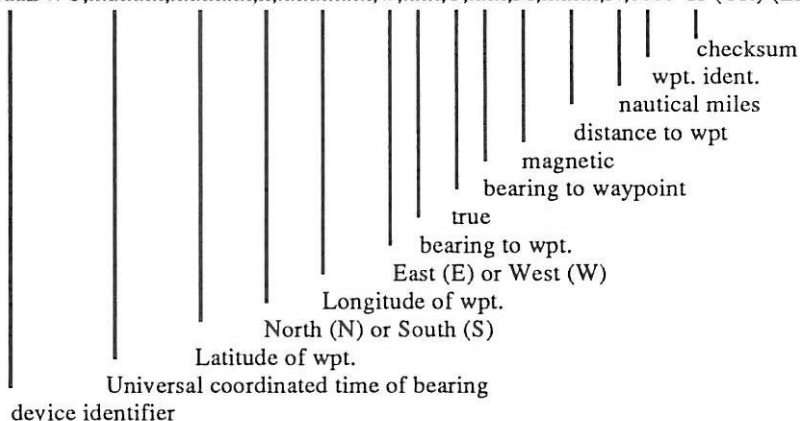
Bearing to destination from origin waypoint, true

Bearing to destination from origin waypoint, magnetic

NMEA specification

Bearing and distance to waypoint, great circle, measured

\$aaBWC,xxxxxx,xxxx.xx,n,xxxxx.xx,w,xxx,T,xxx,M,xxx.x,N,cccc*ss (CR) (LF)



Data extracted:

Bearing to waypoint from present position, great circle, magnetic

Bearing to waypoint from present position, great circle, true

Distance to waypoint from present position, great circle

NMEA specification

Bearing and distance to waypoint, rhumb line, measured

\$aaBWR,xxxxxx,xxxx.xx,n,xxxxx.xx,w,xxx,T,xxx,M,xxx.x,N,cccc*ss (CR)(LF)

checksum
wpt. ident.
nautical miles
distance to wpt
magnetic bearing to wpt.
true bearing to wpt
East (E) or West (W)
Longitude of wpt.
North (N) or South (S)
Latitude of wpt.
Universal coordinated time of bearing
device identifier

Data extracted:

Bearing to waypoint from present position, rhumb line, magnetic

Bearing to waypoint from present position, rhumb line, true

Distance to waypoint from present position, rhumb line,

Bearing to waypoint from waypoint, true & magnetic

\$aaBWW, xxx, T, xxx, M, cccc, cccc*ss (CR) (LF)

checksum
from wpt ident.
to wpt ident.
magnetic bearing
true bearing
device identifier

NMEA specification

Bearing to waypoint from waypoint, true & magnetic (continued)

Data extracted:

Bearing to waypoint from waypoint, true

Bearing to waypoint from waypoint, magnetic

Present position fix, dead reckoned

\$aGDP, xxxxxx, xxxx.xx, n, xxxxx.xx, w, ccccc *ss (CR) (LF)

device indicator UTC of fix latitude, N or S North (N) or South (S) longitude, W or E East (E) or West (W) current wpt. ident. checksum

Data extracted:

Latitude and longitude, present fix

Present position fix

\$aGLL, xxxx.xx, n, xxxxx.xx, w *ss (CR) (LF)

device identifier latitude, N or S North (N) or South (S) longitude, E or W East (E) or West (W) checksum

Data extracted:

Latitude and longitude, present fix

NMEA specification

Present position fix, Loran-C

\$aGLP,xxxxx,xxxx.xx,n,xxxxx.xx,w,cccc*ss (CR) (LF)

device identifier

UTC of fix

latitude, N or S

North (N) or South (S)

longitude, E or W

East (E) or West (W)

current wpt ident.

checksum

Data extracted:

Latitude and longitude, present fix

Recommended minimum implementation sentence, Loran-C specific

\$aARMA,a,xxxx.xx,n,xxxxx.xx,w,xxxxx.x,xxxxx.x,xx.x,xxx,xx,e*ss (CR) (LF)

device identifier

status, valid (A) or invalid (V)

Latitude

North (N) or South (S)

Longitude

East (E) or West (W)

time differences for pair used in position calculation

COG, true

SOG, knots

variation

East or West

checksum

Data extracted:

