Hercules 2000

EXCELLENCE IN MARINE ELECTRONICS ®

USER MANUAL

This manual applies to systems containing the Hercules Main Processor
and version 9 software

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Hercules 2000

USER MANUAL

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PRODUCT LIABILITY AND SAFETY WARNINGS

PRODUCT LIABILITY

Brookes and Gatehouse Limited accept no responsibility for the use and/or operation of this equipment. It is the user's responsibility to ensure that under all circumstances the equipment is used for the purposes for which it has been designed.

WARNING - ELECTRICAL HAZARD

This equipment uses high voltage electrical power. Contact with high voltages may result in injury and/or loss of life.

WARNING - CALIBRATION

The safe operation of this equipment is dependent on accurate and correct calibration. Incorrect calibration of this equipment may lead to false and inaccurate navigational readings placing the yacht into danger.

WARNING - NAVIGATION HAZARD

The Hydra 2000 is an Electronic Navigation System and is designed to assist in the navigation of your yacht. It is not designed to totally replace conventional navigation procedures and precautions and all necessary precautions should be taken to ensure that the yacht is not placed into danger.

CAUTION

This equipment is designed for use with a power supply source of 12v dc. The application of any other power supply may result in permanent damage to the equipment.

The use of alcohol or solvent-based cleaners will damage this equipment and any warranty in force will be invalidated.

Displays installed into locations manufactured of conductive materials (e.g. Steel, Carbon Fibre etc.) should be insulated from the structure to prevent the damage to the casings as a result of the effects of electrolysis

RECORD OF AMENDMENTS

Date	Amendment Number	Description	Signature

PART 1 - INTRODUCTION

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PART 1 - INTRODUCTION

1.1 SYSTEM DESCRIPTION

The heart of the Hercules 2000 Racing Instrument System are two processors: the Hercules Main Processor and the Performance Processor. These two processors integrate raw data from sensors into a set of race winning functions, available on a choice of displays anywhere in the yacht. The modular design allows you to progress from a standard system, adding new units as required. This Manual describes the standard system and then describes how the system can be expanded.

The system is connected together by the Fastnet high speed communications network, which handles all the data that travels between two units; the Main Processor and the Performance Processor, and the Full Function Displays (FFDs), 20/20s, 40/40s and Halcyon Displays. These, combined with the wind speed and angle, compass heading, boat speed and depth sensors make up the standard system.

1.2 PROCESSORS

1.2.1 Hercules Main Processor

The Hercules Main Processor is responsible for monitoring the data from the sensors, including sensors of both the standard system and the expansion options that may be added. The sensors can provide the following functions:

Boat Speed
Depth
Measured Wind Angle
Measured Wind Speed
Compass Heading
Sea Temperature
Air Temperature
Ship's Supply Voltage
Heel Angle
Trim Angle
Mast Rotation
Barometric Pressure

Rigging Loads

From this information the Hercules Main Processor then calculates the following:

Apparent Wind Speed
Apparent Wind Angle
True Wind Speed
True Wind Angle
True Wind Direction
Average Boat Speed
Velocity Made Good (VMG) Upwind/Downwind
Resettable Log
Stored Log
Race Timer
Heading on Opposite Tack
Leeway
Heading Corrected for Leeway (Course)
Dead Reckoning Course and Distance
Pressure Trend

This information, once calculated, is distributed from the Main Processor Unit to the displays via the network.

In addition, the Hercules Main Processor provides four outputs for analogue indicators. Any one of eight different types of analogue indicator can be used on for each of these outputs. The Main Processor also incorporates a battery-backed memory that stores all the calibration, damping and alarm settings whilst the power is OFF; these settings are adjustable from any FFD.

1.2.2 Expansion Processor

The Expansion Processor allows a further four analogue indicators and a number of additional sensors to be added to the system. Further details are given in Part 5 - Options.

1.2.3 Performance Processor

The Performance Processor adds two components to the system: a polar table to store your yacht's performance data, and additional interfacing facilities to enable communications between the Hercules 2000 and other electronic devices.

The polar tables can be adjusted to suit each individual yacht. Once set up, a range of new functions become available to assist with improved sailing of the boat.

Functions provided by the Performance Processor are:

Tacking Performance
Reaching Performance
Target Boat Speed
Target True Wind Angle
Optimum Wind Angle
Next Leg Wind Predictions
Tidal Set and Drift (Not polar related)

The functions listed here are explained in detail in Part 2 - Operating Information.

The interfaces provided are to both the NMEA and RS232C standards. This allows two-way communication with almost any type of electronic equipment, for instance, position fixers and external computers.

Full details on interfacing are given in Part 5 - Options

1.2.4 Halcyon Gyro Processor

The Halcyon Gyro Processor is an interface between the Halcyon Gyro Stabilised Compass and the B&G Fastnet Network. It also outputs NMEA heading information at a rate of 10 Hz for use with other marine instruments and AD10 for use with Radar.

The Halcyon Gyro Processor accepts NMEA data from your position fixer for magnetic variation information to allow display and output of True referenced heading.

The Halcyon Gyro Processor can also be used as an interface to either output NMEA heading and AD10 from a B&G system compass, or to accept NMEA heading information from an external compass for use on the Hercules system.

Full details are given in Part 3 – Calibration.

1.3 SENSORS

1.3.1 Masthead Unit

The Masthead Unit measures the wind speed and angle at the masthead. A choice of units is available; Four sizes of Vertical Masthead Unit, including some available in 'Ocean Specification' for special applications. A standard 450mm (17.5") horizontal unit is also available.

1.3.2 Ultrasonic Speed Sensor

The Ultrasonic Speed Sensor provides highly accurate and stable boat speed measurement. The Ultrasonic Speed Sensor has no moving parts and requires minimal maintenance. The transducer can be fitted flush with the hull, creating zero drag, and can be painted, or anti-fouled over. The Ultrasonic Speed Sensor processes the sensor signals for use by the Hercules Main Processor, which then generates the boat speed and log functions.

1.3.3 Sonic Speed Unit

The Sonic Speed Unit provides highly accurate and stable boat speed measurement. The Sonic Speed Unit does not rely on mechanical moving parts requiring constant attention for protection from weed etc. The transducers are fitted virtually flush with the hull, creating almost zero drag, and can be painted, faired or anti-fouled over. The Sonic Speed Unit processes the sensor signals for use by the Main Processor, which then generates the boat speed and log functions.

1.3.4 Paddle-Wheel Speed Sensor

The Paddle-Wheel Speed Sensor is designed primarily for cruising yachts and consists of a paddle-wheel which protrudes through the hull via a housing. To enable regular cleaning of the paddle-wheel, the housing is provided with a flap valve which closes automatically when the unit is pulled back into the yacht.

1.3.5 Halcyon 2000 Compass

The Halcyon 2000 Compass is a high performance electronic fluxgate compass for use on both sailing and power craft. It is intended to be connected to Hercules 2000, Hydra 2000 or HS 2000 instrument systems through the B&G Fastnet Network.

The Halcyon 2000 Compass has the ability to ‘learn’ the magnetic effect of the vessel on the compass and automatically apply deviation correction.

1.3.6 Halcyon Gyro Stabilised Compass

The Halcyon Gyro Stabilised Compass (HGSC) is a high performance, solid state compass that provides the best available heading information through the use of rate gyros to correct for the motion of your yacht. It also provides high accuracy Heel and Trim. It interfaces to Hercules, Hydra and HS 2000 instruments via the Halcyon Gyro Processor that transmits this information to the B&G Fastnet Network.

The HGSC is an easily calibrated compass that ‘learns’ the magnetic effects of your vessel on the compass and automatically applies the deviation correction.

1.3.7 Depth Sensor

This can either be a removable through hull unit, or moulded in-hull for reduced drag. The depth datum is fully adjustable and can be set to either the waterline, the bottom of the keel or from the transducer.

The foregoing sensors combined with the two processor units provide an integrated set of tactical and performance data. Additional sensors provide either single inputs, or improve the accuracy of other functions on the system and are described in Part 5 - Options.

1.4 DISPLAYS

1.4.1 Full Function Display (FFD)

This is the standard system display; every Hercules 2000 must contain at least one FFD. Additional FFDs and other display types, as described in the following paragraphs, are options with which the system can be expanded and made even more powerful to the user.

The FFDs name provides an indication that this is more than simply a display. The FFD is a terminal for the whole system, allowing you to control everything from the functions displayed (and those functions displayed at the 20/20s and 40/40s) to the calibration of the system.

The FFD simultaneously displays two functions with accompanying descriptive text. Any system function can be called up on any FFD; as many FFDs as you require can be placed on the system - all with full control of the Hercules 2000.

Part 2 - Operating Information describes operation of the FFD to control the system.

1.4.2 20/20 Display

The Hercules 2000 20/20 is a lightweight, large digit, liquid crystal display which can be configured from any FFD to display any system function. A Remote Button is available for scrolling through pre-configured functions quickly.

The 20/20's operation is described in Part 5 - Options.

1.4.3 40/40 Display

The Hercules 2000 40/40 is a lightweight, extra-large digit, liquid crystal display which can be configured from any FFD to display any system function. A Remote Button is available for scrolling through pre-configured functions quickly.

The 40/40's operation is described in Part 5 - Options.

1.4.4 Analogue Indicators

There are a wide range of analogue indicators available, refer to Part 5 - Options for details.

1.4.5 Halcyon Display

This is a tactical compass display and is described in Part 5 - Options.

1.5 CALIBRATION

It cannot be over stressed at this stage the importance of calibrating the system properly; in both the initial stages of the installation and operation, and throughout the life of the system.

Hercules 2000 calibration is an ongoing process and is something you must be aware of each time you go sailing. This is particularly relevant of the true wind calibration, where constant refining will pay huge dividends in accuracy. To this end the process has been simplified as far as possible, so that all you require for accurate instrument data is some background knowledge together with a few simple techniques. Refer to Part 3 - Calibration.

1.6 DAMPING

Another important facility that you need to be constantly aware of is the damping available on certain functions. This allows you to filter signal noise on the function when in unstable or rough conditions. The damping works by applying a filter over a time period; the more you increase this time period, the smoother the data readings will be, but the longer it will take to see the effect of any change. Similarly the lower the time period the greater the jumps you will see in the numbers, but the response to any change will be faster.

Dynamic Damping adjusts your system to deliver the most accurate and realtime information, i.e. when on a beat, it is essential that the wind angle information is accurate but steady with most ‘noise filtered out, however,when tacking, data needs to be more realtime. With Dynamic Damping, the damping value applied will reduce to almost zero during conditions when the data is changing rapidly.

The Damping value is set (in seconds) to a steady state value, the Dynamic Damping is set to a value between 0 (off) and 10 (maximum), the higher the value, the more sensitive the function is to rates of change, and the faster the damping value is lowered.

This allows the effects of the change to be more readily seen on the instruments. As the rate of change of the function reduces, so the damping value is allowed to rise to the preset Damping Value to ensure signal noise is filtered out of the data.

Damping should not be confused with the update rate which is the number of times per second that the function value is sent to the display. The update rate is fixed for all the functions.

1.7 MENU STRUCTURE

The central concept to the operation of the system is the menu structure of the functions, and once this is grasped, operation very quickly becomes familiar. The idea of structured layers of menus is one seen everywhere in modern software, and regular computer users should have a head start.

The principle is that at any one level there is a set of choices which you can scroll through until you find the one you want. Having found the correct menu entry, it is then selected by pressing the Enter key - the FFD then displays the first choice in the next level of menu down. Here you once again scroll through the available options until you find and select your choice. In many cases this is as far as you will need to go, i.e. to choose a function for display. To complete some actions such as entering a calibration value, switching on an alarm, and so on, it may be necessary to go to another menu level.

The options available for each Function Menu Choice are listed in Table 1.1 - Function Menu Choices. Operational Menu Choices together with the applicable Function Menu are listed in Table 1.2 - Operational Menu Choices.

Note
The functions available to the user are dependent on the range of sensors fitted to the system.

Details of the sensors required for each function are fully explained in Part 3 - Operating Information.

Table 1.1 - Function Menu Choices

FUNCTION	MENU CHOICE	FUNCTION TEXT
Speed	Boat Speed	BOAT SPD
	Average Speed	AVG SPD
	Velocity Made Good	VMG
Log	Stored Log	STD LOG
	Trip Log	TRIP LOG
Depth	Depth - Metres	DEPTH M
	Depth – Feet	DEPTH FT
	Depth – Fathoms	DEPTH FM
Navigate	Heading	HEADING
	Off Course	OFF CRSE
	Dead Reckoning Course	D/R CRSE
	Dead Reckoning Distance	D/R DIST
	Course	COURSE
	Leeway	LEEWAY
	Tidal Set	TIDE SET
	Tidal Drift	TIDE RTE
Wind	Apparent Wind Speed (Kt)	APP W/S
	True Wind Speed (Kt)	TRUE W/S
	Apparent Wind Angle	APP W/A
	True Wind Angle	TRUE W/A
	True Direction	TRUE DIR
	Head/Lift Trend	LIFT/HDR
	Next Leg Apparent Wind Angle	N/L AWA
	Next Leg Apparent Wind Speed	N/L AWS
	Apparent Wind Speed m/s	APP W/S MS
	True Wind Speed m/s	TRUE W/S MS
	Measured Wind Angle	MEAS W/A
	Measured Wind Speed (Kt)	MEAS W/S
Perform	Tacking Performance	TACKING
	Reaching Performance	REACHING
	Optimum Wind Angle	OPT W/A
	Polar Speed	POL SPD
	Layline Distance	LAYLINE
	Heel Angle	HEEL
	Next Leg Speed	N/L SPD
	Target Boat Speed	TARG SPEED

	Opposite Tack Fore/Aft Trim Mast Angle Wind Angle to the Mast	OPP TACK TRIM MAST ANG W/A MAST

Table 1.1 - Function Menu Choices (cont.)

Perform (cont.)	Target True Wind Angle Trim Heel	TARG TWA TRIM HEEL
Waypoint	Brg W/point to W/point Mag. Brg W/point to W/point True Brg to W/point Rhumb Mag. Brg to W/point Rhumb True Brg to W/point Great Circle M Brg to W/point Great Circ True Distance to Waypoint Rhumb Distance to W/point Great Circ Course Over Ground Mag Course Over Ground True Speed Over Ground VMG to Waypoint Estimated Time of Arr to WPT Cross Track Error	BRG W-W M BRG W-W T BTW RMB M BTW RMB T BTW GC M BTW GC T DTW RMB DTW GC CRSE O/G M CRSE O/G T SPD O/G VMG WPT ETA WPT CROSS TR
Motor	Battery Voltage	VOLTS
Temperature	Sea Temperature Degrees °C Sea Temperature Degrees °F Air Temperature Degrees °C Air Temperature Degrees °F	SEA TEMP °C SEA TEMP °F AIR TEMP °C AIR TEMP °F
Time	Timer Rolling 5 Timer	TIMER MS ROLLING 5 MS
Miscellaneous	Linear 1 Linear 2 Linear 3 Linear 4 Barometric Pressure Barometric Pressure Trend Rudder Angle Halcyon	LINEAR 1 LINEAR 2 LINEAR 3 LINEAR 4 BAROMETR PR TREND RUDDER HALCYON
Loadcell	Loadcells	User defined
Tanks	Tank Sensors	User defined
External	Remote 0 to 9	REMOTE 0 TO 9

Table 1.2 - Operational Menu Choices

OPERATION	SELECTED FUNCTION(S)	OPERATIONAL CHOICE
Log Control	Trip Log D/R Course D/R Distance	RESET RUN FREEZE
Timer Control	Timer	SET START STOP SYNC
Barometric Pressure Trend Control	PR Trend	PERIOD RESET
Next Leg Control	N/L AWA N/L AWS	LEG BEAR TIDE ON
Alarm Control	BOAT SPD APP W/S DEPTH VOLTS SEA TEMP AIR TEMP	ALL OFF HI ALARM HI ON HI OFF LO ALARM LO ON LO OFF
Sector Alarm Control	HEADING APP W/A	ALL OFF SECTOR SECT ON SECT OFF
Damping Control	BOAT SPD APP W/A APP W/S HEADING TRUE W/A TRUE W/S HEEL TRIM TIDE	Damping Value
Dynamic Damping	BOAT SPD APP W/A APP W/S HEADING TRUE W/A TRUE W/S	Damping Value

	TRUE DIR	

Table 1.2 - Operational Menu Choices (cont.)

Calibrate Log (AUTO CAL)	BOAT SPD STD LOG	SINGLE PORT CAL STBD CAL CAL DIST STRT RUN STOP RUN END CAL
Calibrate Log (MANL CAL)	BOAT SPD STD LOG	SINGLE PORT CAL STBD CAL
Calibrate Log (REF CAL)	BOAT SPD	Reference CAL
Calibrate Temp	SEA TEMP °C SEA TEMP °F	OFFSET C
Calibrate Datum	DEPTH	DATUM (+/-)
Calibrate Measured W/A	MEAS W/A	MHU ANGL
Calibrate Measured W/S	MEAS W/S	MHU CAL MHU OFFS
Calibrate Wind	TRUE W/A TRUE W/S	CORRECTN
All Other Calibrate Functions	Selected Function	CAL VAL 1 CAL VAL 2 CAL VAL 3 CAL VAL 4

PART 2 - OPERATING INFORMATION

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ILLUSTRATIONS

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PART 2 - OPERATING INFORMATION

2.1 INTRODUCTION

The Hercules 2000 System is operated by using the keys on the Full Function Display (FFD).

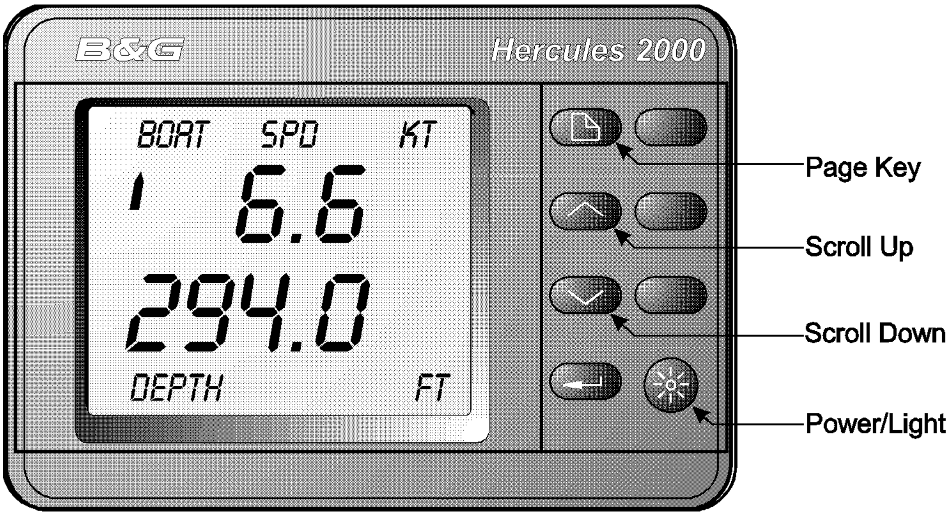

Fig 2.1 - Full Function Display

2.2 THE KEYS

2.2.1 Keylock

To prevent accidental changing of the data displayed, or to any critical calibration values, two keylock features are available on the FFDs.

