

**NAVAID (NMEA REPEATER)**

**OWNER'S HANDBOOK**

**251-HB-0208-02**

**(VERSION 3 SOFTWARE)**

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**Navaid (NMEA Repeater)  
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### **1 DESCRIPTION**

#### **1.1 General**

Navaid is designed to interface with position fixing devices such as Decca, Loran, GPS and Satnav, which provide an NMEA standard output, and display data from these in a clear and easily read form on deck.

The B&G Navaid accepts standard NMEA 0183 data and allows selection of any one of the 13 values listed in para 4.2 for digital display.

Cross Track Error may also be displayed on an analogue repeater for use as a steering indicator, as this form of display requires less mental effort to follow than a digital display.

The control unit is of a similar design to other instruments in the B&G range such as the Harrier 6 or the Digital Repeaters for Hornet, Hunter and HS911. It operates on a nominal supply of 12 - 24V dc and consumes only 20mA with the scale illumination switched off.

Navaid has a digital display and can select any of the following data using three preset buttons:

Distance to a waypoint

Bearing to a waypoint

Course over the ground

Speed over the ground

Cross track error.

Position fixing devices produce a variety of data. Using the fourth button (SELECT), these values can be displayed and these may include:

Vmg to waypoint in knots

Time to waypoint in minutes or minutes and seconds

Bearing to waypoint on true or magnetic rhumb line course

Bearing to waypoint on true or magnetic great circle course

Distance to waypoint in nautical miles on rhumb line course

Distance to waypoint in nautical miles on great circle course

Course over the ground, true or magnetic

Cross track error in nautical miles

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## **1.2 Position Fixers for B&G Navaid**

The choice of position fixer for use with the B&G Navaid should be made bearing in mind that it should be able to output the information required for display, using the NMEA 0183 standard.

The following table lists some typical position fixers, but does not claim to be a comprehensive list.

D =DECCA S =SATNAV L =LORAN	SPEED OVER GROUND	COURSE OVER GROUND	DISTANCE TO WAYPOINT	BEARING TO WAYPOINT	CROSS TRACK ERROR	VMG TO WAYPOINT	TIME TO WAYPOINT
D NAVSTAR A300D	*	*	*	*	*		
D LEAB DA90	*	*	*	*	*		
D SHIPMATE RS4000				*	*		
D SHIPMATE RS4001					*		
S NAVSTAR 603S			*	*	*		
S NAVSTAR A300S			*	*			
S MAGNAVOX MX4102				*			
S MAGNAVOX MX5102				*			
L NORTHSTAR 800	*	*	*	*	*	*	*
L TRIMBLE 300	*	*	*	*	*		
L FURUNO LC 90	*	*			*		

Please ensure that the Position Fixer chosen has NMEA 0183 output.

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## 2 OPERATION

### 2.1 Keyboard

X. T. E.	C. O. G.	DIST TO W/P COURSE	SELECT
*	S. O. G.		

**Keyboard Layout**

### 2.2 Select facility

Press the right hand key to display the currently selected Channel Number (01 to 13). These numbers refer to the following data:

CHANNEL NO	DATA
1	Bearing to Waypoint, True, Rhumb
2	Bearing to Waypoint, Magnetic, Rhumb
3	Bearing to Waypoint, True, Great Circle
4	Bearing to Waypoint, Magnetic, Great Circle
5	Distance to Waypoint, Rhumb (nautical miles)
6	Distance to Waypoint, Great Circle (nautical miles)
7	Course Over Ground, (true)
8	Course over ground (magnetic)
9	Speed Over Ground, knots
10	Vmg to Waypoint, Knots
11	Time to Waypoint, HH : MM/MM : SS
12	Cross Track Error and Sense (measured)
13	Cross Track Error and Sense (dead reckoned)

Hold the key pressed to change the selection which then steps through these 13 Channel Numbers at a rate of about one/second. A flag to the left of the display indicates the direction of stepping which changes direction with successive presses of the key:

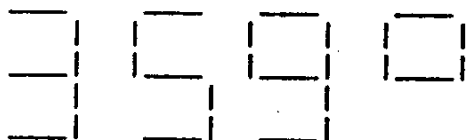


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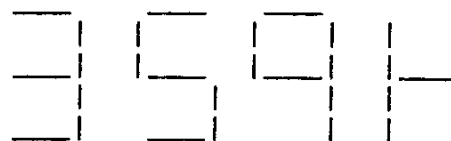
When the SELECT key is released the selected Channel Number will remain displayed until the relevant data is received again via the NMEA input. This may be up to 20 seconds, after which the data is updated whenever it is received. If no data is received for one minute, then the function number 1 to 6 will be displayed.