Course over ground (COG), true

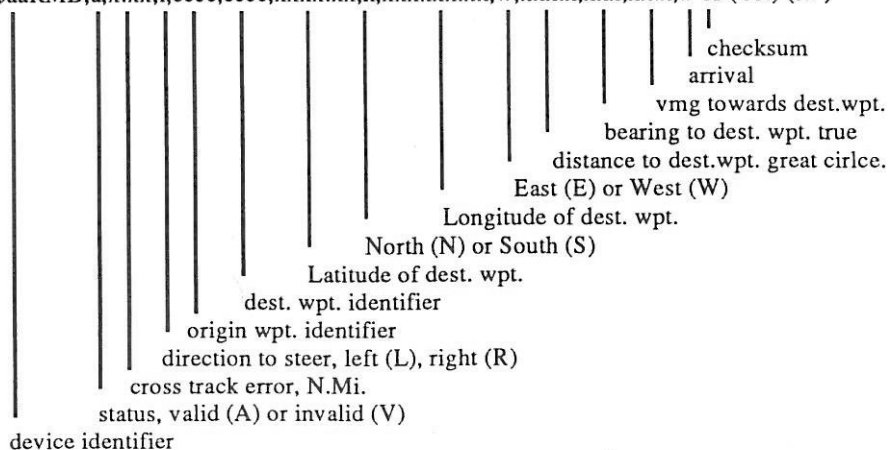
Speed over ground (SOG), knots

Latitude & Longitude, present fix

NMEA specification

Recommended minimum implementation sentence, navigation information

\$aRMB,a,x.xx,l,cccc,cccc,xxxx.xx,n,xxxxxx.xx,w,xxx.x,xxx,xx.x,a*ss (CR) (LF)



Data extracted:

Bearing to waypoint, great circle, true.

Distance to waypoint, great circle in nautical miles

Vmg to waypoint, knots

Cross track error, nautical miles

NMEA specification

Recommended minimum implementation sentence, GPS or Transit specific.

\$aaRMC, xxxxxx,a,xxxx.xx,n,xxxxx.xx,w,xx.x,xxx,xxxxxx,xx,e*ss (CR) (LF)

The diagram illustrates the structure of the RMC sentence with vertical lines separating the fields. The labels below the lines are as follows:

- device identifier
- universal coordinated time
- status, valid (A) or invalid (V)
- Latitude
- North (N) or South (S)
- Longitude
- East (E) or West (W)
- SOG, knots
- COG, true
- date
- variation
- East (E) or West (W)
- checksum

Data extracted:

Course over ground, true
Speed over ground, knots

NMEA specification

Actual track and ground speed

\$a VTG, xxx, T, xxx, M, xx.x, N, xx.x, K *ss (CR) (LF)

device identifier

course over ground, true

true

course over ground, magnetic

magnetic

speed over ground, knots

knots

speed over ground, km/hour

km/hour

checksum

Data extracted:

Course over ground, true

Course over ground, magnetic

Speed over ground, knots

Waypoint closure velocity

\$a WCV, xx.x, N, cccc *ss (CR) (LF)

device identifier

velocity made good towards waypoint

knots

waypoint identifier

checksum

Data extracted:

Velocity made good towards waypoint in knots

NMEA specification

Distance to next waypoint, great circle

\$aawdc, xxx.x, N, cccc *ss (CR) (LF)

device identifier distance to waypoint
 nautical miles
 waypoint identifier
 checksum

Data extracted:
Next waypoint distance, great circle

Distance to next waypoint, rhumb

\$aawdr, xxx.x, N, cccc *ss (CR) (LF)

device identifier distance to waypoint
 nautical miles
 waypoint identifier
 checksum

Data extracted:
Distance to waypoint, rhumb

Measured cross track error

\$aaxte, a, a, x.xx, l, N *ss (CR) (LF)

device identifier signal validation, valid (A) or invalid (V)
 cycle lock, valid (A) or invalid (V)
 cross track error
 steer left (L) or right (R)
 nautical miles
 checksum

Data extracted:
Cross track error in nautical miles

NMEA specification

Dead reckoned cross track error

\$aaXTR, a, a, x .xx, l, N *ss (CR) (LF)

checksum
nautical miles
steer left (L) or right (R)
cross track error
cycle lock, valid (A) or invalid (V)
signal validation, valid (A) or invalid (V)
device identifier

Data extracted:

Cross track error in nautical miles

Time and distance to layline

\$aaZDL, xxxxxx, x.xx, l, N *ss (CR) (LF)

checksum
nautical miles
steer left (L) or right (R)
distance to layline
time to layline
device indicator

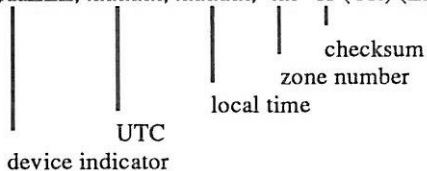
Data extracted:

Distance to layline, nautical miles

NMEA specification

Local time zone

\$aaZLZ, xxxxxx, xxxxxx, -xx *ss (CR) (LF)

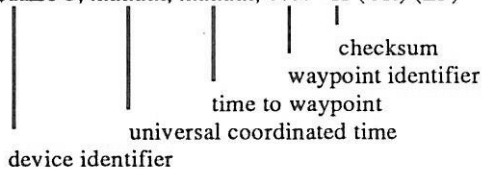


Data extracted:

Local time, HRS, MINS, SECS

Time to waypoint

\$aaZTG, xxxxxx, xxxxxx, cccc *ss (CR) (LF)



Data extracted:

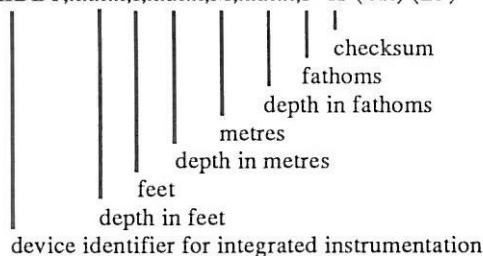
Time to waypoint

NMEA specification

NMEA 0183 sentences output

Depth of water below transducer

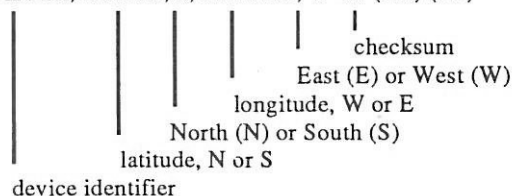
\$IIDBT,xxx.x,f,xxx.x,M,xxx.x,F*ss (CR) (LF)



Note: If the depth sounder is unable to determine the depth and therefore displaying then the sentence will be transmitted with null data fields.

Latitude and longitude, present fix

\$IIgLL,xxxx.xx,n,xxxxx.xx,w*ss (CR) (LF)



NMEA specification

Magnetic heading

\$IHD,M,xxx,M*ss (CR) (LF)

checksum
magnetic
magnetic heading
device indicator

Air temperature

\$IITMA,xxx,C*ss(CR) (LF)

checksum
Celsius
air temperature in degrees Celsius
device indicator

Water temperature

\$IIMTW,xxx,C*ss (CR) (LF)

checksum
Celsius
water temperature in degrees Celsius
device indicator

Surface wind direction and velocity

\$IIMWD,,,xxx,M, xx.x, N, xx.x, M, *ss (CR) (LF)

checksum
m/s
true wind speed in m/s
knots
true wind speed in m/s
magnetic
true wind direction
device indicator

NMEA specification

Heading and water speed

\$IIVHW,,,xxx,M,xx.xx,N,,*ss (CR) (LF)

device identifier
magnetic heading
magnetic
boatspeed in knots
knots
checksum

Water referenced log mileage

\$IIVLW,xxxx.xx,N,xxxx.xx,N*ss (CR) (LF)

device identifier
total cumulative distance
nautical miles
distance since reset and started
nautical miles
checksum

Device measured velocity parallel to true wind

\$IIVPW,xxx.x,N,,*ss (CR) (LF)

device identifier
Vmg upwind (positive) or downwind (negative)
knots
checksum

NMEA specification

Wind relative bearing and velocity

\$IIVWR,xxx,a,xx.x,N,xx.x,M,*,ss (CR) (LF)

checksum
metres/second
apparent wind speed in m/s
knots
apparent wind speed in knots
from port (L) or from starboard (R)
apparent wind angle, 0 to 180 degrees
device indicator

True wind relative bearing and velocity

\$IIVWT,xxx,a,xx.x,N,xx.x,M,*,ss (CR) (LF)

checksum
metres/second
true wind speed in m/s
knots
true wind speed in knots
from port (L) or from starboard (R)
true wind angle, 0 to 180 degrees
device indicator

Measured cross track error

\$IIXTE, a, a, x.xx, l, N*ss (CR) (LF)

checksum
nautical miles
steer left (L) or right (R)
cross track error
cycle lock, valid (A) or invalid (V)
signal validation, valid (A) or invalid (V)
device identifier

NMEA specification

Checksum

The checksum is a two character hexadecimal value calculated by exclusive ORing each data character in the sentence between the \$ and the *. This is used by the interface unit to check for errors in received data. If an error is found then Err 4 will be displayed. See Fault finding.

The checksum is optional except in sentences RMA, RMB and RMC.

*Note: In some earlier implementations of the 0183 standard an extra comma is transmitted before the *, this will not cause an error message.*

Further information

Further information on the NMEA and copies of the 0183 standard can be obtained from:

National Marine Electronics Association
49 Delwood Lane
Tinton Falls
NJ07724
USA

Installation

Connections

See Installation Sheet 330-IS-0460.

Adding the NMEA display to existing systems

The NMEA display is connected to the system using the network in the same manner as a normal FFD, see installation sheet supplied.

Note: The software used in the existing FFDs should be version 3B or later. If unsure see Fault finding - software version number.

Using multiple NMEA displays

Multiple NMEA display units can be installed when for instance, a second position fixer is required, this can be interfaced to the existing system by simply adding the additional display to the network.