1. Press the **Enter** and **Lights** keys simultaneously once. All keys except the **Page** key are locked.

2. Press the **Enter** and **Lights** keys simultaneously once more. All keys are locked.

3. Press the **Enter** and **Lights** keys simultaneously a third time. All keys are unlocked.

2.2.2 Power/Light Key

This key controls the application of power to the system and the level of illumination at all displays.

One short press of this key applies power to the Hercules 2000 System and the display is activated to show the last page used on the previous operation. A second short press of the key provides full background illumination on all system displays. Further short presses of the key decrease the illumination in three stages from full brightness to OFF. The next press of the key enables full illumination. This operation at any one Hercules 2000 Display invokes the same sequence on all Hercules 2000 Displays connected to the system. However, display lighting can be localised so that the level is adjustable for individual displays.

To switch the system OFF press and hold down the key for two seconds. After this time lapse, the message POWER OFF appears in the upper text, release the key and after a further two seconds the system switches OFF.

2.2.3 Page Key

Operation of this single key enables the user to quickly access eight functions of the Hercules 2000 System, by selecting any one of the four pre-set page displays (2 functions per page) with a simple key press. This key also allows the operator to prematurely terminate any other function, such as calibration, and return to the normal page display.

Default Pages:

True Wind Angle/Opposite Tack
True Wind Direction/Timer
VMG to Waypoint/Cross Track Error
Course Over Ground/Speed Over Ground

Notes

1. If you are lost in the system, press the **Page** Key to immediately return to the top level display.
2. The initial four pages can be reconfigured using the remaining keys and the menu system as described in Paragraph 2.3.2.
3. Successive presses of the **Page** Key displays each page in rotation.
4. Holding down the **Page** Key for 2 seconds initiates control of 20/20 Displays (refer to Part 5 - Options).

2.2.4 Scroll Keys

Two scroll keys are provided: **Scroll Up** and **Scroll Down.** The scroll keys have two functions:

To scroll through the menu choices.

To increase or decrease numerical values, such as calibration values.

When the **Scroll Up** Key is first pressed, the large digits in the upper display are no longer displayed and the name of the current menu flashes in the upper text. If the key is held down, then the upper text will scroll through some of the menu choices. If, when you are scrolling up, the required menu choice is passed, then the **Scroll Down** Key will allow you to reverse back to the required choice. When the required menu choice is found, the text will flash until selected by pressing the **Enter** Key.

2.2.5 Enter Key

The principle use of the **Enter** Key is to invoke selections chosen from the menu by the scroll keys. As a general rule, when any menu choice is flashing, pressing the **Enter** Key will select that choice.

The **Enter** Key is also used to enter data. When the value that needs changing is displayed on the screen, it is altered by pressing the **Enter** Key, which starts the value flashing, then using the **Scroll Up** or **Scroll Down** Keys for change to the required value. Press the **Enter** Key again to complete the operation.

The use of the **Enter** Key differs depending on whether you want to select a Function Menu Choice or an Operation Menu Choice.

Function Menu Choice If a Function Menu Choice is selected from the system menu using the **Scroll Up** Key, the new function will appear in the upper display when the **Enter** Key is pressed.

Operation Menu Choice If an Operation Menu Choice is selected from the system menu using the **Scroll Up** Key, the new operation will appear on the upper display when the **Enter** Key is pressed.

Therefore, to select a different FUNCTION in the upper display the **Scroll Up** Key must be used.

To perform an operation (such as changing a calibration value) on the function in the upper display the **Scroll Down** Key must be used**.**

The two additional uses of the **Enter** Key are as follows:

Accept and Reset Alarms When an alarm sounds (if the audible alarm is fitted) or flashes at the FFD, two presses of the **Enter** Key stops the warning and resets the alarm.

Expand Function Displays When displaying the LOG , TIMER, LATITUDE and LONGITUDE functions the **Enter** Key can be used to expand the display**.** Normally the Log function displays nautical miles to two decimal places, i.e**.** 99.99nm (maximum)**.** One press of the **Enter** Key expands the display to 0099nm, giving a maximum available display of 9999nm if required**.** Similarly the TIMER function normally displays a minutes and seconds reading**.** Expansion by the **Enter** Key displays hours and minutes instead.

2.2.6 Speed/Depth (SPD/DEP) Key

Pressing the **SPD/DEP** Key will select the Speed/Depth Display**.** After selection of the Speed/Depth functions, successive operations of the **SPD/DEP** Key will display the following information in a fixed order:

Boat Speed/Depth
Boat Speed/Speed Over Ground
Boat Speed/Apparent Wind Angle
Boat speed/True Wind Speed

2.2.7 Wind (WIND) Key

Pressing the **Wind** Key will select the Wind Display**.** After selection of the Wind Display, successive operations of the **Wind** Key will display the following information in a fixed order:

Apparent Wind Speed/Apparent Wind Angle
True Wind Speed/True Wind Angle
True Wind Speed/True Wind Direction
Velocity Made Good/True Wind Angle

2.2.8 Navigation (NAV) Key

Pressing the **NAV** Key will select the Navigation Display**.** After selection of the Navigation Display, successive operation of the **NAV** Key will display the following information in a fixed order:

Heading/Course Over Ground
Heading/Boat Speed
Distance to Waypoint/Bearing to Waypoint
Tide Set/Tide Rate

Note
The NAV key may be configured to show waypoint information in either Great Circle or Rhumb modes. Refer to section 2.3.3 for further details.

2.3 EXAMPLES OF OPERATION

The general principle of operating the Hercules 2000 will be made clear by the following examples of function and page selection, damping and calibration adjustment.

2.3.1 Function Selection

Our first example will be to select another function for one of the pages**.** The new function is Stored Log and since we want to place this function in the bottom display we will be using the **Scroll Down** Key.

(1) Press the **SPD/DEP** Key until the display is showing BOAT SPD in the upper display and DEPTH in the lower display.

(2) Press **Scroll Down**, the lower text now shows DEPTH flashing, the upper display is not affected.

(3) Press **Scroll Down** until the lower text shows LOG flashing, the upper display is not affected.

(4) Press **Enter**, the lower text now shows STD LOG flashing, the upper display not affected.

(5) Press **Enter** again, the lower display now shows required function, the upper display is not affected.

We are now able to view this function; press the **Page** Key, the configured pages will return and Stored Log will no longer be displayed**.** If you wish to keep Stored Log on a page, then you can configure the page.

2.3.2 Page Display Configuration

The **Page** Key allows the user to configure four pages per FFD depending on the required use at that position.

To store the setting in Paragraph 2.3.1 as a permanent new page, proceed as follows:

(1) Press **Scroll Up** or **Scroll Down** and scroll text to CNFG DSP.

Note
Scroll Up or **Scroll Down** can be used because we are configuring the whole page, both upper and lower displays.

(2) Press **Enter**, PAGE is shown in the appropriate display.

(3) Press **Enter**, the digital display is blanked and the two functions selected are displayed in the text.

Note
At this point, either of the two functions may be changed if required using the **Scroll Up** or **Scroll Down** Keys.

(4) Press **Enter** to accept the new page configuration and restore the digital display.

You will be able to set up each FFD on the boat for the people in the immediate vicinity, each crew member being able to develop their own pages for the information that is most needed on the FFD**.** All page displays are held in the display memory, independent of the power supply**.**

2.3.3 NAV Key Configuration

Our second example is configuring the NAV key. The NAV key allows the user to select either Rhumb Line or Great Circle navigation information to be displayed. To select the required mode, proceed as follows:

(1) Press the **Page** Key once.

(2) Press **Scroll Up** until the upper display shows CNFG DSP flashing.

(3) Press **Enter**, the upper text now shows PAGE flashing.

(4) Press **Scroll Up** to select either NAV MODE GC (Great Circle) or NAV MODE RH (Rhumb).

(5) Press **Enter** to select your desired choice. The display will stop flashing**.**

2.3.4 Damping Adjustment - Boat Speed

Our third example is the entry of a Damping Value**.** We want to damp Boat Speed which is in the upper display we therefore use the **Scroll Down** Key.

(1) On the upper display select BOAT SPD.

(2) When BOAT SPD is shown in the upper display, press and hold **Scroll Down** to select DAMPING which flashes in the lower text.

(3) Press **Enter** and the current damping value is displayed on the lower display.

(4) Press Scroll Down to toggle between **DAMPING** and **DYN DAMP**.

(5) Press **Enter** and **DAMPING** (or **DYN DAMP**) value flashes.

(6) Press **Scroll Up** or **Scroll Down** to increase/decrease the damping value as required.

(7) Press **Enter** to accept new value.

(8) Press **Page** to return to normal display.

Damping control for any of the other functions that can be damped is completed in a similar manner.

2.4 EXAMPLES OF CALIBRATION

The method of calibration for your Hercules 2000 System should be made clear by following the examples of calibration**.** The calibration process is described in detail in Part 3 - Calibration.

2.4.1 Manual Calibration Adjustment - Boat Speed

(1) Select BOAT SPD.

(2) If BOAT SPD is in the upper display, press and hold the **Scroll Down** Key to select CALIBRATE from the menu.

(3) Press **Enter** then press **Scroll Down** and the display shows MANL CAL, which is the choice that we require.

(4) Press **Enter** and the display shows SINGLE.

Notes

1. SINGLE is the choice required if a single speed sensor is fitted.

2. If two paddle-wheels are fitted, the **Scroll Up** or **Scroll Down** Keys should be used to select PORT CAL or STBD CAL, as required.

(5) Press **Enter** to reveal the current calibration value in Hertz/knot.

(6) To adjust the calibration value, press **Enter** and the value flashes.

(7) Use **Scroll Up** or **Scroll Down** to change the calibration value as required to the new calibration value.

(8) Press **Enter** to store the new value into the system.

(9) Press **Page** to return to full display.

2.4.2 Calibration Adjustment - Depth

(1) Select DEPTH.

(2) When DEPTH is shown in the upper display, press and hold the **Scroll Down** Key to select CALBRATE from the menu.

(3)

Note

Scroll Down is used because we are using an Operation Menu Choice relating to the function on the upper display**.** If DEPTH is in the lower display then **Scroll Up** must be used.

(3) Select **Enter** and the display shows DATUM which flashes.

(4) Press **Enter** again, DATUM stops flashing and the current datum value is displayed.

(5) Press **Enter** and the DATUM value flashes.

(6) Use **Scroll Up** or **Scroll Down** to select the new DATUM value.

Note

If DATUM is referenced to the water line, the value is positive**.** If DATUM is referenced to the keel, the value is negative and this is indicated by a minus sign.

(7) Press **Enter** to store the new DATUM value into the system.

(8) Press **Page** to return to full display.

2.4.3 Calibration Adjustment - Wind Angle

(1) Select MEAS W/A.

(2) If MEAS W/A is shown on the lower display press **Scroll Up** and scroll to CALBRATE which flashes**.** If MEAS W/A is on upper display, press **Scroll Down** and scroll to CALBRATE.

(3) Press **Enter** twice and the current alignment value is shown.

(4) Press **Enter**, MHU ANGL flashes, use **Scroll Up** or **Scroll Down** to select the new value.

(5) Press **Enter** to accept the new value.

(6) Press **Page** to return to the normal display.

2.5 ALARMS

2.5.1 Alarm Control

When a pre-set alarm parameter is reached, e.g. the depth reducing, the system raises an alarm automatically. In an alarm condition, the lower display changes to highlight the cause of the alarm, which flashes on and off continuously until **Enter** is pressed twice; at which point all the FFDs except the one on which **Enter** was pressed, return to normal**.** The audible alarm, if fitted, is also silenced by this key operation**.** After this, the lower display continues to monitor the alarm condition**.**

The alarm is still active and, if the alarm parameter is again exceeded, the alarm will flash/sound as necessary**.** The displayed alarm function remains on the lower display until **Page** is pressed.

2.5.2 Alarm Types

The system incorporates the following types of alarm:

HI ALARM - This is generated if the value of a function exceeds a pre-set level.

LO ALARM - This is generated if the value of a function drops below a pre-set level.

SECTOR ALARM - This is generated when the heading leaves the safe sector as shown in Fig 2.2**.** - Sector Alarm.

Example

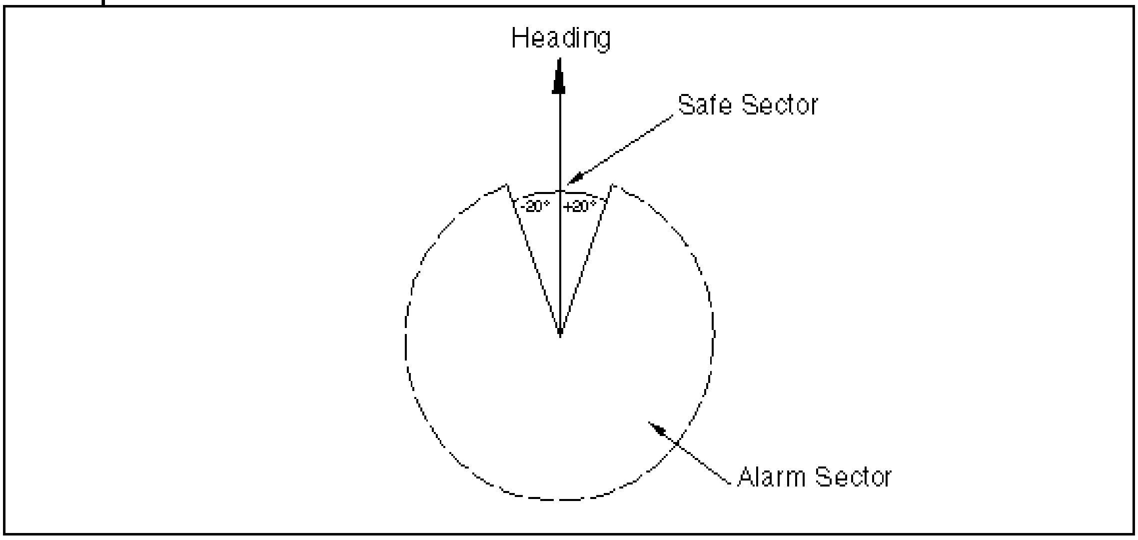

Fig 2.2 - Sector Alarm

For example, when the SECTOR alarm is turned on, the alarm reference heading is the current compass heading**.** If the SECTOR alarm is set at 40 degrees, the sector value is the compass heading +/- 20 degrees**.** It is therefore important to switch the SECTOR alarm OFF before carrying out a course alteration, switch the alarm ON again when settled on the new course heading.

Any alarm can be switched ON and OFF individually, or all alarms can be turned OFF collectively.

2.5.3 Set Lo Alarm - Depth

(1) Select DEPTH on the display.

(2) Press **Scroll Up** or **Scroll Down** to scroll text until ALARMS appears flashing.

(3) Press **Enter**, text shows ALL OFF flashing.

(4) Press **Scroll Up** until upper text shows LO ALARM flashing.

(5) Press **Enter**, the display shows current LO ALARM value.

(6) To change the LO value press **Enter**, the value flashes.

(7) Press **Scroll Up** or **Scroll Down** to increase or decrease the value as required. Press **Enter** to accept the new value and switch the alarm ON.

(8) Press **Page** to return to full display.

To access the HI ALARM, press **Scroll Up** until HI ALARM appears and press **Enter** to reveal current HI ALARM value**.** To change the value, use the same procedure as used to change the LO ALARM value.

2.5.4 Switch Alarms On/Off

To switch an alarm OFF (HI, LO or SECTOR) press **Scroll Up** until the required item (e.g. HI OFF) appears in the text and press **Enter**.

To switch an alarm ON press **Scroll Up** until the required item (e.g. LO ON) appears in the text and press **Enter**.

2.5.5 Disable Alarms

(1) Select any function with an alarm facility, e.g**.** DEPTH.

(2) If the function is in the upper display, press **Scroll Down** to ALARMS, or if the function is on the lower display use the **Scroll Up** Key**.** Then press **Enter** and ALL OFF appears flashing.

(3) Press **Enter** again, all alarms are switched OFF and the normal page display will be restored.

WARNING - All alarms in the system will remain OFF until the values are reset or the individual alarms are turned on again.

2.5.6 Selective Alarm Display

When an alarm condition arises all FFDs in the system flash the alarm function on the bottom half of their displays.

Individual FFDs can be set to ignore alarm messages.

The procedure for Selective Alarm Display is as follows:

(1) Press the **Page** key.
(2) Scroll up to CNFG DSP, then press **Enter**.
(3) Scroll up to SHOW ALM, then press **Enter**.
(4) Scroll to NO, then press Enter.
(5) Press the **Page** key to return to normal view.

This display is now set to ignore any alarm function.

2.6 TRIP FUNCTIONS

The Hercules 2000 provides three trip functions: Timer (count-up and count-down), Trip Log and Dead Reckoning**.** The functions can be reset and restarted as required, e.g. for keeping a separate log of elapsed time and distance run for a given passage.

When any trip function is started, all other trip functions which have been reset start simultaneously, except when the timer countdown is started**.** Under this condition, the other functions start, again if previously reset, when the countdown reaches zero**.** This is designed for the beginning of races, so that you have DR, log and timer running without pressing buttons during the intense moments of the start itself**.**

When a trip function is on the display, the two right hand characters show the status of the display.

The letters MS (Minutes/Seconds) and NM (Nautical Miles) indicate that the function is running.

The letters RE denote RESET, where the function is zeroed and waiting to be started.

The letters FR denote FROZEN, where the displayed value is frozen, but the function is still counting in the background.

2.6.1 Race Timer

(1) With **TIMER MS** shown on one half of the display, press the **Scroll** key adjacent to the opposite half of the display to display the **CONTROL** menu. Press **Enter** to activate the **SET/START/STOP/SYNC** loop function.