### 2.3 Course Over Ground

Course over the ground is displayed on the first press of the C.O.G/S.O.G key. If F2: is displayed, then no data has been received over the last minute.



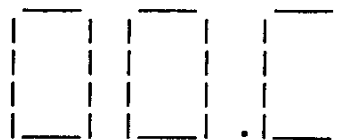
degrees magnetic



degrees true

### 2.4 Speed over Ground (knots)

Speed over Ground is displayed on a second press of C.O.G/S.O.G key. If F3: is displayed, then no data has been received over the last minute.



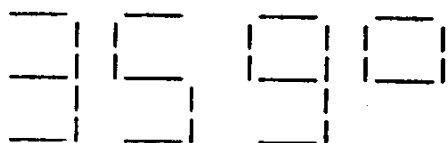
### 2.5 Distance to Waypoint (nautical miles)

Distance to waypoint is displayed on the first press of the DISTANCE TO WAYPOINT/COURSE key. If F4: is displayed then no data has been received over the last minute.



### 2.6 Course to Waypoint

Course to Waypoint is displayed on a second press of the DISTANCE TO WAYPOINT/COURSE key. If F5: is displayed then no data has been received over the last minute.



degrees magnetic



degrees true

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## **2.7 Cross Track Error (nautical miles)**

Cross Track Error is displayed on the first press of the X.T.E/\* key. data has been received during the last minute. If Fl: is displayed, then no data has been received over the last minute.

□.□□□□      □.□□□□

The 'L' or 'r' character is as received in the NMEA sentence.

## **2.8 Lighting Level**

This is displayed on a second press of the X.T.E/\* key. Subsequent presses adjust the lighting level and display the new lighting level (1, 2 or 3 or OFF)

□□□□      to      □□□□  
off                                  maximum brightness

All keyboard selections are remembered when power is interrupted

## **3 SETTING UP**

### **3.1 Main functions**

There are four possible values which could be displayed for Bearing to Waypoint and two possible values for Distance to Waypoint and Course over Ground. The value required probably depends on what data is available from the Position Fixer being used, so some setting up of the Navaid may be required after it is installed.

The Select Key should be used first to find which Channels are being Output from the Position Fixer.

The factory settings for the five main functions are :

Function 1 CROSS TRACK ERROR  
Channel 12                  Cross Track Error

Function 2 COURSE OVER GROUND  
Channel 7                  Course Over Ground, True

Function 3 SPEED OVER GROUND  
Channel 9                  Speed Over Ground

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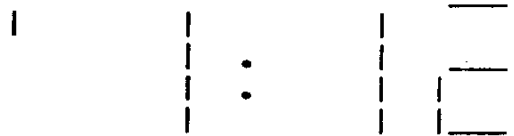
**Function 4 DISTANCE TO WAYPOINT**

Channel 5                      Distance to Waypoint, Great Circle

**Function 5 COURSE TO WAYPOINT**

Channel 2                      Bearing to Waypoint, True, Great Circle

Each of these functions can be programmed to display data from any other Channel number 1 to 13. To do this, select the required function as usual but do not release the key. Then press the SELECT key simultaneously. The display will show the function number 1 to 5 and the channel selected for display as this function.



Still holding the main function key, operate the SELECT key to set the flag displayed to the direction of change required, then hold both keys for 10 seconds to start stepping through channel numbers until the required number is displayed. Release all keys. Then the appropriate function will be updated when data is received.