Additional NMEA display units will generate further sets of NMEA functions depending of course on the information received from the position fixers. For example, if cross track error is being received by multiple NMEA display units then cross track error will appear twice in the **WAYPOINT** menu on all FFDs as **CROSS TR NM** and **CROSS TR 1**, see note.

By referring to the displayed value of cross track on each of the position fixers, and relating it to the value shown on the FFD, it is possible to see which displayed text relates to which position fixer. Once this is established, this relationship will not change even when the system is switched off.

Note: That all other duplicated display functions with the suffix 1 relate to the same position fixer. If a third NMEA display is used, then the suffix 2 appears and so on.

Fault finding

The major problem when trying to trace faults in an interfaced system is identifying which device or interconnection is at fault. For example, it is easy to assume that the problem lies in the NMEA display, when a particular function cannot be selected, where in reality the position fixer may not been configured properly to output NMEA.

Note: The NMEA display unit contains a number of diagnostic routines to help.

Checking the NMEA display unit is working

If interfaced correctly with a suitable position fixer for example, the NMEA display will show the **NMEA** legend if it is receiving correct NMEA data from the position fixer.

If the position fixer is not functioning correctly, the **NMEA** legend will not appear. Should this occur, check the following:

- 1 All connections to the NMEA input and output are good. See Installation - connections for further information.
- 2 The position fixer is configured correctly for NMEA 0183 output.

Fault finding

If these two points check out correctly, then there may be a fault with the interface in the NMEA display or with the position fixer.

The NMEA display has a comprehensive self test facility which will give the user an immediate indication of possible failure.





Testing NMEA input and output

The NMEA display input and output may be tested as follows:

- 1 Ensure the instrument system is switched OFF.
- 2 Locate the main NMEA display junction box and do the following:

Remove yellow and violet wires from display and connect them together (ie, NMEA O/P to NMEA I/P signal).

Remove blue wire from display, and connect to black (ie, connect NMEA I/P return to ground).

- 3 Switch on the system whilst holding the  key down on the NMEA display, the **DIAGNOST** menu will appear.
- 4 Press the  key, **KEYTEST** appears, now press and hold the  key until **NMEA** appears, now press the  key to initiate the NMEA I/P, O/P test.

Fault finding

5 The following messages may appear:

RX TX OK - NMEA input and output are functioning correctly.

FAIL - Internal open circuit in the interface hardware.

Corrupted or nonsensical text appears - Internal component failure in the interface hardware.

Error messages

There are three messages that can be displayed when using an NMEA function to indicate an interface input error, these are:

Err 3

Syntax or parity error on received NMEA data

Err 4

NMEA 0183 checksum error on received NMEA data

OFF

No data for function received within last minute

Fault finding





If either **Err 3** or **Err 4** is displayed you should check for interference or more likely the compatibility of the equipment.

If the **OFF** legend is displayed, then a check should be made on the set-up of the interfaced equipment or the connecting cable(s).



If the **NMEA** legend disappears, reception of NMEA data has ceased. Check NMEA connecting cables and the set-up of the interfaced equipment.

Software version number

It is important when liaising with a B&G service agent that you know the software version number of your NMEA display unit. This can be identified using the display's diagnostic feature, as follows:

- 1 With the power OFF, press and hold the  key and switch on the system. The upper menu text shows **DIAGNOST**.
- 2 Press the  key again to enter the diagnostics main menu, the text will indicate the first option **KEYTEST**.
- 3 Press and hold the  key until **VERSIONS** appears, then press the  key to enter the versions menu.

Fault finding

- 4 **DISPLAY** is shown flashing, then press the  key to reveal software version number. When the test is completed the PROM checksum is displayed on the display's lower digits. The last two digits displayed represent the software version number.
- 5 To return the display to normal operation, press the  key.

Specification

Physical

Construction -

Fully sealed, moulded, ABS chassis plate with metal rear can

NMEA Display unit -

Size: 165mm x 110mm x 30mm

Weight: 0.5 Kg

Temperature range -

Operating: -10°C to 60°C

Storage: -25°C to 80°C

Humidity range -

0 to 100%

Shock/bump vibration -

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Specification

Electrical

Power supply -

Voltage: 12V nominal (10V to 16V)

Current: 25mA maximum without lighting

90mA maximum with lighting

Processor and memory -

CMOS 8 bit microprocessor 64K x 8 EPROM,

8K x 8 RAM, 256 x 8 EEPROM

Data retention -

Settings retained by EEPROM (10 years retention)

Interface standards -

NMEA 0183 version 1.5

Baud rate -

NMEA 0183 - 4800 bits per second

NMEA output drive -

15mA at 4V

NMEA input drive requirement -

7mA at 4V