(2) Scroll to **SET** and press **Enter**. The **SET** time flashes. Using the **UP/DOWN** arrow keys, alter the time (to a maximum of 120 minutes), press **Enter** to confirm the time selected. This automatically activates the **START** page.

(3) When **START** is selected, the current **SET** time is transferred to the timer and it starts counting down.

(4) The other half of the display shows **SYNC**. Pressing **Enter** will cause the timer value to be reset to the nearest whole minute, pressing the **UP/DOWN** scroll arrow continues the cycle.

(5) When the timer reaches zero, the counter starts counting upwards. Selecting **START** in this condition resets the counter to the **SET** value and starts counting down again.

When **STOP** is selected, the timer stops at whatever value is currently displayed.

2.6.2 Rolling 5 Timer

As an alternative to the main settable timer, a ‘rolling 5’ is provided. This simply cycles from 5:00 minutes to zero then starts again counting down from 4:59, until stopped. The same **START**, **STOP** and **SYNC** functions as used in the settable timer are available in the **CONTROL** menu.

2.6.3 Timer Alarm Sounder

When the timer is counting down, the Audible Alarm (optional, fitted to the Hercules Main Processor) will sound every 10 minutes until the counter reaches 10 minutes to go, the alarm sounder will then sound briefly at the following intervals:

5:00, 4:00, 3:00, 2:00, 1:00, 0:30, 0:15, 0:10, 0:05 and 0:00.

2.6.4 Reset Trip Log

(1) Select TRIP LOG on the upper display.

(2) Press **Scroll Down** once, the lower display shows CONTROL flashing.

(3) Press **Enter**, and then press **Scroll Down** repeatedly until the display shows RESET flashing.

(4) Press **Enter** and the display shows the TRIP LOG reset and RUN in the lower menu flashing.

(5) Press **Enter** again and the display now shows the TRIP LOG running.

(6) Press **Page** to resume normal operation.

Each time you reset the TRIP LOG, the AVERAGE SPEED resets and begins its calculation again**.** The control facility for the

Dead Reckoning functions work in the same manner. The bearing and distance are linked, so that when one is started, both start.

2.7 LIGHTING CONTROL

The level of illumination at system displays is controlled by the **Power Lights** Key. Use of this key normally controls all the Hercules 2000 displays simultaneously**.** However, the level of illumination on a single FFD can be controlled individually under the menu choice - LIGHTING - LOCAL.

2.7.1 Select Local Lighting Control

(1) Press and hold **Scroll Up** or **Scroll Down** until LIGHTING appears in the text.

(2) Press **Enter** and use **Scroll Up** or **Scroll Down** until LOCAL appears in the text.

(3) Press **Enter** again and the original page display appears**.** The FFD is now in local mode.

The **Power Lights** Key now controls this display only**.** This will enable you to use very low lighting at the chart table down below, whilst retaining the brightness up on deck.

2.7.2 System Lighting Control

(1) Select LIGHTING.

(2) Press **Enter** and use **Scroll Up** or **Scroll Down** to select SYSTEM.

(3) Press **Enter** again, the original page display appears and the lighting has returned to system control.

The Performance Unit has an input that allows the display lighting to be controlled externally**.** This can be used to switch the Hercules 2000 lighting ON and OFF.

The lighting brightness is still controlled by successive short presses of the lower right hand key on an FFD in the normal way**.** Displays which have their lighting control set to LOCAL will not be affected by the lighting control input.

2.8 OPERATION DESCRIPTION

The rest of this Manual contains some detailed examples; to describe further operations we will use the following shorthand. Each successive selected menu choice will be in capitals, separated by a ® symbol. For instance, the example given in Paragraph 2.4.1 to manually calibrate the log would look like this:

SPEED ® BOAT SPD, **CALBRATE ® MANL CAL ® SINGLE**

Menu choices plain, in capitals is the selection of the required Function Menu Choice. Menu choices in **bold** is the selection of the relevant operation and are completed using the other half of the display.

2.9 OPERATING FUNCTIONS

We have seen how the Hercules 2000 System is built up and how the key and menu system operates. Here we will describe each of the functions in greater detail, to see not only the information they provide, but also some of the ways this can be employed on the boat.

2.9.1 Air Temperature

Menu heading:	TEMP
Function text:	AIR TEMP
Update rate:	1 Hz
Units:	Degrees Centigrade, Fahrenheit

Notes

1. Requires Air Temperature sensor.
2. Audible high/low alarm available.

A useful addition to the meteorological data.

2.9.2 Apparent Wind Angle

Menu heading:	WIND
Function text:	APP W/A
Update rate:	4 Hz

Units: Degrees

Notes

1. Variable damping 0-99 seconds.
2. Dynamic damping available.
3. Analogue indicators available.
4. Audible, sector alarm available.
5. Corrected for Heel and Trim angles (requires sensors)

Used in calculated functions such as True Wind Speed and Angle.

There is a special analogue indicator called Magnified Wind which only shows the 0-50º upwind/downwind sector of apparent wind angle in a magnified form. Analogues are described in Part 5 - Options.

2.9.3 Apparent Wind Speed

Menu heading:	WIND
Function text:	APP W/S
Update rate:	4 Hz
Units:	Knots, metres per second

Notes

1. Variable damping 0-99 seconds.
2. Dynamic damping available.
3. High/low alarm available.
4. Analogue indicator available.
5. Programmable meter scaling.
6. Corrected for Heel and Trim angles (requires sensors)

The apparent wind speed is simply the speed of the wind blowing across the deck, and is derived from the same components as the apparent wind angle. Used in calculated functions such as True Wind Angle and Speed, also important in its own right since many sail selection decisions are based on the apparent wind speed.

2.9.4 Average Speed

Menu heading:	SPEED
Function text:	AVG SPD
Update rate:	1 Hz
Units:	Knots

Average speed is a trip function that averages your speed through the water over the period for which the Trip Log has been running, i.e.

$$\frac{\text{Trip Log}}{\text{Trip Time}}$$

2.9.5 Barometric Pressure

Menu heading:	MISC
Function text:	BAROMETR
Update rate:	1 Hz
Units:	Millibars

Notes

1. Requires pressure sensor.
2. Offset calibration.

A must for the offshore sailor, giving not only the instantaneous value but also the all important trend (see below) towards higher or lower pressure that helps position you in a weather system and so predict the next change**.** There is a calibration if you wish to check your pressure reading against another barometer**.** CAL VAL1 should be set to the current correct barometric pressure and is found under:

MISC ® BAROMETER, **CALIBRATE ® CAL VAL1**

2.9.6 Barometric Pressure Trend

Menu heading:	MISC
Function text:	PR TREND
Update rate:	1 Hz
Units:	Millibars

This shows the change in pressure over a period of time that can be set at any value up to 24 hours**.** The period change facility can be found as a control option in the Operation Menu:

MISC ® PRTREND, **CONTROL ® PERIOD**

A reset facility at the same menu level is also provided**.** This is selected using the following sequence:

MISC ® PRTREND, **CONTROL ® RESET**

This resets the data collected to zero**.** This is useful when the instruments are first switched ON after a prolonged break, because if you switch the instruments OFF on Sunday night, and ON again the following Friday, the Pressure Trend will have data from the previous weekend that you will need to reset.

2.9.7 Battery Voltage

Menu heading:	MOTOR
Function text:	VOLTS
Update rate:	1 Hz
Units:	Volts

Notes

1. High/low alarm available.
2. Calibration facility.

Measures the voltage that the batteries supply to the system, especially useful for monitoring the supply offshore enabling you to optimise your engine running time.

To calibrate against another voltmeter, measure the supply voltage and then enter this actual voltage into:

MOTOR ® VOLTS, **CALBRATE ® CAL VAL1**

2.9.8 Bearing to Waypoint

Menu heading:	WAYPOINT
Function text:	BTW RMB or BTW GC
Update rate:	Provided by the position fixer

Units:	Degrees magnetic or true

Notes

1. Requires interfaced position fixing system.
2. Rhumb Line or Great Circle

Once the position fixer is connected and sending information, the information gathered automatically appears in the menu and becomes available for display.

2.9.9 Bearing Waypoint to Waypoint

Menu heading:	WAYPOINT
Function text:	BRG W-W
Update rate:	Provided by the position fixer
Units:	Degrees magnetic or true

Note

Requires interfaced position fixing system. This is the bearing from the active waypoint to the next waypoint on the active route.

2.9.10 Boat Speed

Menu heading:	SPEED
Function text:	BOAT SPD
Update rate:	4 Hz
Units:	Knots, MPH or KPH

Notes

1. Automatic calibration facilities.
2. Boat speed offset correction to minimise tack-to-tack errors.
3. Variable damping 0-99 seconds.
4. Dynamic damping available.
5. Acceleration, deceleration indicator.
6. Analogue indicators available.
7. Programmable meter scaling.
8. High/low alarm available.

Boat Speed is probably the most fundamental piece of information on the Hercules 2000 and is used in many of the calculations of higher functions: true wind angle/speed/direction, VMG, the log and trip functions. Boat Speed is also the primary performance measure that the boat is sailed to. Accurate calibration of Boat Speed is therefore fundamental to the performance of the system.

It is also important to be aware of the effect you can have over the readout via the damping facility. Damping set for twenty knots of breeze will not be as satisfactory in two knots - you must be prepared to alter the damping regularly, remembering that the calmer the conditions are, the lower the damping required.

2.9.11 Course

Menu heading:	NAVIGATE
Function text:	COURSE
Update rate:	1 Hz
Units:	Degrees magnetic or true

Note
Requires heel sensor.

This incorporates Leeway into heading and is sometimes called Course Made Good**.** Leeway can only be calculated if you have the heel sensor fitted, but Course is the preferred function for most navigational purposes and should be used when possible.

2.9.12 Course Over Ground

Menu heading:	WAYPOINT
Function text:	CRSE O/G
Update rate:	Provided by the position fixer
Units:	Degrees magnetic or true

Note
Requires interfaced position fixing system.
Once the position fixer is connected and sending information, the information gathered automatically appears in the menu and becomes available for display**.** This is your actual track over the ground and is invaluable to the Navigator for helping deal with tidal areas.

2.9.13 Cross Track Error

Menu heading:	WAYPOINT
Function text:	CROSS TR
Update rate:	Provided by the position fixer
Units:	Nautical miles

Notes
1. Requires interfaced position fixing system.
2. Analogue indicator available.

This is also sent direct from the position fixing system and is necessary for keeping the yacht tracking directly in to the target**.**

Cross Track Error indicates how far you are from the direct (Rhumb Line or Great Circle) as a perpendicular distance and allows you to correct even the slightest deviation. Although this may not be the objective, on long, tidally affected legs you will plan to be swept first one way and then the other**.** The Cross Track Error is useful for monitoring your tidally corrected course to see if you have the right offset, and that you are not being swept too far one way**.**

2.9.14 Course to Steer

Menu heading:	WAYPOINT
Function Text:	CTS
Update rate:	Provided by the Position Fixer
Units:	Degrees magnetic or true

Note
Requires NMEA 0183 interfaced position fixing system**.** APB sentence.

2.9.15 Dead Reckoning

Menu heading:	NAVIGATE
Function text:	D/R CRSE or D/R DIST
Update rate:	1 Hz
Units:	Degrees magnetic or true, nautical miles

Notes
1. Course and distance.
2. Corrected for leeway if heel sensor fitted.
3. Can be independently reset as a trip function.

Formerly the mainstay of all offshore navigation, now with such widespread use of electronic position fixing equipment it is more often used as an essential back up**.**

It can be particularly effective as an indicator of the net course steered on long offshore legs**.** Calculated from a base point, which is set when you start the function running, (see Para 2.3.3 for details of control) both the course as a bearing from the start point, and its distance in nautical miles, can be displayed as separate functions. If the heel angle sensor is fitted then the Course calculation will include leeway correction.

In the worst case, a Man Overboard (MOB) situation, immediately resetting the Dead Reckoning (DR) will bring the vessel back to the MOB position. DR is the course and distance over the water and not over the land as would be given by a position fixer.

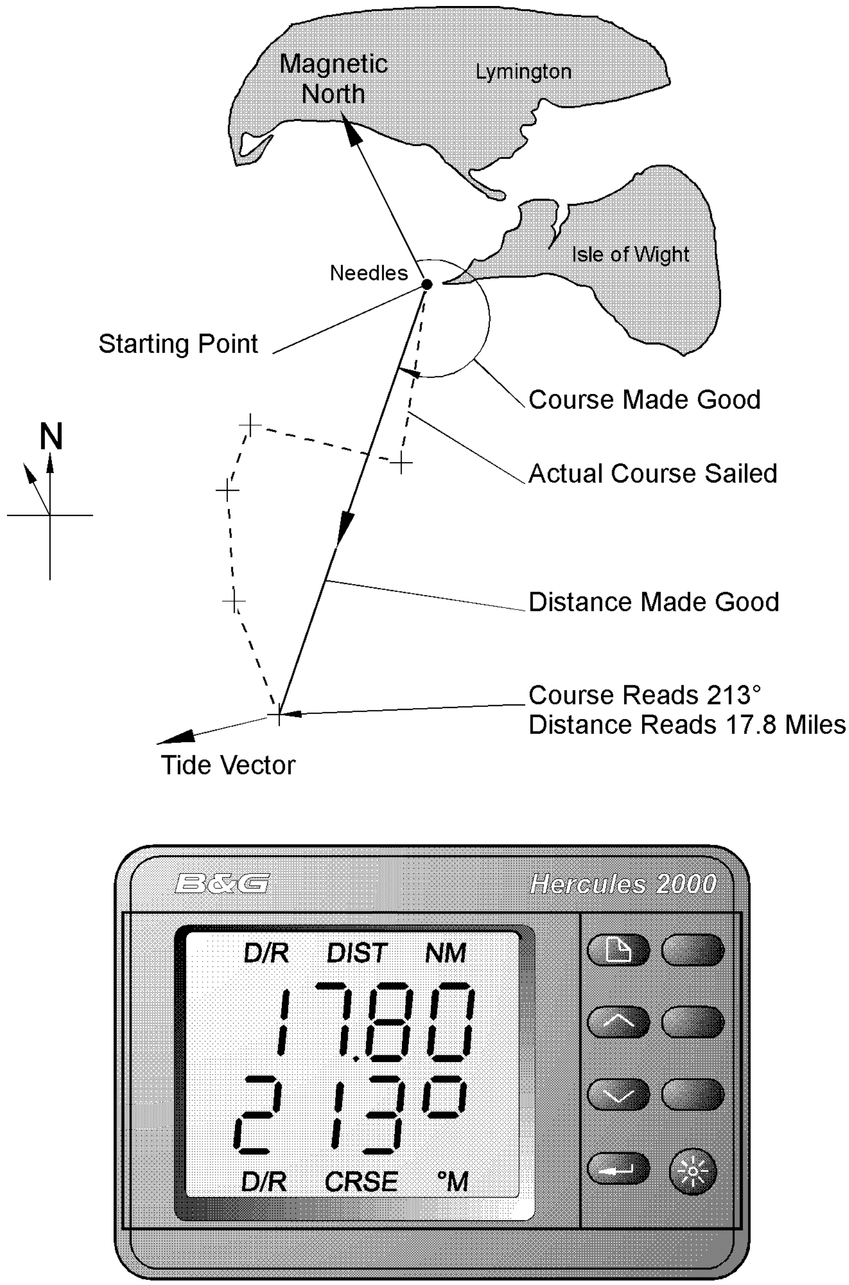

Fig 2.3 - Course Made Good

2.9.16 Depth

Menu heading:	DEPTH
Function text:	DEPTH
Update rate:	1 Hz
Units:	Metres, feet and fathoms

Notes

1. Shallow alarm available, range 0-99.9m
2. Deep alarm available.
3. Analogue indicator available, 0-200 m or 0-100 ft/fm

Depth calculation is one of the most important functions required for essential navigational and safety. On a network, rather than as a separate unit, Depth can be accessed from any display on the boat. A datum adjustment allows the base point to be moved to give either depth under the keel from the waterline or depth from the transducer.

Depth sounder performance is dependent on transducer type and installation, boat speed, electrical noise, sea state, sea bed conditions, air and plankton in the water. There will always be times when a reliable measurement of depth is not possible; in such cases, for instance, following in the wake of another boat, the display shows four floating bars to indicate a signal problem.

- - - -

The accuracy of the measurement is dependent on the velocity of sound and the amount the sound penetrates the sea bottom. Changes in the velocity of sound are not normally significant, however, errors up to one foot can result from sound penetration into very soft mud.

2.9.17 Distance to Waypoint

Menu heading:	WAYPOINT
Function text:	DTW RMB or DTW GC
Update rate:	Provided by the position fixer
Units:	Nautical miles

Notes

1. Rhumb Line or Great Circle

Once the position fixer is connected and sending the information it automatically appears in the menu, and becomes available for display.

2.9.18 Fore/Aft Trim

Menu heading:	PERFORM
Function text:	TRIM
Update rate:	1 Hz
Units:	Degrees

Notes

1. Adjustable for vertical sensor alignment.
2. Requires Halcyon Gyro Stabilised Compass system or a Trim Angle (clinometer) sensor.
3. Variable damping 0 - 99 seconds.

Fore and Aft Trim angle (along with Heel Angle) is used by the Hercules Main Processor to correct Apparent Wind Angle.

2.9.19 Heading

Menu heading:	NAVIGATE
Function text:	HEADING
Update rate:	2 Hz
Units:	Degrees magnetic or true

Notes

1. Adjustable damping, 0-99 seconds.
2. Dynamic Damping available
3. Audible, sector alarm available.

4. Sensor alignment calibration.
5. Moving card analogue meter available.

This is your compass heading, derived directly from the Halcyon Gyro Stabilised Compass, Halcyon 2000 Compass or valid NMEA heading input which allows calculation of true wind direction, dead reckoning and other course related navigation functions.

Heading fulfils a very important tactical role, and it does this best when connected to the Halcyon Display**.** This permanently shows heading in a digital form and has a segmented bar graph display to show off course**.**

2.9.20 Heading on Opposite Tack

Menu heading:	PERFORM
Function text:	OPP TACK
Update rate:	1 Hz
Units:	Degrees magnetic or true

This informs you of the heading you would be sailing on the opposite tack, and can therefore be used in conjunction with a hand bearing compass to confirm that you are on the layline. This is calculated from the true wind angle and compass heading.