### 3.2 Analogue Meter

The analogue meter drive outputs of the Navaid can be programmed to display:

**Bearing** from channels 1,2,3 or 4 using 360° meter type 215-00-018

**Course** from channel 7 or 8 using 360° meter type 215-00-018

**Cross Track Error** from channel 12 or 13 using centre zero meter type 215-00-119

To select the channel number to be output press the XTE/\* key for lighting level until '01' is displayed, but do not release the key. Press the SELECT key simultaneously to display the channel number currently selected for the meter e.g.



Still holding the XTE/\* key, operate the SELECT key to set the flag displayed to the direction of change required and then hold down both keys for 10 seconds to start stepping through the channel numbers. When the required number is displayed, release all keys. The meter will now be updated as data is received



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### 3.3 NMEA Output

The NMEA output of the Navaid can be set for 183 data (same as received) for connection to further Navaid's or 180 data (Cross Track Error only) derived from the 0183 input to drive an Autopilot. To change the output mode press the X.T.E/\* key for lighting level until OFF is displayed for lights off but do not release the key. Then press the SELECT key simultaneously to display current output mode as follows:



factory setting

Hold both keys for 10 seconds to alternate between 180 or 183. Then release all keys when the required mode is displayed.

## 4 TECHNICAL NOTES

### 4.1 NMEA 183 standard

All NMEA 0183 sentences consist of ASCII characters and all begin with \$ and end with CR LF. The second two characters are ignored by the Navaid as they only describe the type of equipment providing the data.

There is an optional Checksum Field which can be inserted just before the CR but this is also ignored by the Navaid.

Individual characters are transmitted with the following parameters:-

Baud rate:	4800
Data bits:	8 (bit 7 = 0)
Parity:	disabled (none)
Stop bits:	one or more

### 4.2 Data Extracted from NMEA Sentences

CHANNEL NO	DATA	SENTENCES USED
1	Bearing to Waypoint, True, Rhumb	BWW, BER, BWR, WBD*
2	Bearing to Waypoint, Magnetic, Rhumb	BWW, BER, BWR, WBD*
3	Bearing to Waypoint, True, Great Circle	BEC, BWC
4	Bearing to Waypoint, Magnetic, Great Circle	BEC, BWC
5	Distance to Waypoint n/mile, Rhumb	BER, BWR, WBD*
6	Distance to Waypoint n/mile, Great Circle	BEC, BWC
7	Course Over Ground, True	VTG
8	Course over ground, magnetic	VTG
9	Speed Over Ground, knots	VTG
10	VMG to Waypoint, knots	WCV
11	Time to Waypoint HH : MM/MM : SS	ZTG
12	Cross Track Error and Sense (measured)	XTE, XTR, APA
13	Cross Track Error and Sense (dead reckoned)	XTR

\* WBD is not a standard NMEA sentence.

### 4.3 NMEA sentences

#### 4.3.1 Actual track and ground speed

Data extracted:	Format
Actual track - true	xxxx
Actual track - magnetic	xxx°
Speed over ground - knots	xx.x or x.xx

```
$AAWCV , xx.x , N , xxx[CR][LF]
```

Waypoint number

Knots

Velocity made good to waypoint

#### 4.3.3 Bearing to waypoint from waypoint

Note: waypoint number 0 will normally represent the present position.

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Data extracted:	Format
Bearing between waypoints, magnetic	xxx0
Bearing between waypoints, true	xxxt

## 4.3.4 Next waypoint distance (great circle)

```
$AAWDC , xxx.x , N , xxx[CR][LF]
```

|            |            |  
 |            |            |            Waypoint number  
 |            |            |            Nautical miles  
 |            |            |            Next waypoint distance (great circle)

Data extracted:	Format
Next waypoint distance - nautical miles (great circle)	xxx.x

## 4.3.5 Next waypoint distance (rhumb)

```
$AAWDR, xxx.x , N , xxx[CR][LF]
```

|            |            |  
 |            |            |            Waypoint number  
 |            |            |            Nautical miles  
 |            |            |            Next waypoint distance (rhumb)

Data extracted:	Format
Next waypoint distance (rhumb) - nautical miles	xxx.x

## 4.3.6 Cross track error (measured)

```
$AAXTE , A , A , x.xx , L , N[CR][LF]
```

|            |            |            |            |  
 |            |            |            |            |            Nautical miles  
 |            |            |            |            |            Steer left (L) or right (R)  
 |            |            |            |            |            Cross track error (measured)  
 |            |            |            |            |            Cycle lock A = valid I = invalid  
 |            |            |            |            |            Signal validation (SNR 'OR'ed with blink for Loran C)