2.9.21 Head Lift Trend

Menu heading:	WIND
Function text:	LIFT/HDR
Update rate:	1 Hz
Units:	Degrees

Notes

1. Requires Halcyon Display.
2. Analogue indicator available.
3. Can be reset on any FFD via the following:

WIND ® LIFT/HDR, **CONTROL ® RESET**

This function can also be displayed on an FFD, 20/20 or an analogue indicator.

2.9.22 Heel Angle

Menu heading:	PERFORM
Function text:	HEEL
Update rate:	1 Hz
Units:	Degrees

Notes

1. Adjustable for vertical sensor alignment.
2. Requires Halcyon Gyro Stabilised Compass system or a Heel Angle (clinometer) sensor.
3. Variable damping 0 - 99 seconds.

Heel angle (along with Fore and Aft Trim angle) is used by the Hercules Main Processor to correct Wind data, and is a useful option which improves the accuracy of some of the calculated functions. Heel can be used to give an indication of the wind pressure when abnormal shear or gradient is affecting the true wind speed. It can also be checked when going upwind to ensure that the boat is not sailed over the optimum heel angle.

2.9.23 Leeway

Menu heading:	NAVIGATE
Function text:	LEEWAY
Update rate:	1 Hz
Units:	Degrees

Notes

1. Requires clinometer for heel.
2. Calibration for leeway factor, see Part 3 - Calibration.

Leeway is the angle between the boat's heading and course through the water. The difference is caused by the sideways slip that the boat has when going upwind. For the Hercules 2000 to be able to measure this it needs to know the heel angle, and hence a sensor must be fitted. Leeway is of great importance in the calculation of Dead Reckoning, since the 3-4 degrees of leeway can considerably affect the dead reckoned position.

2.9.24 Layline Distance

Menu heading:	PERFORM

Function text:	LAYLINE
Update rate:	Provided by position fixer
Units:	Nautical miles

Note
Requires NMEA 0183 interfaced position fixing system transmitting the ZDL sentence.

If tacking upwind or downwind to a waypoint, some position fixing systems will provide layline information based on a pre-defined tacking angle (usually adjustable). This function displays the distance off both left and right-hand laylines by alternating the display between the two. An L or R is shown in the right hand digits to signify Left or Right laylines respectively. This function can be particularly useful when nearing a waypoint. When the value reaches zero, it is time to tack or gybe for the mark. The calculation should be corrected for any tidal offset.

2.9.25 Local Time of Day

Menu heading:	TIME
Function text:	LOC TIME HR
Update rate:	Provided by the position fixer
Units:	Hours, minutes, seconds

Notes
1. Requires NMEA 0183 interfaced position fixing system transmitting the ZLZ sentence.
2. Check that the Local Time Offset is entered on the position fixer correctly.

The function normally shows the Local Time of Day in hours and minutes as given by the position fixer. To reveal minutes and seconds press the **Enter** Key once. A further press of the **Enter** Key returns the display to hours and minutes.

2.9.26 Loadcell

Menu heading:	LOADCELL
Function text:	User selected in hardware
Update rate:	1 Hz
Units:	Tonnes, Klb

Notes

1. Requires Digital Amplifier.
2. Calibration available.

System for accurate measurement of load on rigging pins that are in shear. See Loadcell manual.

2.9.27 Mast Angle

Menu heading:	PERFORM
Function text:	MAST ANG
Update rate:	1 Hz
Units:	Degrees

Notes

1. Requires mast rotation sensor.
2. Offset calibration available.

Required for yachts with rotating masts, such as multi-hulls, who have the mast rotation sensor fitted. This function displays the angle between the mast and the centreline of the yacht, i.e. the angle it is twisted off the centreline.

2.9.28 Measured Wind Angle

Menu heading:	WIND
Function text:	MEAS W/A
Update rate:	4Hz
Units:	Degrees

Notes

1. Alignment calibration.

The Measured Wind Angle is the angle measured by the Masthead Unit sensor and corrected by alignment calibration. Measured Wind is not used whilst sailing, but is a useful function for checking the operation of Wind instruments before additional corrections are applied to the data.

2.9.29 Measured Wind Speed

Menu heading:	WIND
Function text:	MEAS W/S
Update rate:	4Hz

Units:	Knots

Notes

1. Anemometer calibration.
2. Offset Correction.

The Measured Wind Speed is the angle measured by the Masthead Unit sensor and corrected by alignment calibration. Measured Wind is not used whilst sailing, but is a useful function for checking the operation of Wind instruments before additional corrections are applied to the data.

2.9.30 Next Leg Wind Information

Menu heading:	WIND
Function text:	N/L AWA or N/L AWS
Update rate:	1 Hz
Units:	Knots and degrees

Notes

1. Apparent wind speed and angle.
2. Corrected for tide if required.
3. Requires a Performance Processor.

Next Leg information is a prediction of the conditions of apparent wind speed and angle that you will meet on the next leg, and is calculated from the current true wind speed and direction, and a bearing that you enter for the next leg course**.** From this the true wind angle on the next leg is calculated, and using the polar tables the corresponding boat speed is given, and hence the apparent wind speed and angle.

Should the leg be upwind or downwind, rather than free, the Hercules 2000 calculates on the basis of the true wind angle for the optimum VMG on the advantaged tack; this is indicated by the position of the small bar at the top or bottom of the digits**.** The tide calculated by the Hercules 2000 can be applied to the calculation if required.

The Next Leg Bearing is entered as a CONTROL option under N/L AWA, found by:

WIND ® N/L AWA, **CONTROL ® LEG BEAR**

At the same menu level is the tidal option where entering a 1 applies tide to the calculation, and entering a zero removes tide from the calculation, found by:

WIND ® N/L AWA, **CONTROL ® TIDE ON**

The tide is calculated by the Performance Processor when a position fixing system is connected, see Paragraph 2.9.41.

2.9.31 Next Leg Polar Boat Speed

Menu heading:	PERFORM
Function text:	N/L SPD KT
Update rate:	1 Hz
Units	Knots

Notes
1. Requires a Performance Processor.

This is the predicted target speed for immediately after rounding the next mark of the course**.** This function is linked to the Next Leg Apparent Wind Function and thus relies on the Next Leg Bearing being entered correctly**.** Since the bearing is known, the Next Leg True Wind Angle can be calculated based on the current True Wind Direction**.** The Next Leg Target Speed is then found from the polar tables based on the current True Wind Speed and the Next Leg True Wind Angle**.** If the next leg is upwind or downwind, the next leg speed is based on the optimum true wind angle upwind, or downwind, at the current true wind speed.

2.9.32 Off Course

Menu heading:	NAVIGATE
Function text:	OFF CRSE
Update rate:	1 Hz
Units:	Degrees Magnetic

Notes
1. Requires Halcyon Display.
2. Analogue indicator available.
3. Can be reset via FFD:

NAVIGATE ® OFFCRSE, **CONTROL ® RESET**

This can also be displayed on any FFD or 20/20.

2.9.33 Optimum Wind Angle

Menu heading:	PERFORM
Function text:	OPT W/A
Update rate:	1 Hz
Units:	Degrees

Note

1. Requires Performance Processor.

For every target boat speed there is an angle at which that speed will be achieved (the Target Wind Angle). The optimum wind angle is the difference between this angle and that at which you are presently sailing, so keeping the optimum wind angle at zero achieves the angle for Target Boat Speed.

Sometimes, particularly downwind, it is easier to try to sail to a wind angle rather than to the target boat speed. The accuracy of this function will depend on how accurate the polar tables are for your boat.

2.9.34 Polar Boat Speed

Menu heading:	PERFORM
Function text:	POL SPD KT
Update rate:	1 Hz
Units:	Knots

Note

1. Requires Performance Processor.

This is the predicted maximum achievable boat speed for the current wind conditions. Unlike Target Boat Speed, which only applies whilst sailing at the optimum wind angle upwind or downwind, Polar Boat Speed applies at all wind angles. It is useful when sailing on a free leg. The helmsman and trimmers can use this figure as the target to achieve maximum performance independent of any changes in the wind speed.

2.9.35 Reaching Performance

Menu heading:	PERFORM
Function text:	REACHING
Update rate:	1 Hz
Units:	percent

Note

1. Requires Performance Processor.

Reaching performance compares the actual boat speed with the value given in the polar table for the current true wind speed and true wind angle (the Polar Speed) and displays the result as a percentage; this will keep helmsman and trimmers alert, particularly at night. Because it accounts for changes in windspeed, it is a better indication of performance gains and losses than just boat speed.

2.9.36 Rudder Angle

Menu heading:	MISC
Function text:	RUDDER
Update rate:	1 Hz
Units:	Degrees

Notes

1. Requires rudder angle sensor.
2. Offset calibration available.
3. Analogue available.

Can be helpful for indicating how the boat is balanced.

2.9.37 Sea Temperature

Menu heading:	TEMP
Function text:	SEA TEMP
Update rate:	1 Hz
Units:	Degrees Centigrade or Fahrenheit

Notes

1. Requires temperature sensor.
2. High/low alarm available.
3. Offset calibration available under Cal Val 2

This is most useful in races such as the Newport-Bermuda, where the ocean currents are critical to the tactics. Changes in sea temperature are good indications of ocean current. Sea temperature can be useful in other ways too; water flowing out of rivers differs in temperature quite markedly to the sea, and this can assist in choosing a favourable current.

2.9.38 Speed Over Ground

Menu heading:	WAYPOINT
Function text:	SPD O/G
Update rate:	Provided by the position fixer
Units:	Knots

Note

Requires interface to position fixing system.

This also comes direct from the position fixing system, and is available, provided it is sent, as soon as the position fixer is connected. Comparing the speed over the ground to the speed attained through the water is a key tactical tool, particularly so in strong tidal waters and at night.

2.9.39 Stored Log

Menu heading:	LOG
Function text:	STD LOG
Update rate:	1 Hz
Units:	Nautical miles

The Stored Log runs continually, and is always available as an accumulative total of the boat miles.

To expand the display, the **Enter** Key should be pressed, this will allow the log to display up to a maximum of 9999 nautical miles.

2.9.40 Tacking Performance

Menu heading:	PERFORM
Function text:	TACKING
Update rate:	1 Hz
Units:	Percent

Notes

1. Requires Performance Processor.

The Hercules 2000 calculates the optimum VMG from the polar tables for the wind speed and then compares this to the VMG actually being achieved, displaying the result as the tacking performance percentage**.** The same problems of time lag exist here as they do with VMG, this is discussed in the section on VMG**.**

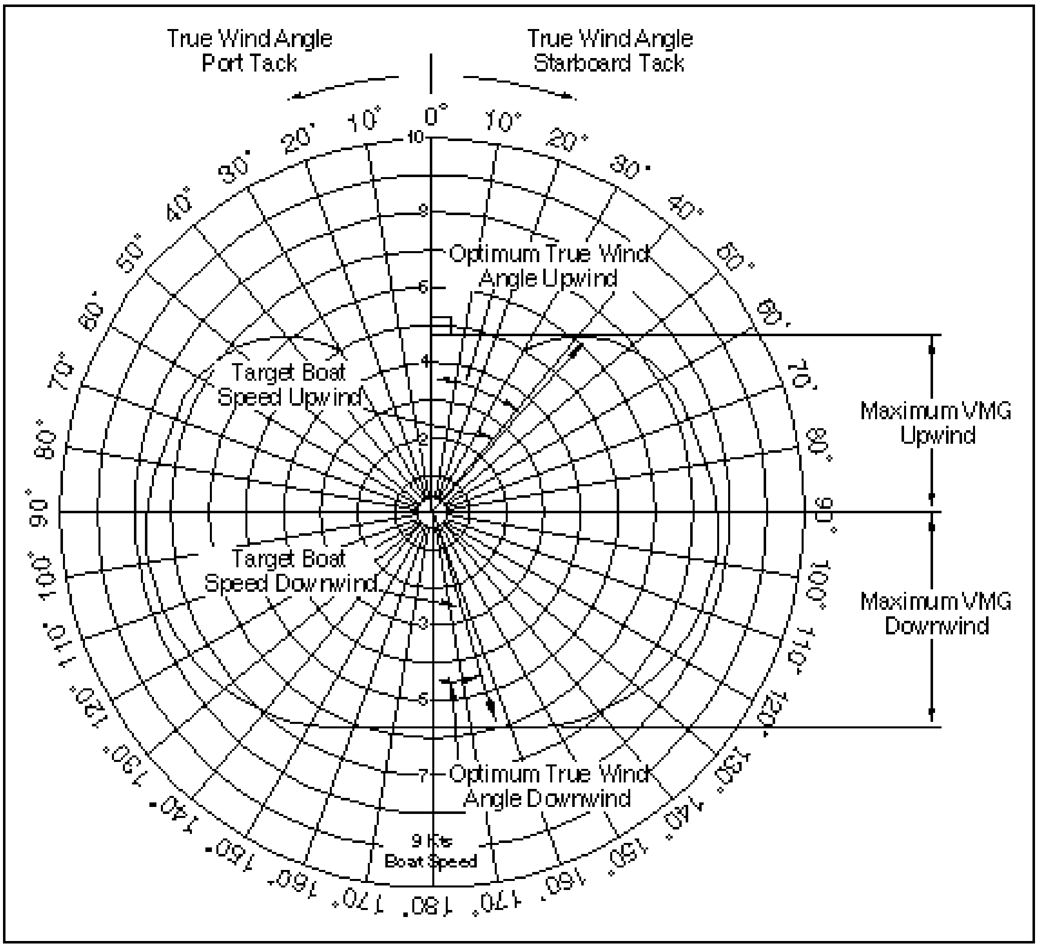

Fig 2.4 - Polar Performance Curve

The advantage of tacking performance over VMG is that it takes into account changes in windspeed. You should also be aware of the potential inaccuracies caused by your polar table being incorrect.

Tacking Performance has a CALBRATE option which allows you to choose a type of polar table which equates to your type of yacht**.** In the next Paragraph, Target Boat Speed, we discuss polar tables in general and the implications of this choice.

2.9.41 Target Boat Speed

Menu heading:	PERFORM
Function text:	TARG SPD
Update rate:	1 Hz
Units:	Knots

Notes

1. At Target True Wind Angle.
2. Requires a Performance Processor.

This is the boat speed at which the optimum VMG will be achieved, and can be measured from the polar table or obtained by careful analysis of both VMG and boat speed while you are sailing.

The Polar Table describes the performance of the boat in all conditions of True Wind Speed and Angle. The Boat Speed is plotted radially against the True Wind Angle for each True Wind Speed in turn. The result is a diagram as shown in Fig 2.4 - Polar Wind Curve, which shows the boat speed plotted for just one value of true wind speed.

Polar tables can be derived either by theoretical predictions, the IMS certificate for instance, or by analysing the boat's actual performance. You may well use one of these techniques to obtain your polar table, however, if you do not, then the Hercules 2000 has one polar table already stored in its memory. A copy of this polar table is shown in Table 2.1 on page 2-47.

The polar table is located within the Hercules 2000 system under the following:

PERFORM → TACKING, **CALBRATE ® CAL VAL1 (TAB TYPE)**

It can then be scaled to your rating using the RATING Menu choice, which is at the same level, and found by:

PERFORM → TACKING, **CALBRATE ® CAL VAL2 (RATING**)

These values are entered in the normal manner.
Once you have understood and developed the polar table it will improve all the performance functions: reaching and tacking

performance, optimum wind angle and target boat speed, as well as the predictions of next leg.

We can see from Fig. 2.4 how the target boat speed is obtained from the polar tables. It is the point at which a perpendicular drawn to the 0 degree true wind angle first touches the curve, hence optimising speed in a windward direction. The boat speed on the curve at this point becomes the target boat speed for that wind speed, and the true wind angle at that point becomes the optimum wind angle. The two combined give the optimum VMG and so allow us to calculate tacking performance.

2.9.42 Target True Wind Angle

Menu heading:	PERFORM
Function text:	TARG TWA
Update rate:	1 Hz
Units:	Degrees

Notes

1. Derived from Polar Table.
2. Requires Performance Processor.

The True Wind Angle at which the optimum VMG will be achieved according to the Polar Table.

2.9.43 Tide Set and Rate

Menu heading:	NAVIGATE
Function text:	TIDE SET or TIDE RTE
Update rate:	1 Hz
Units:	Degrees magnetic or true, knots

Notes

1. Damping 0-99 minutes.
2. Calibration: Magnetic variation.
3. Some position fixers output the current local magnetic variation on the NMEA 0183 port using either HVD, HVM, RMA or RMC sentences. As a result, CAL VAL1 on the TIDE SET function will be automatically set to the correct variation.

Your position fixer will either supply true or magnetic bearing to the Hercules 2000**.** If it supplies true bearing then you must enter the magnetic variation into the Hercules 2000**.** It is found in the menu under:

NAVIGATE → TIDE SET, **CALBRATE ® CAL VAL 1 (MAG VAR)**

Note
If your position fixer sends magnetic bearing, check that the variation is correctly entered.

The calculation involves comparing the course and speed over the ground, from the position fixing system, to the course and speed of the boat through the water, from the dead reckoning**.** Any differences are due to the tidal set and drift, and can be displayed as such**.** To make this accurate the dead reckoning requires the leeway input which in turn, requires the clinometer to measure heel angle**.**

The damping on this function is adjustable and can be important**.** In rapidly changing tidal situations you need to lower the damping down as far as possible to be able to see the changes quickly**.** Conversely, in a steady tide or current the longer the period over which the calculation is averaged, the more accurate the results will be.

The lag in the position fixer's ability to adjust to rapid changes in direction, such as when tacking, should also be borne in mind when considering the results of this function**.** Frequent tacking produces figures which are unreliable and should be treated with caution.

2.9.44 Timer

Menu heading:	TIME
Function text:	TIMER
Update rate:	1 Hz
Units:	Hours, Minutes, Seconds

Note

Can be reset independently of other trip functions

Used for both the start and to record elapsed time. The timer will act as either a stopwatch or a countdown.

The Enter key will toggle the display between minutes/seconds and hours/minutes. Paragraph 2.6.1 describes control of the timer.

2.9.45 Time to Layline

Menu heading:	TIME
Function text:	TIME L/L
Update rate:	Provide by the position fixer
Units:	Hours, minutes, seconds

Note
Requires NMEA 0183 interfaced position fixing system transmitting the ZDL sentence.

This function is linked to Layline Distance. The information displayed shows the time to go before reaching the appropriate layline. A value of zero indicates time to tack or gybe.

2.9.46 Time to Waypoint

Menu heading:	WAYPOINT
Function text:	ETA WPT
Update rate:	Provided by the position fixer
Units:	Hours, minutes

Note
Also gives ETA. Requires interfaced position fixing system.

This is calculated directly by the position fixer, and is based on your speed over the ground towards the mark, which is assumed to be constant.

2.9.47 Trip Log

Menu heading:	LOG
Function text:	TRIP LOG

Update rate:	1 Hz
Units:	Nautical miles

Note
Can be reset independently of other trip functions.

This is the log for recording individual trip distances, it displays the distance travelled from the time the function was started in nautical miles. It must be remembered that this is the distance sailed through the water, not over the ground. It also forms part of the calculation for Average Speed. A particularly useful feature is that when reset prior to the start of the race, the Timer counts down to zero, the Trip Log (and any other trip functions that have been reset) start automatically.

The Trip Log display can be expanded to display 9999nm by pressing **Enter**. See Paragraph 2.6.2 for details of trip function control.

2.9.48 True Wind Angle

Menu heading:	WIND
Function text:	TRUE W/A
Update rate:	4 Hz
Units:	Degrees

Notes
1. Relative to the boat's heading.
2. Corrected for masthead and other errors via the look-up table.
3. Variable damping 0-99 seconds.
4. Dynamic damping available.

The true wind is calculated from the vector triangle shown in Fig. 2.5. This uses the Apparent Wind Speed, Apparent Wind Angle and the Boat Speed in the calculation. The results are then corrected by the true wind correction tables, which are discussed in Part 3 - Calibration.

Note
The true wind is the wind relative to the water, not the land. The true wind is not the same as the ground wind, unless there is zero tide.

The True Wind Angle is the angle between the boat's heading and the true wind.

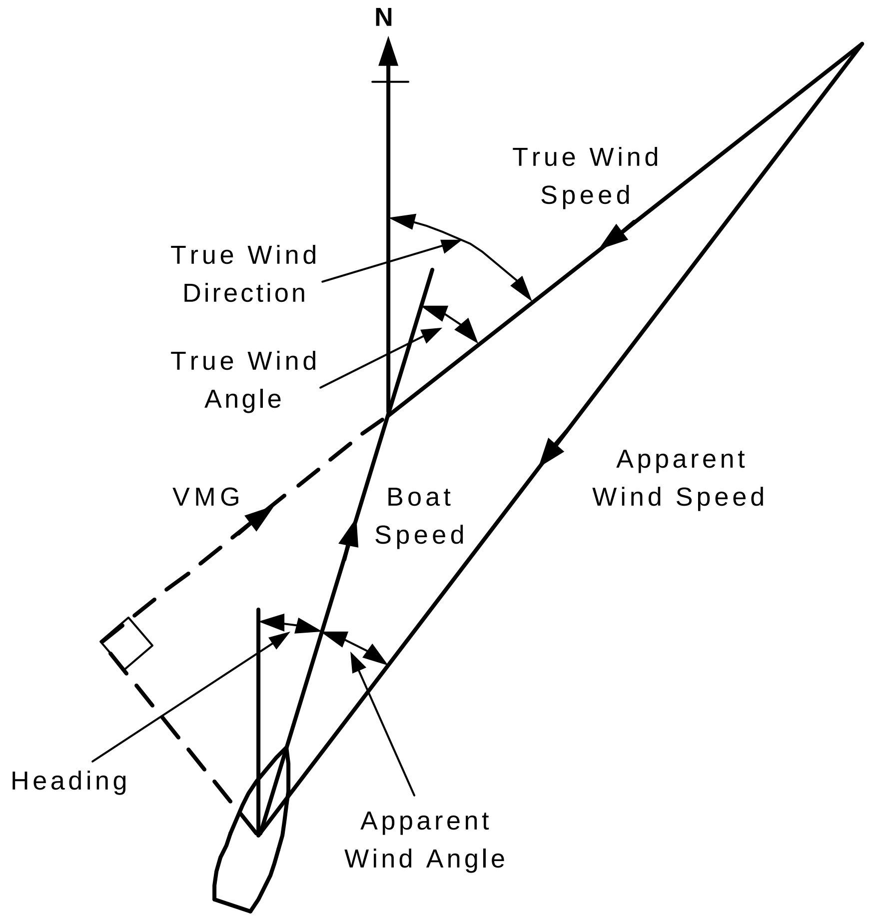

Fig 2.5 - True Wind Angle

2.9.49 True Wind Direction

Menu heading:	WIND
Function text:	TRUE DIR
Update rate:	4 Hz
Units:	Degrees magnetic or true

Notes

1. Corrected for Masthead and other errors via the look-up table, see Part 3 - Calibration.
2. Dynamic damping available.

This is the Tactician's greatest ally in the search for the right wind shifts. It shows the compass direction that the wind is coming from regardless of the boat's heading. It is calculated from the true wind angle and heading, and is corrected for calibration errors by the true wind look-up table. It is very important to understand the function of this, in order to have an accurate true wind direction. It is fully explained in Part 3 - Calibration.

2.9.50 True Wind Speed

Menu heading:	WIND
Function text:	TRUE W/S
Update rate:	4 Hz
Units:	Knots, metres per second

Notes

1. Corrected for masthead and other errors via the look-up table, see Part 3 - Calibration.
2. Variable damping 0-99 seconds.
3. Dynamic damping available.

When the boat is sailing downwind, the air passing over the mast is accelerated, and in the past this has tended to make the true wind speed over-read**.** The Hercules 2000 has introduced a calibration for this which will allow you to correct out the error, it is explained in Section 3.6

2.9.51 VMG to Waypoint (VMC)

Menu heading:	WAYPOINT
Function text:	VMG WPT
Update rate:	Provided by the position fixer
Units:	Knots

This is another function which is directly calculated by the position fixing system**.** This can be a very important function on free legs, particularly if you are a long way from the mark, since the greatest VMG to Waypoint (VMC) is not necessarily obtained by sailing straight at the mark**.** In Fig 2.6 we can see how this works.

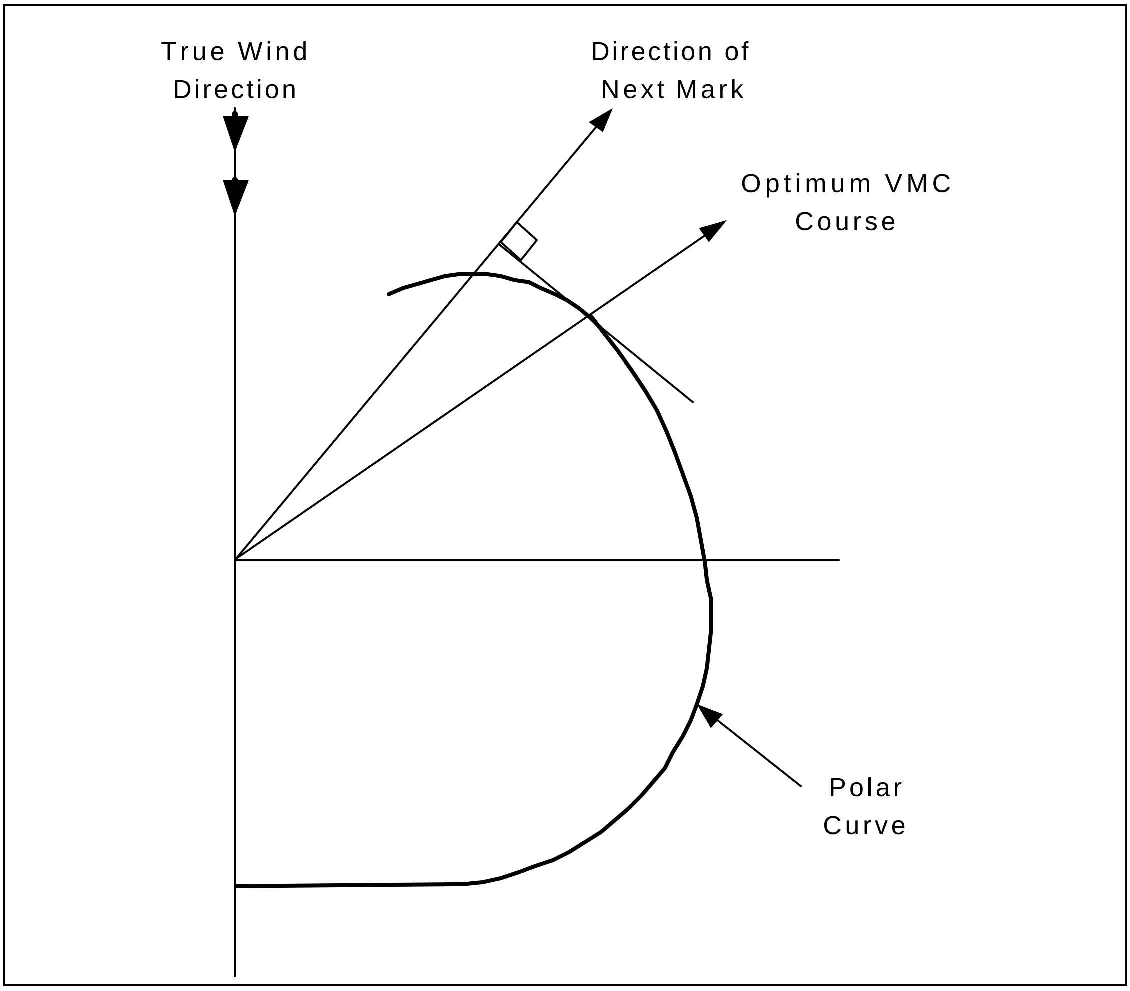

Fig 2.6 - Optimum VMG to a Mark

2.9.52 VMG

Menu heading:	SPEED
Function text:	VMG
Update rate:	1 Hz
Units:	Knots

Note

1. Upwind/downwind Referenced.

As a measure of performance VMG has both advantages and disadvantages**.** It is calculated from the true wind angle and the boat speed.

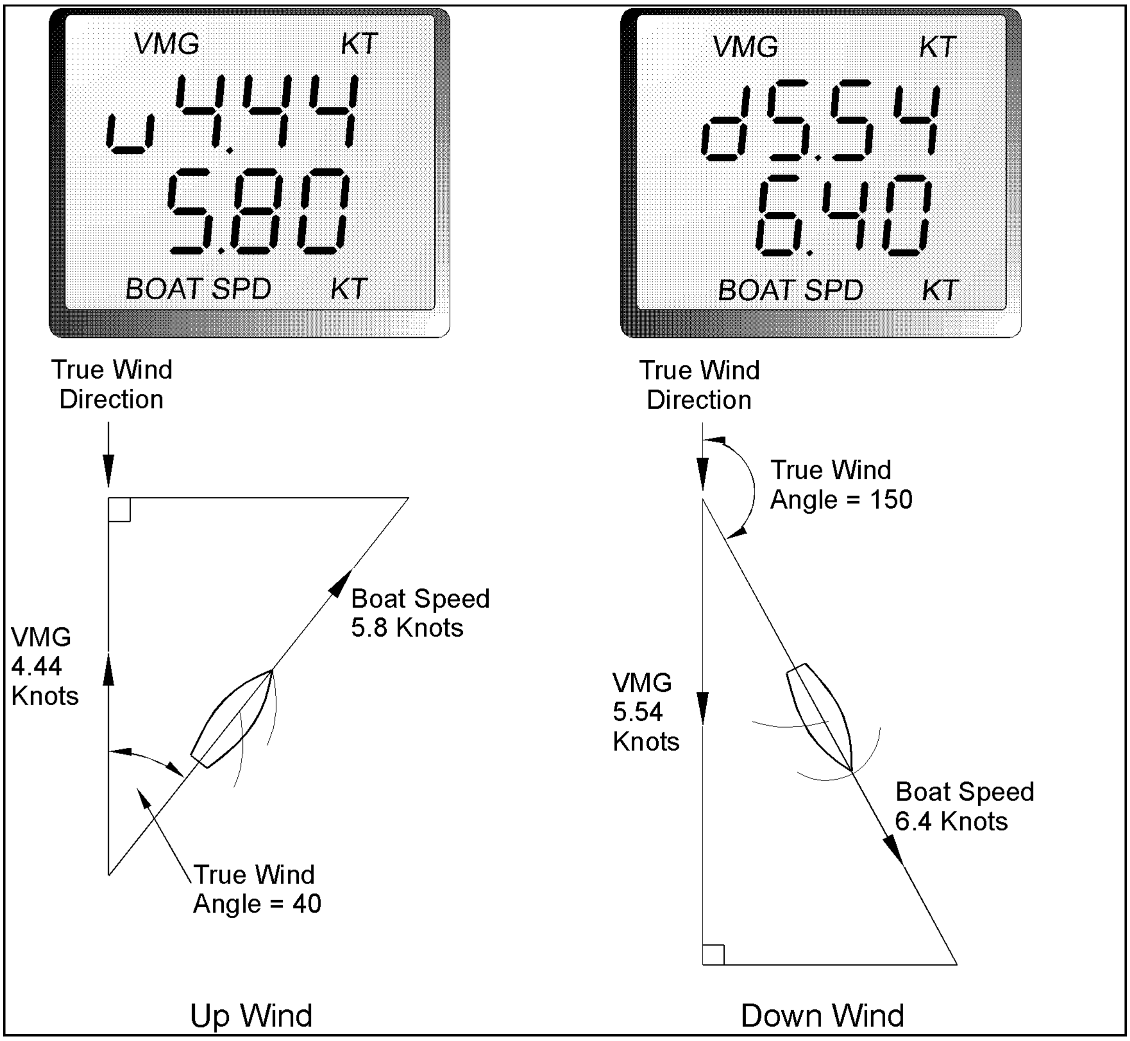

Fig 2.7 - Calculation of VMG

VMG can measure the performance upwind and downwind much more effectively than boat speed, since it takes into account how close the boat is sailing to the wind. However, it is not possible for the helmsman to sail to it directly because of the momentum of the boat. As the boat sails closer to the wind, the VMG will initially rise because the boat will hold its speed due to the energy contained in its momentum. VMG increases, and the helmsman, seeing this, would be encouraged to sail even closer to the wind thus increasing the VMG still further. Ultimately the boat will be head to wind and stop dead. VMG will then drop.

Because of this, the technique has been developed of analysing the boat's performance to find out at which speed the greatest VMG occurs.

Once this is known the helmsman steers to this target boat speed knowing that this is optimising their upwind or downwind performance.

Whilst VMG is an important part of sailing technique, it should be checked by someone other than the helmsman. This person should develop a feel for the boat speeds when the greatest VMG is attained and then communicate these to the helmsman.

2.9.53 Wind Angle to the Mast

Menu heading:	PERFORM
Function text:	W/A MAST
Update rate:	1 Hz
Units:	degrees

Note

1. Requires mast rotation sensor

When the mast rotation sensor is fitted, this measures the apparent wind angle to the mast's centreline, thus giving the actual attack angle of the entry of the sail to the wind.

Table 2.1 - Polar Table 0

	TRUE WIND SPEED IN KNOTS									
TRUE WIND ANGLE	2.5	5.0	7.5	10.0	12.5	15	17.5	20	22.5	25
20	1.56	2.70	3.57	4.10	4.50	4.80	5.00	5.20	5.50	5.40
30	1.87	3.04	4.04	4.88	5.30	5.66	5.95	5.99	6.15	6.20
40	2.08	3.29	4.40	5.49	5.99	6.54	6.78	6.87	6.86	6.75
50	2.13	3.52	4.67	5.90	6.50	6.95	7.23	7.33	7.35	7.29
60	2.19	3.75	4.95	6.09	6.69	7.07	7.36	7.45	7.51	7.50
70	2.10	3.83	5.22	6.18	6.79	7.22	7.48	7.58	7.67	7.72
80	2.02	3.91	5.40	6.27	6.88	7.30	7.61	7.73	7.89	7.95
90	2.00	3.90	5.45	6.31	7.02	7.45	7.74	7.88	8.11	8.18
100	1.98	3.85	5.40	6.39	7.10	7.59	7.87	8.03	8.30	8.39
110	1.99	3.76	5.26	6.39	7.11	7.65	7.96	8.19	8.40	8.50
120	1.97	3.65	5.08	6.30	7.06	7.65	8.00	8.30	8.43	8.53
130	1.90	3.50	4.90	6.00	6.87	7.51	7.96	8.21	8.36	8.48
140	1.87	3.25	4.60	5.67	6.67	7.38	7.80	8.10	8.28	8.42
150	1.84	3.01	4.20	5.23	6.30	7.04	7.56	7.93	8.19	8.37
160	1.80	2.80	3.90	4.80	5.80	6.60	7.20	7.70	8.05	8.27
170	1.75	2.60	3.65	4.50	5.50	6.31	6.96	7.53	7.93	8.22
180	1.70	2.40	3.42	4.30	5.29	6.02	6.83	7.44	7.88	8.17
OPTIMUM VMG	1.80	2.85	3.79	4.34	4.69	5.00	5.23	5.33	5.37	5.32
OPT TWA U/W	40	39	38	37	36	35	34.5	34	34	33.5
OPTIMUM VMG	1.80	2.70	3.70	4.80	5.70	6.20	6.80	7.40	7.80	8.10
OPT TWA D/W	157	158	160	161	162	163	165	168	170	172

PART 3 - CALIBRATION

CONTENTS

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ILLUSTRATIONS

TABLES

PART 3 - CALIBRATION

3.1 INTRODUCTION

WARNING - Every care must be taken when undertaking any Calibration Procedure to ensure that the Hercules 2000 System is calibrated accurately and correctly. Incorrect calibration could lead to incorrect navigational information placing the yacht into danger.

Calibration of an integrated instrument system is probably one of the most misunderstood processes in the world of yacht racing. Rather in the way that fast sails badly trimmed will add little or nothing to the boat's performance, good instruments badly calibrated, will also achieve very little. In the same way that just a few trimmers guard their skills in a mystique amounting to a black art, the navigators who really understand and can get the maximum from their electronic partners, have tended to hide what is, like sail trim, a highly logical understandable process in a veil of mystifying jargon. This part of the manual hopes to remove some of that mystique and break the calibration process down into a series of simple steps, which, when carefully undertaken in the right order, will consistently produce good results.

There are four sensor inputs to your system that are fundamental to its integrated approach - Boat Speed, Compass Heading, Measured Wind Angle and Measured Wind Speed.

Without these basic inputs you cannot have the more important values of true wind speed and direction and velocity made good, which are calculated from them. As an absolute minimum your system should measure these four parameters. There are many really useful additional values that the Hercules 2000 allows you to measure, but they are not essential to the system's primary function. Nevertheless, these will need to be calibrated as well, but we shall deal with them separately, after we have the main system up and running.