Data extracted:	Format
Cross track error (measured) - nautical miles	x.xx

## 4.3.7 Time to waypoint

```
$AAZTG , xxxxxx , xxxxxx , xxx[CR][LF]
```

|            |            |  
 |            |            |            Waypoint number  
 |            |            |            Time to waypoint HH :MM :SS  
 |            |            |            Universal co-ordinated time ~ HH :MM :SS

Data extracted:	Format
Time to waypoint - HH :MM :SS	xxxxxx

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HH :MM normally displayed unless HH = 00 in which case MM :SS are displayed.

#### 4.3.8 Autopilot format A

```
$AAAPA , A , A , x.xx , L , N , A , A , xxx , M , xxx[CR][LF]
```

Waypoint number

Magnetic

Bearing of best wp from  
original wp

Arrival perpendicular

Arrival circle

Nautical miles

Steer left (L) or Right (R)

Cross track error (measured)

Cycle lock

Signal validation (SNR 'OR'ed with blink for Loran C)

**Data extracted:**

### Format

Cross track error (measured) - nautical miles

**X.XX**

Relay to NMEA output

If signal validation and/or cycle lock are not equal to A, then the cross track error is displayed with two decimal points (e.g. x.x.xL) to provide a warning of lost lock or suspect signal.

#### 4.3.9 Bearing and distance to waypoint - rhumb (measured)

\$AABWR,xxxxxx,xxxx.xx,N,xxxxx.xx,W,xxx,T,xxx,M,xxx.x,N,xxx[CR][LF]

WP number  
Nautical miles  
Waypoint distance  
Magnetic  
Waypoint bearing from  
present position  
True  
Waypoint bearing  
Longitude east (E) or west (W)  
Longitude DDDMM.SS  
Latitude north (N) or south (S)  
Latitude DDMM.SS  
Universal co-ordinated time - HH MM SS

**Data extracted:**

## Format

Waypoint bearing from present position - rhumb (magnetic)

XXX

Waypoint bearing from present position - rhumb (true)

XXX

Waypoint distance from from present position - rhumb (nm)

xxx.x

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#### 4.3.10 Bearing and distance to waypoint - rhumb (dead reckoning)

SAABER,xxxxx,xxxx.xx,N,xxxxx.xx,W,xxx,T,xxx,M,xxx.x,N,xxx[CR][LF]

```

      WP number
      Nautical miles
      Waypoint distance
      Magnetic
      Waypoint bearing from
      present position
      True
      Waypoint bearing
      Longitude east (E) or west (W)
      Longitude DDDMM.SS
      Latitude north (N) or south (S)
      Latitude DDMM.SS
      Universal co-ordinated time - HH MM SS

```

Data extracted:	Format
Waypoint bearing from dead reckoned position - rhumb (magnetic)	xxx°

```
Waypoint bearing from dead reckoned
position - rhumb (true)                                xxxt
```

```
Waypoint distance from dead reckoned
position - rhumb (n/mile)                                xxx.x
```

#### 4.3.11 Bearing and distance to waypoint - great circle (measured)

\$AABWC,xxxxxx,xxxx.xx,N,xxxxxx.xx,W,xxx,T,xxx,M,xxx.x,N,xxx[CR][LF]

[illegible]

Data extracted:	Format
Waypoint bearing from present position	
- great circle (magnetic)	xxx

Waypoint bearing from present position  
- great circle (true) xxx

Waypoint distance from present position  
- great circle (n/mile) xxx

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#### 4.3.12 Bearing and distance to WP - great circle (dead-reckoning)

\$AA\$WR,xxxxxx,xxxx.xx,N,xxxxx.xx,W,xxx,x,xxx,M,xxx.x,N,xxx(CR) (RF)

	WP number
	Nautical miles
	Waypoint distance
	Magnetic
	Waypoint bearing from present position
	Tide
	Waypoint bearing
	Longitude east (E) or west (W)
	Longitude DDMM.SS
	Latitude north (N) or south (S)
	Latitude DDMM.SS
	Universal co-ordinated time - 04 AM SS