On any yacht after the launch, the calibration of the sensors should have the same priority as making sure that the sails fit. It is crucial to keep a full record of the process. Appendix 1 contains calibration tables for this purpose.

3.2 BOAT SPEED/LOG CALIBRATION

3.2.1 Principle of Log Calibration

To calibrate the log we must work out the number of revolutions of a paddle-wheel, or sonic pulses per second that correspond to each knot of boat speed. The boat speed/log calibration value is always shown as Hertz per knot (Hz/Kt)

The Hercules 2000 allows for calibration of a port and starboard log, as well as a single unit.

There are occasions when you will need to calibrate each tack separately e.g. for dual or single sensor installations, due to the placement of the units off the centre line. If you have a single unit which you have calibrated automatically, as we are about to explain, and it shows differences between one tack and the other, then the solution lies in using the manual method of entering percentage offset values into the Boat Speed correction table.

The Hercules 2000 will always use the calibration value for the lower (leeward) sensor, this is determined using the heel angle if it is fitted and the apparent wind angle if it is not.

3.2.2 Preparation for Log Calibration

Before calibrating the log you should ensure that the underwater unit is correctly aligned as follows:

Sonic Speed: Check that the unit is operating correctly.

Ultrasonic Speed: The notch on the transducer is located in the cut-out in the housing.

Paddle-Wheel: The moulded arrows on top of the unit must be pointing forward along the fore and aft line of the hull. The unit must also be totally free of any weed or other fouling.

3.2.3 Calibration Runs

Consecutive runs, under power at a constant speed, should be made along the given course. To eliminate the effect of tidal conditions, it is advisable to perform at least two runs, preferably three, along the measured course. There are three available options for calibrating the log, Automatically (AUTO CAL), Manually (MANL CAL) or to a Reference speed (REF CAL).

3.2.4 Log AUTO CAL Facility

This facility enables the user to calibrate the yacht's log accurately and simply. Calculations are performed by the Hercules 2000 computer. Referring to the Fig 3.1, A and B are the markers for each run and X is the actual distance for each run as ascertained from the chart.

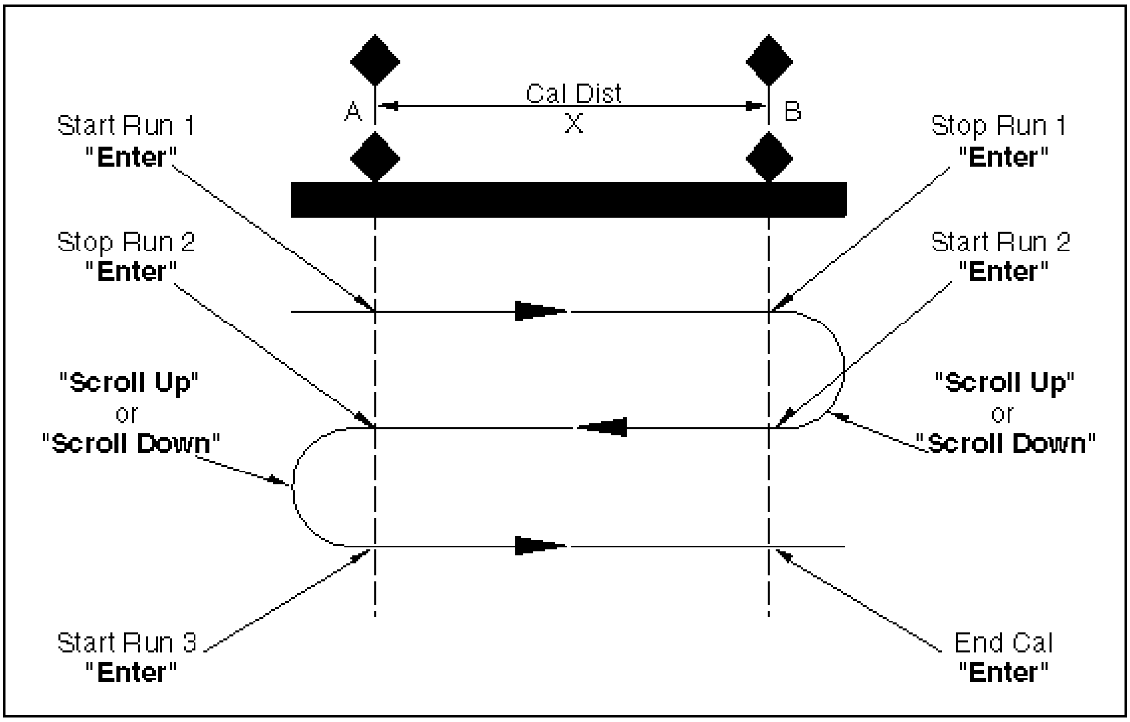

Fig 3.1 - Calibration Runs

The user is required to enter the distance X in nautical miles (CAL DIST) and then, as the yacht passes marks A and B on each run, to instruct the system to start (STRT RUN) and stop (STOP RUN) and finally to end calibration (END CAL) after the last run is completed.

Note

The calibration process can be cancelled at any time during the operation by pressing the **Page** Key, if the operator is not satisfied with the calibration runs underway, e.g., hampered by another vessel, or wash etc.

3.2.5 Log AUTO CAL Procedure

(1) Select BOAT SPD on the upper display.

(2) Press and hold **Scroll Down** to select CALBRATE.

(3) Press **Enter**, the display shows the current Boat Speed on the upper display with AUTO CAL flashing below.

(4) Press **Enter**, the display shows the current Boat Speed with SINGLE flashing.

(5) Press **Enter** twice and display shows the default setting for the actual calibration distance for each run along the given course.

(6) Press **Enter**, the value for CAL DIST will flash. The **Scroll Up** and **Scroll Down** Keys can now be used to select the appropriate measured distance (X). Press **Enter** to accept the new distance. The system is now ready to start the first calibration run.

(7) Press **Scroll Up** and STRT RUN appears, flashing.

(8) When crossing the first transit mark of the run, press **Enter**, the display now shows the current Boat Speed with STOP RUN flashing.

(9) When crossing the transit mark at the end of the run press **Enter**, the display shows the current Boat Speed with END CAL flashing.

(10) Press **Scroll Down** to select STRT RUN again and repeat steps (8) and (9).

(11) If only two runs are required, press **Enter** to end calibration. The lower display will now show the new calibration value which has automatically been calculated by the Main Processor. This should be recorded in the chart provided (Appendix 1).

(12) If a third run is required, press **Scroll Down** to STRT RUN then repeat from step (8).

Note
"Err" is displayed if the system encountered a problem during the calibration run. For example, if the calibration run distance was too short.

The log is now calibrated and the new calibration value is stored permanently in the Main Processor memory.

3.2.6 Manual Calibration

The calibration values can be adjusted directly as follows

(1) Select BOAT SPD in the upper display.

(2) Press and hold the **Scroll Down** Key to select CALIBRATE from the menu.

(3) Press **Enter** then press **Scroll Down** and the display shows MANL CAL, which is the choice that we require.

(4) Press **Enter** and the display shows SINGLE.

Notes
1. SINGLE is the choice required if a single paddle-wheel or sonic speed is fitted.
2. If two paddle-wheels are fitted it is possible to access the individual port and starboard calibration values: use the **Scroll Up** or **Scroll Down** keys to select PORT CAL or STBD CAL, as required.

(5) Press **Enter** to reveal the current calibration value in Hertz/knot.

(6) To adjust the calibration value, press **Enter** and the value flashes.

(7) Use **Scroll Up** or **Scroll Down** to change the calibration value as required to the new calibration value.

(8) Press **Enter** to store the new value into the system.

(9) Press **Page** to return to full display.

3.2.7 Boat Calibration Referenced to a Known Value

To calibrate the Boat Speed by reference to a known value, e.g. another boat with an accurately calibrated log, proceed as follows:

(1) Select BOAT SPD KT on upper half of FFD display:
(2) Press **Scroll Down** until the lower text shows CALBRATE flashing.
(3) Press **Enter**, the lower text now shows AUTO CAL flashing.
(4) Press **Scroll Down** until the lower text shows REF CAL flashing.
(5) Press **Enter**, the lower text now shows REF CAL along with the current value of Boat Speed.
(6) Press **Enter**, the lower text now shows the REF CAL value flashing and by use of the **Scroll Up/Down** the reference speed may be adjusted to the new value.
(7) Press **Enter**, the new speed value is accepted and the upper display will show the re-calibrated Boat Speed.

3.2.8 Boat Speed Units (Knots, MPH, KPH)

To configure the required boat speed units proceed as follows:

(1) Press **Scroll Up** until the upper text shows LOG flashing.

(2) Press **Enter**, the upper text now shows STD LOG flashing.

(3) Press **Scroll Up** until the upper text shows TRIP LOG flashing.

(4) Press **Enter**, the upper text shows TRIP LOG and the current value.

(5) Press **Scroll Down** until the lower text shows CALBRATE flashing.

(6) Press **Enter**, the lower text now shows CAL VAL 1 flashing.

(7) Press **Scroll Down** repeatedly and the lower text will cycle through CAL1, VAL 1, CAL VAL 2, and CAL VAL 3.

When CAL VAL 1 is displayed:

(8) Press **Enter**, the lower text shows SPD KTS.

When CAL VAL 2 is displayed:

(9) Press **Enter**, the lower text shows SPD MPH.

When CAL VAL 3 is displayed:

(10) Press **Enter**, the lower text shows SPD KPH.

For whichever selection is made:

(11) Press **Enter**, the lower text now shows SPD KTS, SPD MPH, or SPD KPH with the current boat speed value in its original units.

(12) Press **Enter**, the current boat speed value, in its original units, will flash.

(13) Press **Enter**, the current boat speed will be converted to and displayed in the newly selected units.

3.2.9 Boat Speed Offset Calibration

If a difference in boat speed is indicated from tack to tack, it is possible to calibrate out the error using an offset table.

It is necessary to first calibrate the boat speed using one of the methods described previously, it is then important to establish which tack is providing the correct boat speed, set the other tack to be the "correction tack" under TACK OFF.

(1) Select **BOAT SPD** on an FFD.

(2) Press **Enter**, then scroll to select CALIBRATE.

(3) Scroll to CORRECTN, press **Enter**.

(4) Select TACK OFF**,** press **Enter**

(5) Set to PORT or STBD.

(6) Press **Enter** to confirm, then scroll up to HEEL.

(7) Set the current value for the heel angle.

(8) Scroll up to OFFSET PC and enter the percentage error on this (inaccurate) tack.

The entered percentage offset is applied for angles greater than, and equal to the entered heel angle, and is interpolated to 0% at 0 degrees of heel.

3.2.10 Speed Linearity Correction

After the Tack correction is applied (3.2.9) it is possible to apply both Heel Angle and Linearity corrections to the boat speed data.

The Linearity correction table is provided due to the characteristics of different speed sensors, a paddlewheel sensor (for example) is inherently non-linear so at high boat speeds due to their mechanical nature, they are likely to over-read and require correction. An Ultrasonic sensor is linear in its response and does not require significant correction.

Heel Angle corrections apply to all types of sensor and are actually due to the change in water flow patterns over the surface of the hull rather than the sensor characteristics.

The procedure to enter correction values is as follows:

SPEED-BOAT SPD_CALIBRATE-CORRECTN-TABLE

Heel	Boat Speed (Knots)					
	5	**10**	**15**	**20**	**25**	**30**
0º	0.0	-2.0	-3.9	-6.0	-7.8	-9.3
10º	-0.2	-2.3	-4.0	-6.5	-9.6	-11.0
20º	-0.4	-3.9	-6.1	-8.5	-11.5	-13.3

Values are entered as a percentage, all default values are zero.

3.2.11 Substituting Speed Over Ground for Boat Speed

It is possible to substitute Speed Over Ground (SOG) in place of Boat Speed for calculated functions. This may be desirable for certain applications such as fast multi-hulls where the speed sensor may spend periods of time out of the water. It could also be used in the case of sensor failure.

Note that using SOG for calculated functions has some disadvantages: SOG is not the same as Boat Speed as it is referenced to the ground rather than the water, which may be moving due to tidal flows and currents, so SOG will not allow calculation of Tide. Calculation of Wind data via SOG will actually give Ground Wind data, so will appear inaccurate in strong tidal conditions. SOG is also updated less frequently on the network.

3.3 MEASURED WIND SPEED AND ANGLE

3.3.1 Principles of Wind Speed/Angle Calibration

One of the greatest problems for an instrument system to overcome, which has not yet been conquered, is wind shear and wind gradient. These two effects are at the root of some apparent instrument inaccuracies. The effects themselves are relatively straightforward and are due to the simple fact that as moving air comes into contact with the ground it slows and changes direction.

The slowing creates the effect called wind gradient. The change in direction creates wind shear. Both shear and the wind gradient depend on the amount of mixing of the wind at ground level and the wind aloft; if the wind is well mixed both effects are minimised. The best example of this is the sea breeze, which starts off almost completely unmixed. Differences of direction of 40-50 degrees between the wind at the mast head and the wind at the water are not uncommon in an early sea-breeze, but as the day goes on and the sea-breeze strengthens this will disappear.

This creates a problem for the two things we are about to try to calibrate, measured wind speed and measured wind angle. It is easy to see how shear can affect the measured wind angle; no sooner have you set it up than the shear changes and everything is out again.

This can lead to a circular situation if one is not careful, and the best solution is to do your calibration on a day when the shear is minimal, and thereafter leave it as an indicator of the wind angle at the masthead, always remembering that this is not necessarily the wind angle that you are sailing at.

How do you know the shear is minimal? If you are finding it easier to get speed on one tack than the other for no obvious reasons, then there is likely to be shear. A good look at the general weather conditions is also helpful. Do not calibrate in building sea breezes.

Wind gradient is the biggest culprit for getting true wind speeds accused of gross inaccuracy. The problem is that most people use the wind speed as a measure of the pressure, which it is not. It is a measure of the wind speed at the top of the mast, and that is all. If it is 12 kts at the top of the mast and only 4 at the water, then the breeze will feel a lot softer, and provide less power for the rig than if the breeze is twelve knots all the way down to the water.

There are other signs that can help get a feel for the pressure on the rig. One of the most important of these is the heel angle; it is no bad thing to have an idea of how much heel you normally have in any given windspeed. Target boat speeds can also provide valuable information as to the wind gradient. The target is read from a polar table which only knows about one average wind condition, it does not know if the wind has a strong gradient or none at all. So next time you are having trouble reaching the target speeds, think about the wind gradient and whether or not it is a soft or heavy breeze, and use the input to help sail the boat. The information from the instruments is generally useful - it just needs rather more interpreting than it sometimes gets.

This is why we recommend that the last thing you touch is the Measured Wind Speed. It is calibrated in the factory where wind tunnel calibrated units are available, and apparent inaccuracies are 99% attributable to effects such as wind gradient, rather than to a basic calibration problem.

3.3.2 Measured Wind Angle (MWA) Calibration

To discover the MWA alignment error we can employ one of two techniques. The first is simply to go head to wind and read the value of the Measured Wind Angle. If it reads anything other than 0, you have an error. If the error is greater than 0 (up to 180 degrees), you should subtract the error from 0 and enter this as the calibration value. So if when you go head to wind the measured wind angle reads 4 degrees, then you should enter -4 as the calibration value. If it is less than 0 then the opposite applies.

The second method involves a sailing trial as shown in Fig 3.2 - Masthead Unit Alignment.

(1) Whilst monitoring MEAS W/A on a display, sail upwind at the optimum close-hauled angle.

(2) When conditions are steady, write down the mean MEAS W/A reading.

(3) Tack the vessel and sail at the optimum close-hauled position as before.

(4) When conditions are again steady, write down the mean MEAS W/A reading.

(5) Repeat steps (1) to (4) inclusive at least two or three times to obtain an average MEAS W/A for each tack.

(6) Half the difference between the two Measured W/A's needs to be applied to the MHU OFFSET. If STBD is greater than PORT, then subtract half the difference.

WIND → MEAS W/A, **CALBRATE ® MHU ANGL**

Full details are given in Examples of Calibration contained in Part 2 - Operating Information.

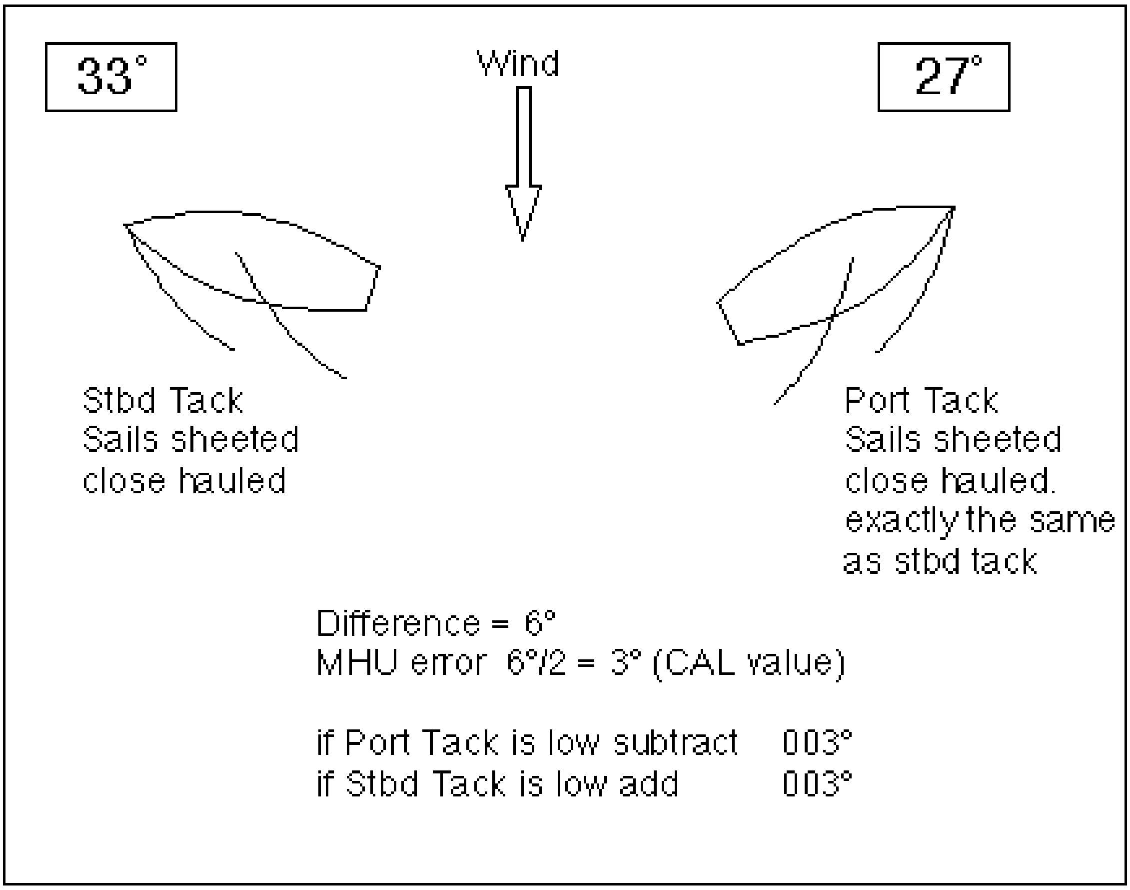

Fig 3.2 - Masthead Unit Alignment

3.3.3 Measured Wind Speed

As previously stated you are strongly discouraged from changing the measured wind speed calibration. However, should you need to do it, then the changes are made in the system menu under:

WIND → MEAS W/S, **CALBRATE ® MHU CAL**

and

WIND → MEAS W/S, **CALBRATE ® MHU OFFS**

3.4 TRUE WIND CORRECTION

Calibration of True Wind Angle and True Wind Speed will automatically correct Apparent Wind Angle and Apparent Wind Speed errors.

3.4.1 True Wind Direction

The need for further calibration of true wind direction will become clear as soon as you go sailing. The true wind might vary in direction from tack to tack, independently of any wind shifts. This phenomenon has come to be known as the true wind 'tacking'. We can see the direct connection between true wind angle and direction in Fig 3.3 below.

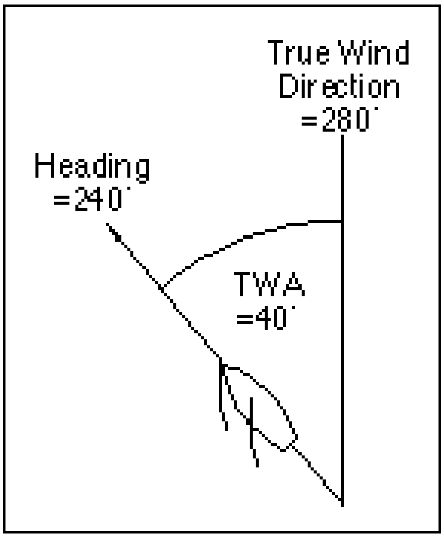

Fig 3.3 - True Wind Direction

The reason for this is a variety of errors that enter into the calculation of true wind angle from measured wind angle.

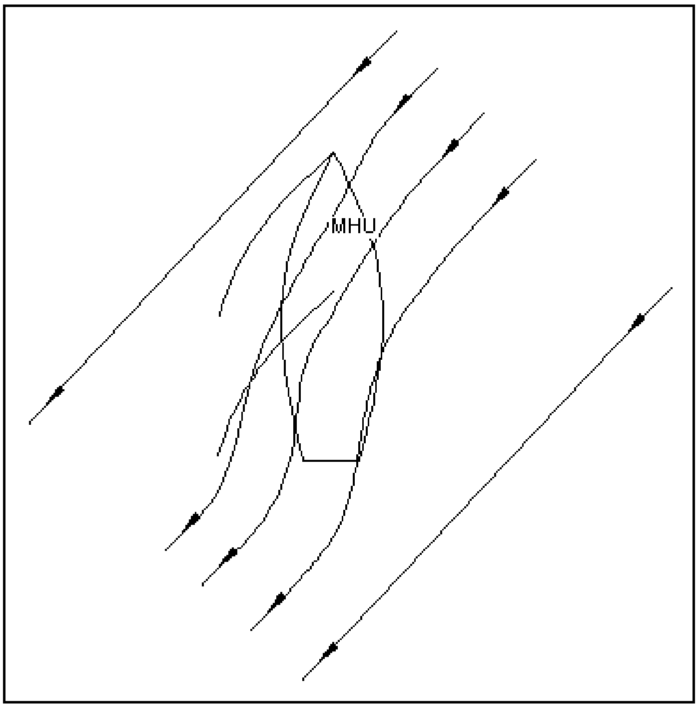

Fig 3.4

In Fig 3.4 the measured wind that the instruments measure is actually deflected from the 'real' measured wind angle we need to calculate the true wind. Add to this the various twisting effects of the mast and the Masthead Unit, and we get some idea of the problems involved. The hardest part is that it is easy to see the true wind direction 'tack' as little as 2-3 degrees, which would mean the correction factors being as accurate as 0.5 degree, or about 1%. For any particular windspeed the correction needed for all these errors has to be different from day to day, not least because of the problems of wind gradient we discussed earlier.

As we have seen the problem stems from the true wind direction 'tacking' as the boat manoeuvres from tack to tack. We need to know the error that the true wind suffers in any manoeuvre, be it tacking upwind, a reach to reach tack, or gybing downwind. Once you know the error, and the windspeed you had at the time, then we can enter it as a correction into a table of corrections similar to that shown in Table 3.1 - Example True Wind Angle Correction Table.

Wind Angle	**True Wind Speed**					
	5	**10**	**15**	**20**	**25**	**30**
Upwind	2	5	3	2	1	1

Reaching	3	5	6	5	4	3
Downwind	0	0	0	0	0	0

Table 3.1 - Example of True Wind Angle Correction Table

The table initially contained in the Hercules 2000's memory is empty and we need to discover and enter the relevant corrections for true wind direction. To see how we work out the correction we will look at an on the water situation, from which we can determine some general rules.

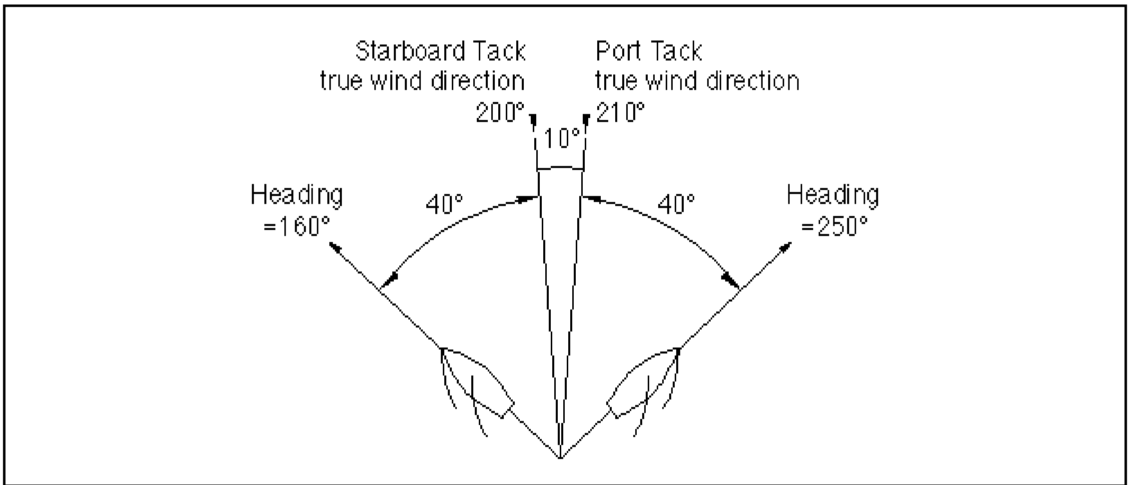

Fig 3.5 -True Wind Direction Error

In Fig 3.5 we see a typical situation, sailing on port tack, upwind, in ten knots, the true wind direction reads 210. We tack over onto starboard and settle the boat down, now the true wind direction reads 200. There is a ten degree error tack to tack. The true wind direction should read 205 on both tacks. To correct the true wind angle so that the true wind direction reads 205 on both tacks, we need to add 5 degrees to the true wind angle. So for a general rule we can say:

If you are lifted from Tack to Tack subtract half the difference.

And the converse will apply:

If headed from Tack to Tack add half the difference.

All we need to do now is tell the Hercules 2000 the correction value at each of the points in the table. The true wind correction facility, is found in the menu under:

WIND → TRUE W/A, **CALBRATE ® CORRECTION**

This then allows you to scroll through all the correction values in the table (using **Scroll Up** or **Scroll Down**) until you find the one where you wish to enter a correction, in our example above we would be looking for "upwind, 10 knots". Once you have scrolled through to this, a press of the **Enter** Key will allow you to enter the required number of degrees correction (i.e. +5) using the **Scroll Up** and **Scroll Down** Keys to increase/decrease the value accordingly. A final press of the **Enter** Key stores this to the Hercules 2000.
In the early stages of calibration when the table is nearly empty, it is important to enter the same value of correction to the windspeeds either side of the one you are using. This is to avoid the true wind direction jumping in value when the wind speed drops or increases outside the range you are correcting.

As your table gets closer to being finished you will be able to make individual changes, because the other corrections will be accurate enough to avoid any strange "step" changes as the true wind speed varies. For this reason it is very important to enter all these corrections into a Calibration Chart (see Appendix 1). This way you will notice any big gaps in the correction table where you have entered no values at all.
Initially you may require to do some sailing trials, and it is advisable to get into a pre-start routine of carrying out each of the tacking manoeuvres before the start of a race, correcting any problems as they arise.

Finally, the most important thing is to record all these entries in the Calibration Charts provided in Appendix 1.

3.4.2 True Wind Speed

The True Wind Speed suffers from another, mainly aerodynamic, problem, where it tends to over-read downwind because of acceleration of the airflow over the top of the mast. It is possible to correct for this by applying a downwind correction to the true wind speed. This correction is applied at the angle set (default 165 degrees) and linearly interpolated to zero correction at 90 degrees true wind angle. The routine here is to bear away quickly from close-hauled to your usual downwind True Wind Angle and watch the increase in true wind speed. Then the difference is entered as the negative correction. The table will look similar to the one shown in Table 3.2 - True Wind Speed Correction.

Wind Angle	True Wind Speed					
	5	10	15	20	25	30
Correction (kt)	0	0	0	0	0	0
Correction angle	165	165	165	165	165	165

Table 3.2 - Example of True Wind Speed Correction Table

The corrections are found in the menu under:

WIND → TRUE W/S, **CALBRATE ® CORRECTION**

They are entered in the same way as the true wind direction corrections. It is crucial to keep a full record of the process.

3.5 COMPASS CALIBRATION

3.5.1 Principles of Compass Calibration, Halcyon 2000 & Halcyon Gyro Stabilised Compasses

B&G's Autoswing compasses contain software that allows them to record the magnetic fields in the yacht that are causing the deviation errors. It calculates the corrections every time the boat completes a 360° turn, provided the following conditions are met:

(a) The 360° turn - Halcyon 2000 & Halcyon Gyro Stabilised Compass is completed in the same direction.

(b) The rate of change of heading does not exceed 3°/s; i.e. the turn should take about 3 minutes to complete.

(c) The rate of change of heading must not fall below 0.2 of a degree per second during the 360° turn, i.e. the turn must not take longer than 12 minutes.

(d) The rate of change in heading is constant.

(e) The compass is installed in a location a safe distance from magnetic interference such as iron keels, engines, loudspeakers etc. Consideration should also be given to electrical cables which may carry high currents (e.g. navigation lights).

(f) The compass is installed in a location as close to the centreline of the boat as possible. Avoid areas such as the fore peak and the sides of the hull where the effects of pitch and roll are at their greatest.

(g) On steel hulled vessels, the compass will need to be installed above decks away from the effects of the hull.

3.5.2 Heading Source Selection

The Hercules 2000 System can accept heading data from a variety of different sources. These different sources are known as Nodes and allow the system to identify which heading devices are connected to the system. The list below shows the various sources of heading available with its respective address node:

Device	**Node**
Halcyon Gyro Stabilised Compass	15
NMEA input to Halcyon Gyro Processor	15
Halcyon 2000 Compass	16
ACP Pilot Remote Compass	18
NMEA input to NMEA FFD	96

Enter the required heading node by following the procedure below:

(a) Press the **Scroll Up** key until NAVIGATE is shown in the text, flashing.

(b) Press **Enter**.

(c) Press the **Scroll Up** key again until the display shows COURSE flashing.

(d) Press **Enter**. COURSE will now stop flashing.

(e) Press **Scroll Down** until the display shows CALBRATE.

(f) Press **Enter** 3 times. The display now shows HDG NODE and will display a value which flashes.

(g) Use the **Scroll Up** and **Scroll Down** keys to change the value to the required setting.

(h) Press **Enter**.

(i) Switch the system off, and then back on again to complete the calibration process.

Notes

1. Hydra Pilots, Hercules Pilots, HS Pilots and Halcyon FFDs will also require the Heading Node to be set to your desired choice. Refer to the relevant user manual for further information.
2. 20/20 displays will require Heading to be re-selected following Heading node selection. Simply re-select this function, refer to section 5.4.5 for more information.

3.5.3 Halcyon 2000 Compass Calibration Procedure

(1) Check for any magnetic devices placed near the compass, especially ones that are out of their normal places.

(2) On a calm day select a stretch of open water with little traffic (so you will not have to take avoiding action which would affect the calibration). The flatter the water and the less the wind the easier it will be to meet the conditions for calibration.

(3) Check for and avoid sailing close to any large steel structures nearby, that may cause additional, erratic deviations.

(4) Scroll to the NAVIGATE menu and select COMP CAL on the top half of the display. The display shows OFF.

(5) Press **Scroll Down** until the lower text shows CALBRATE flashing.

(6) Press the **Enter** key twice to display START and a default setting of ‘0’.

(7) Press the **Enter** key once and the ‘0’ starts to flash. Use the **Scroll Up** key to change the value to ‘1’.

(8) Press the **Enter** key. The display now shows 000°.

(9) At a speed not exceeding five knots, turn the boat through 360° at a rate not greater than 2-3° per second. The display will show the amount of turn completed so far. Continue to turn the boat until the display shows PASS or FAIL. If FAIL is displayed the compass calibration should be re-started.

(10) Eliminate any constant error in heading. These are normally checked for by using shore-based transits, once the error is known it can be eliminated by entering the value into the Hercules under:

NAVIGATE ® HEADING, **CALBRATE ® CAL VAL1**

For example, the compass was reading 320 degrees and it should read 316, then the value to enter would be -4.

Notes

1. The compass calibration swing may be aborted at any time. To do this, press the **Enter** key once. Next, using the **Scroll Down** key change the value from '1' to '0', and then press **Enter** to store. The display will now show OFF.
2. The first time the system is switched on, or after a system reset, the Heading will alternate with CAL. This is to indicate to the user that the compass must be calibrated. This will disappear after the compass has been calibrated.

3.5.4 Halcyon Gyro Stabilised Compass Calibration Procedure

(1) Check for any magnetic devices placed near the compass, especially ones that are out of their normal places.

(2) On a calm day select a stretch of open water with little traffic (so you will not have to take avoiding action which would ruin the calibration). The flatter the water and the less the wind the easier it will be to meet the conditions for calibration.

(3) Check for any large steel structures nearby, that may cause additional, erratic deviations.

(4) Scroll to the **MISC** menu and select HALCYON on the top display. GYRO will be displayed in the top data line if a Halcyon Gyro Stabilised Compass is connected.

(5) Press **scroll down** until the lower text shows ‘CALIBRATE’ press the **ENTER** key

(6) Press **scroll down** until the lower text shows CALIBRATE, press the **ENTER** key, and scroll down to CAL VAL 1, press enter and START will be displayed with ‘0’ as a default value

(7) Press **enter** and the ‘0’ starts to flash. Use the **scroll up** key to change the value to ‘1’.

(8) Press the **Enter** key. The display now shows 000°.

(9) At a speed not exceeding five knots, turn the boat through 360° at a rate not greater than 2-3° per second. The display will show the amount of turn completed so far. Continue to turn the boat until the display shows PASS or FAIL. If FAIL is displayed you must re-calibrate your compass.

Notes

1. The compass calibration swing can be aborted at any time. To do this press the Enter key once. Next press the Scroll Down key and change the value from ‘1’ to ‘0’.
2. You can re-calibrate at any time by following the above procedures.

If you have any constant error in your heading, you can correct for this:

NAVIGATE ® HEADING, **CALBRATE ® CAL VAL1**

Enter the value to offset your heading e.g. if your heading displays 100° and it should read 97°, then the value to enter would be –3.

3.5.5 Halcyon Gyro Processor Setup

Data under the MISC > HALCYON function describes the current mode of the Halcyon Gyro Processor, and are as follows:

OFF — No heading detected from either a Halcyon Gyro Stabilised Compass sensor or a B&G system compass

GYRO — Receiving data from Halcyon Gyro Stabilised Compass or NMEA input to Halcyon Gyro Processor

SYS — Receiving data from a B&G system compass or NMEA input to NMEA FFD or performance processor

PASS — Calibration swing is complete

FAIL — Calibration swing failed and the compass needs to be re-calibrated

xxx° — Number of degrees turned during calibration swing, indicates calibration swing in progress

3.5.6 Halcyon Gyro Processor NMEA output setup

NMEA sentence output settings determine what sentences are output with respect to which heading source is available.

MISC>HALCYON, **CALIBRATE>CAL VAL 2 (NMEA MDE)**

Mode	Output	Details
0	HDT	from Halcyon Gyro Stabilised Compass or NMEA input to Halcyon Gyro Processor
1	HDM	from Halcyon Gyro Stabilised Compass or NMEA input to Halcyon Gyro Processor
2	HDG	from Halcyon Gyro Stabilised Compass or NMEA input to Halcyon Gyro Processor
3	HDM/HDT	from a B&G system [compass or NMEA input to FFD]
4	HDG	from a B&G system [compass or NMEA input to FFD]

NOTE:

1. Mode 0 is the default value
2. Mode 3 will output the correct sentence depending on configuration.

Navigate > Heading, **CALIBRATE>CAL VAL 2.**

0 = Magnetic
1 = Auto (^{o}T if mag. variation available, otherwise ^{o}M)

3. If Mode 4 is selected and magnetic variation is not available then only the magnetic heading will be output.

3.6 HEEL ANGLE/LEEWAY CALIBRATION

Calibration of Heel Angle and Leeway is only necessary if a Heel Angle Sensor (Clinometer) or Halcyon Gyro-Stabilised Compass is fitted to the yacht.

3.6.1 Heel Angle

The Heel Angle sensor (clinometer) should be mounted to read zero when the boat is upright. However, small misalignments can be corrected by means of the heel angle calibration.

On a calm day with the boat lying at slack warps in the dock, head to wind, all the gear stowed in its normal place, and anyone onboard standing on the centreline the heel angle should be recorded, under these conditions it should be zero, any error can be taken out by the heel angle calibration, by adding or subtracting the error from the existing calibration.