Data extracted:	Point
Waypoint bearing from dead reckoned position - great circle (magnetic)	200.0
Waypoint bearing from dead reckoned position - great circle (true)	200.0
Waypoint bearing from dead reckoned position - great circle (n/mile)	200.0

#### 4.3.12 Cross track error (dead reckoned)

\$AAXTR,x.xx,L,N[CR][LF]

Nautical miles

Steer left (L) or right (R)

Cross track error (dead reckoned) - nautical miles

Data extracted:	100000
Cross track error (dead reckoned) - nautical miles	2.1780

#### 4.3.14 Waypoint bearing and distance

```

EAXMBD,xxx,T,xxx,M,xxx.x,N,xxx[CR][LF]
|
|
|
|
|
|
Waypoint number
Nautical miles
Distance to waypoint
Magnetic
Bearing to waypoint
True
Bearing to waypoint

```

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Data extracted:	Format
Bearing to waypoint true, rhumb	xxxxt
Bearing to waypoint magnetic, rhumb	xxx°
Distance to waypoint, rhumb, nautical miles	xxx.x

Note: WBD is not a standard NMEA sentence.

#### 4.4 NMEA 180 Standard

The NMEA 180 format is a single byte for Cross Track Error which is transmitted by the Navaid whenever Cross Track Error is received on NMEA 183, if NMEA 180 output is selected (see section 3.3).

Baud rate	1200
Data bits	8 (bit 7 = 0)
Parity	disabled (none)
Stop bits	1 or more

The individual data bits are as follows:

Bit 7	always 0 to distinguish from 182 data
Bit 6	set to 1 if there are no warning signals received as V instead of A in the relevant 183 sentence.
Bits 5 to 0	Cross Track Error value 111111 for maximum left (> 0.31L) 100000 for 0 left or 0 right 000001 for maximum right (>0.31r)

## 5 SPECIFICATION

### 5.1 Physical

Construction: glass filled injection moulded thermoplastic cases. All units containing electronic circuits are fully sealed and fitted with desiccators that can be withdrawn for reactivation

#### Size & Weight

##### Digital Display Unit

110mm (4in) x 110mm (4 in) x 42mm(1.6in)  
0.5kg (1.1lb)

##### Analogue Repeater

Bezel width 110mm (4in)  
Barrel Diameter 66mm (2.6in), depth 57mm (2.25in)  
0.5kg (1lb)

##### Operating Conditions

Temperature - operating -10°C to +60°C, storage -25°C to +80°C

Humidity - 0 to 100%

Safe Distance from Compass - 200mm (8 in)

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**5.2 Electrical**

**Power Requirements:** Each digital display unit can drive one Analogue Repeater. Lighting for the digital display unit is controlled from the keyboard and supplied from the main supply input. Lighting for the Analogue Repeater must be provided and controlled separately.

<b>Voltage Range:</b>	9V to 32V for Digital Display Unit
<b>Lighting supply:</b>	0V to 16V for Analogue Repeater
<b>Current drain:</b>	Lights Off - 20mA max @ 12V or 24V. If meter is connected add 30mA at 12V or 24V Lights On - 70mA max @ 12V or 24V. If meter is connected add 30mA at 12V or 24V
<b>NMEA Input:</b>	standard opto-isolated
<b>Logical 0:</b>	> 4V
<b>Current drain:</b>	1mA $\pm$ 0.2mA at 4V
<b>Logical 1:</b>	< 1V
<b>Current drain:</b>	<0.2mA at 1V
<b>NMEA Output:</b>	single sided current source
<b>Logical 0:</b>	>4V at 15mA (current is limited to <40mA if shorted)
<b>Logical 1:</b>	<0.1V
<b>Meter Drive:</b>	one synchro meter only
<b>Common Output:</b>	4V $\pm$ 0.3V
<b>Current Source or Sink:</b>	30mA
<b>Sine and Cosine phases:</b>	1.5V $\pm$ 0.3V to 6.5V $\pm$ 0.3V
<b>Current Source or Sink:</b>	15mA