Heel angle calibration is to be found in the system menu under:

PERFORM → HEEL**, CALBRATE ® CAL VAL1**

3.6.2 Leeway

Calibrating leeway is a notoriously difficult thing to do; it may be easier, and as accurate, to consult the yachts designer who may have a theoretical value for leeway coefficient, as it is to try to measure it. Should that not be possible then we can calculate the Leeway coefficient from the following formula:

$$L = \frac{K \times H}{Bs \times Bs}$$

where, Bs = Boat Speed
K = Leeway Coefficient
H = Heel Angle
L = Leeway Angle

K then is the constant that needs to be entered, and to establish a value for leeway coefficient we need to measure the leeway angle at a particular heel angle and boat speed shown in Fig 3.6 below.

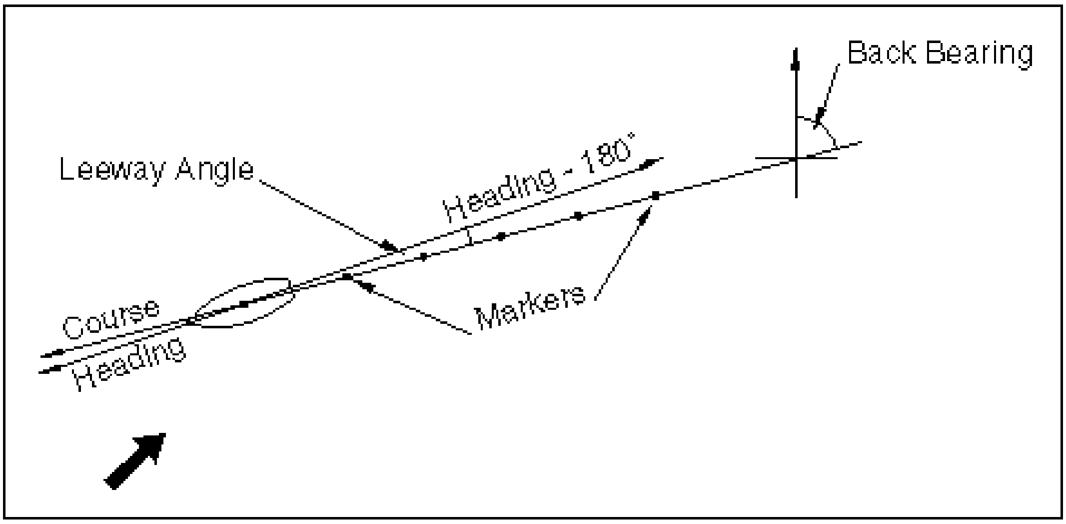

Fig 3.6 Leeway Angle Measurement

The idea is to sail on a steady course and drop markers over the stern at regular intervals, the angle between them and the centreline of the yacht is measured with a hand bearing compass, and hence leeway angle is measured. Whilst this is happening the boat speed and heel angle should be noted at intervals and an average calculated. These values can then be used to calculate the leeway coefficient from the following expression.

$$K = \frac{L \times Bs \times Bs}{H}$$

Obviously the flatter the water and the steadier the breeze the more likely this is to be successful, but even in perfect conditions it is difficult, to say the least. Once you have the leeway coefficient 'K' then it is entered into the system under:

NAVIGATE → LEEWAY, **CALBRATE ® CAL VAL1**

3.6.3 Heel and Trim angle with the Halcyon Gyro Stabilised Compass.

The heel and trim information from the Halcyon Gyro Stabilised Compass is displayed in the PERFORM menu.

The **H** symbol will be placed on left indicating heel to port and on the right for heel to starboard. The display will always be shown to 1 decimal point

The **U** symbol on the left indicates that the bow is up, while a **d** will be shown indicating bow down. The display will always be shown to 1 decimal point

Both heel and trim have an offset calibration to allow for any constant errors, adding or subtracting from CAL VAL 1 will correct this.

PERFORM → HEEL, **CALIBRATE ® CAL VAL 1**
PERFORM → TRIM, **CALIBRATE ® CAL VAL 1**

If you have heel and trim sensors connected to your system as well as a Halcyon Gyro Stabilised Compass then the Heel and Trim from the Compass will be used by default. If you wish to use your external sensors then set CAL VAL 2 to ‘0’.

PERFORM → HEEL, **CALIBRATE ® CAL VAL 2**
PERFORM → TRIM, **CALIBRATE ® CAL VAL 2**

3.7 DEPTH

A typical transducer installation is through the hull at a suitable position between the water line and the bottom of the keel. A DATUM (offset value) can be set, such that the depth display refers to either the water line or the keel line.

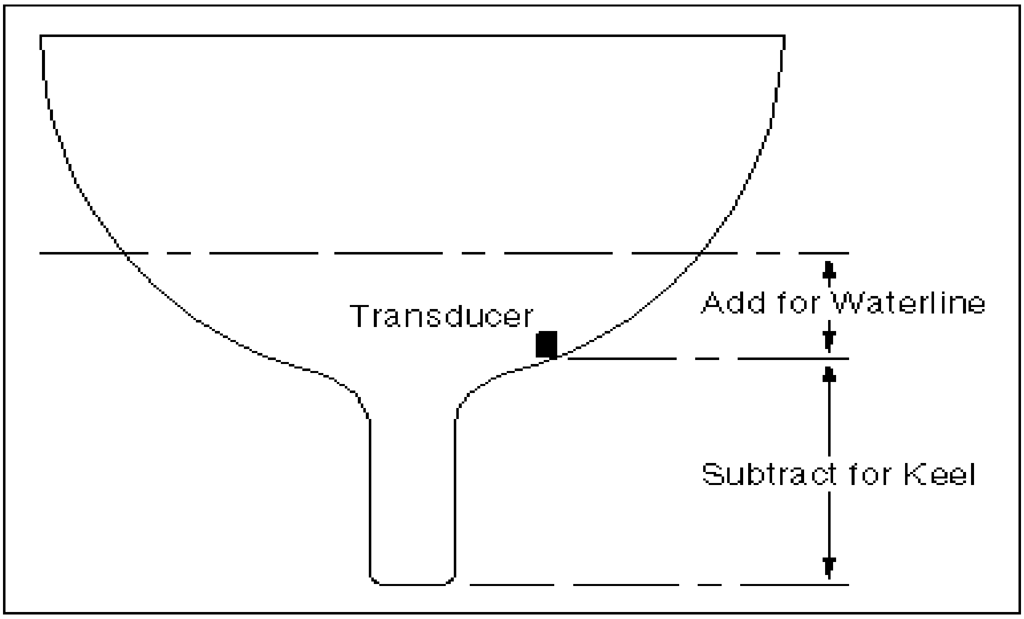

Fig 3.7 - Depth Datum

The datum is entered under:

DEPTH → DEPTH**, CALBRATE ® DATUM**

3.8 BATTERY VOLTS

The Hercules 2000 monitors the yacht's battery supply and can be called up on any display, giving a reading in volts. This is calibrated by the manufacturer and should not require adjustment except in exceptional circumstances or after a system reset. If it is necessary to calibrate this function a suitable voltmeter is required. The calibration value is found in the menu under:

MOTOR → VOLTS, **CALBRATE** → **CAL VAL1**

Using the independent voltmeter, measure the battery supply at terminals 18 (+) and 17 (-) at the Computer Unit connection block.

Alter CAL VAL1 to match the value from the voltmeter.

3.9 SEA TEMPERATURE

If a suitable temperature sensor is fitted, the Hercules 2000 will monitor the current sea temperature.

The paddle-wheel has a sensor incorporated within it, in this case no further action is required.

If the sensor is a totally independent fitting (B&G part no. 224-00-065) then it is necessary to change the sensor selection value.

This value is found in:

TEMP → SEA TEMP, **CALBRATE ® CAL VAL1 (SENSORS)**

The default selection value is 1, for the independent sensor we need to change to 2.

3.9.1 Sea Temperature Offset Calibration

To calibrate SEA TEMP proceed as follows:

(1) Select SEA TEMP on upper half on FFD display

(2) Press **Scroll Down** until the lower text shows CALBRATE flashing

(3) Press **Enter**, the lower text now shows CAL VAL 1 flashing

(4) Press **Scroll Down**, the lower text now shows CAL VAL 2 flashing

(5) Press **Enter**, the lower text now shows OFFSET

(6) Press **Enter**, the lower text now shows OFFSET flashing and by use of **Scroll Up**/**Down** the reference temperature may be entered.

(7) Press **Enter**, the offset value is accepted and the upper display will show the adjusted measured temperature.

This calibration can be carried out on either SEA TEMP ^{o}C or SEA TEMP ^{o}F

The offset value is automatically converted so that both degrees C and F are adjusted correctly.

3.10 TIMER

The Timer uses a stable quartz crystal to provide an accurate time base when calibrated. The calibration is set when the unit is manufactured and should not normally require further adjustment. If adjustment is necessary the calibration can be found as follows:

TIME → TIMER, **CALBRATE ® CAL VAL1**

The Calibration value is the number of seconds correction required a day. If the timer is gaining then the number of seconds it is gaining a day should be subtracted from the current calibration value. If the timer is losing time the number of seconds lost a day should be added to the current calibration value.

PART 4 - INSTALLATION INFORMATION

CONTENTS

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PART 4 - INSTALLATION INFORMATION

4.1 INTRODUCTION

This part of the manual contains information relating to the interconnection of the units that make up the Hercules 2000 system. It is provided to enable a qualified technician to fault find or undertake the installation of additional units and thereby increase the number of functions available.

The information provided consists of drawing sheets showing equipment options and the interconnections between them.

Also on the installation data sheets are details of cables, cable colours, instructions for installation and notes to assist the technician.

The installation sheets following are:

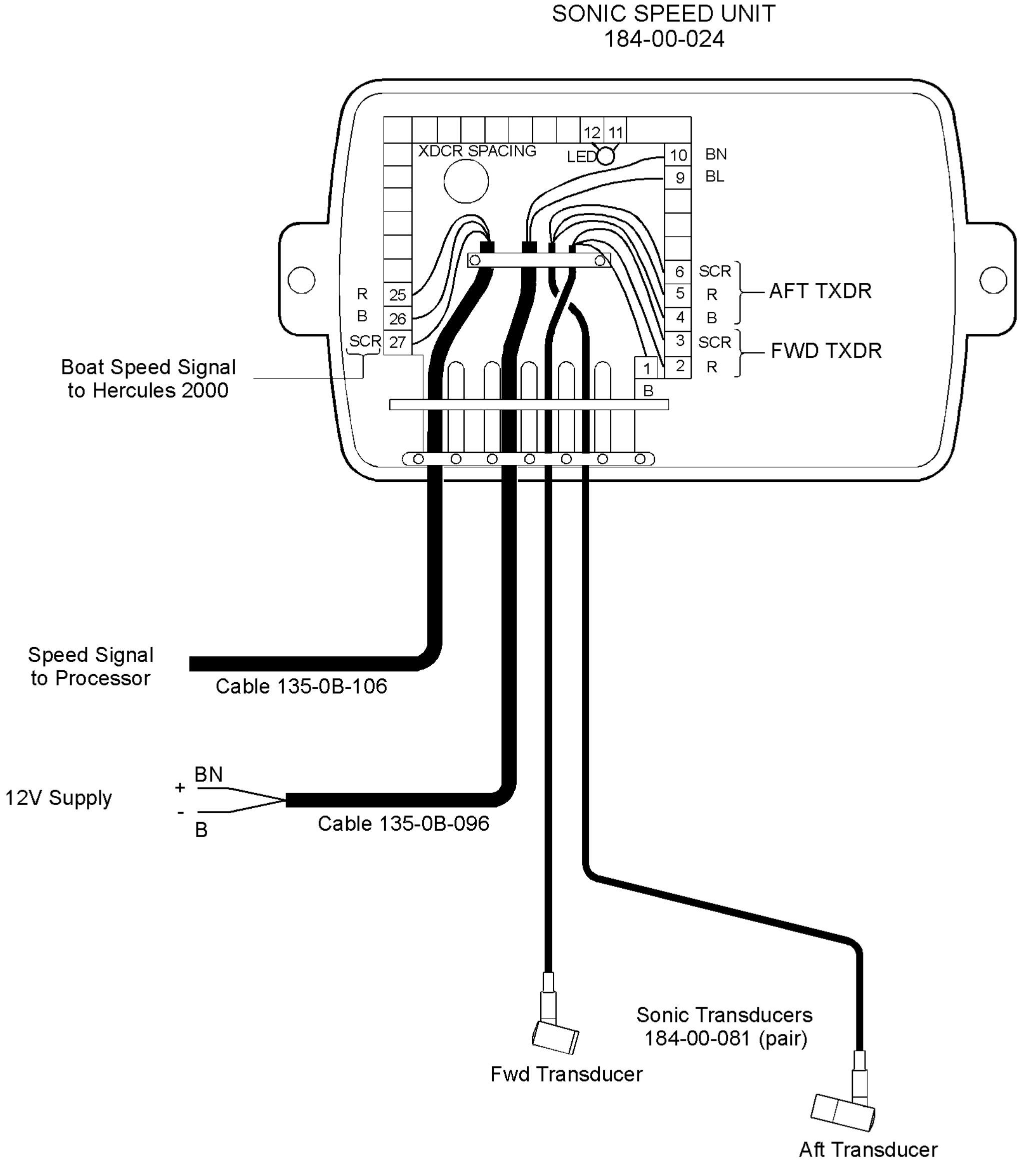
1. Sonic Speed Unit and Sonic Transducers
2. Depth Transducer, Sonic Speed and Sea Temperature
3. Multiple Linear Sensor Inputs
4. Analogue Meters
5. Alarm Unit, Network and Power Supply
6. Network Terminator
7. 213 Masthead Unit
8. Twin XTL Fins Gravity Switch
9. Change-over Switch
10. Hercules 2000 System Example Reference
11. Depth Transducer and Paddle/Sea Temperature Sensor
12. Hercules 2000 Performance Processor
13. Clinometer and Barometric Pressure Sensor
14. NMEA Full Function Display
15. Non-NMEA Full Function Display
16. Halcyon 2000 Compass
17. Halcyon Gyro Processor with Halcyon Gyro Stabilised Compass
18. Halcyon Gyro Processor with NMEA Gyro input
19. Halcyon Gyro Processor as output interface
20. Ultrasonic Speed Sensor Unit

Notes

1. All screens should be connected under the metal clamp bar on the processor box.
2. Cables are not to be run near Depth cables or other cables where interference may result.

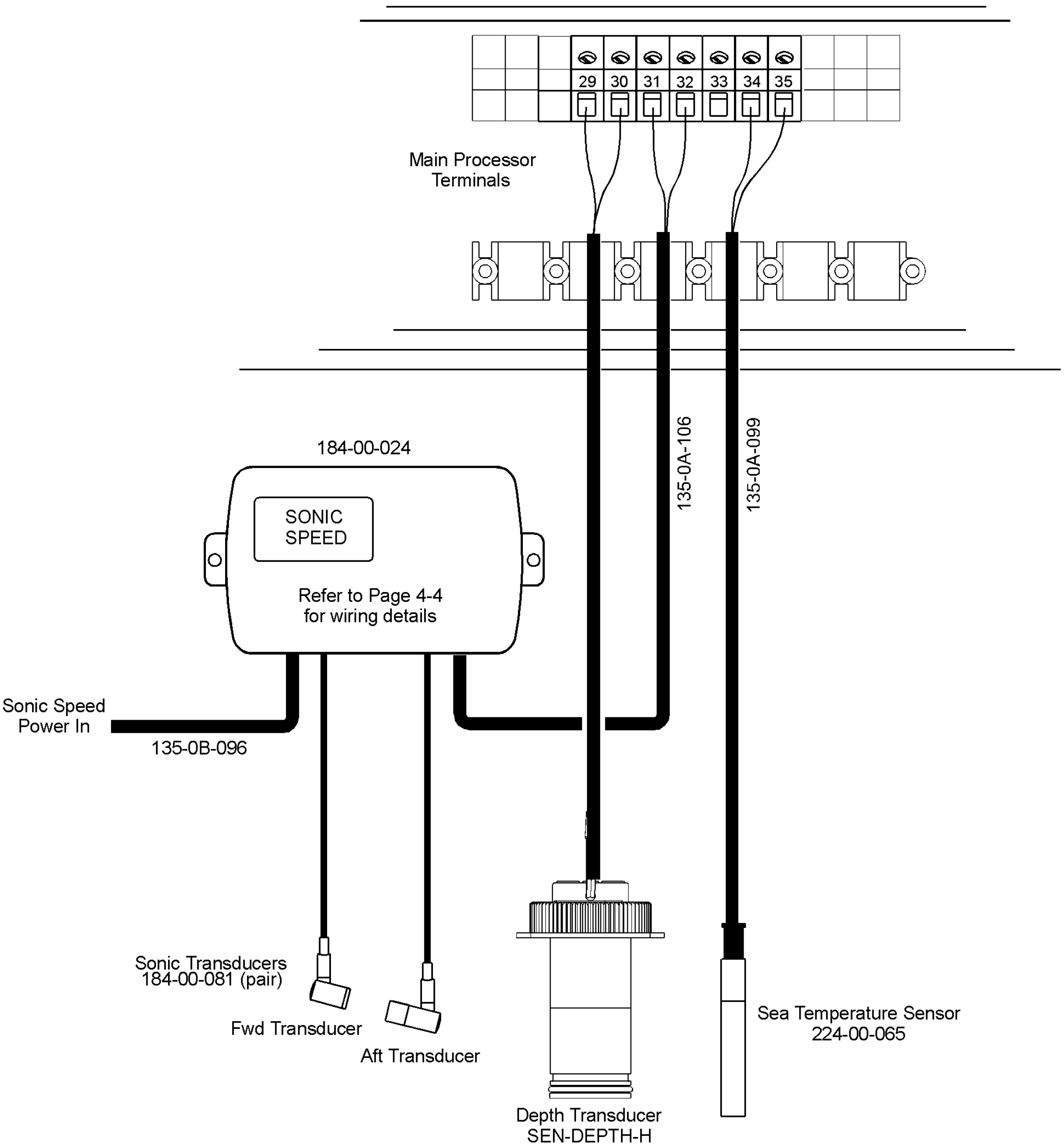
4.2 INSTALLATION DATA SHEETS

SONIC SPEED UNIT & SONIC TRANSDUCERS
ELECTRICAL INSTALLATION SHEET



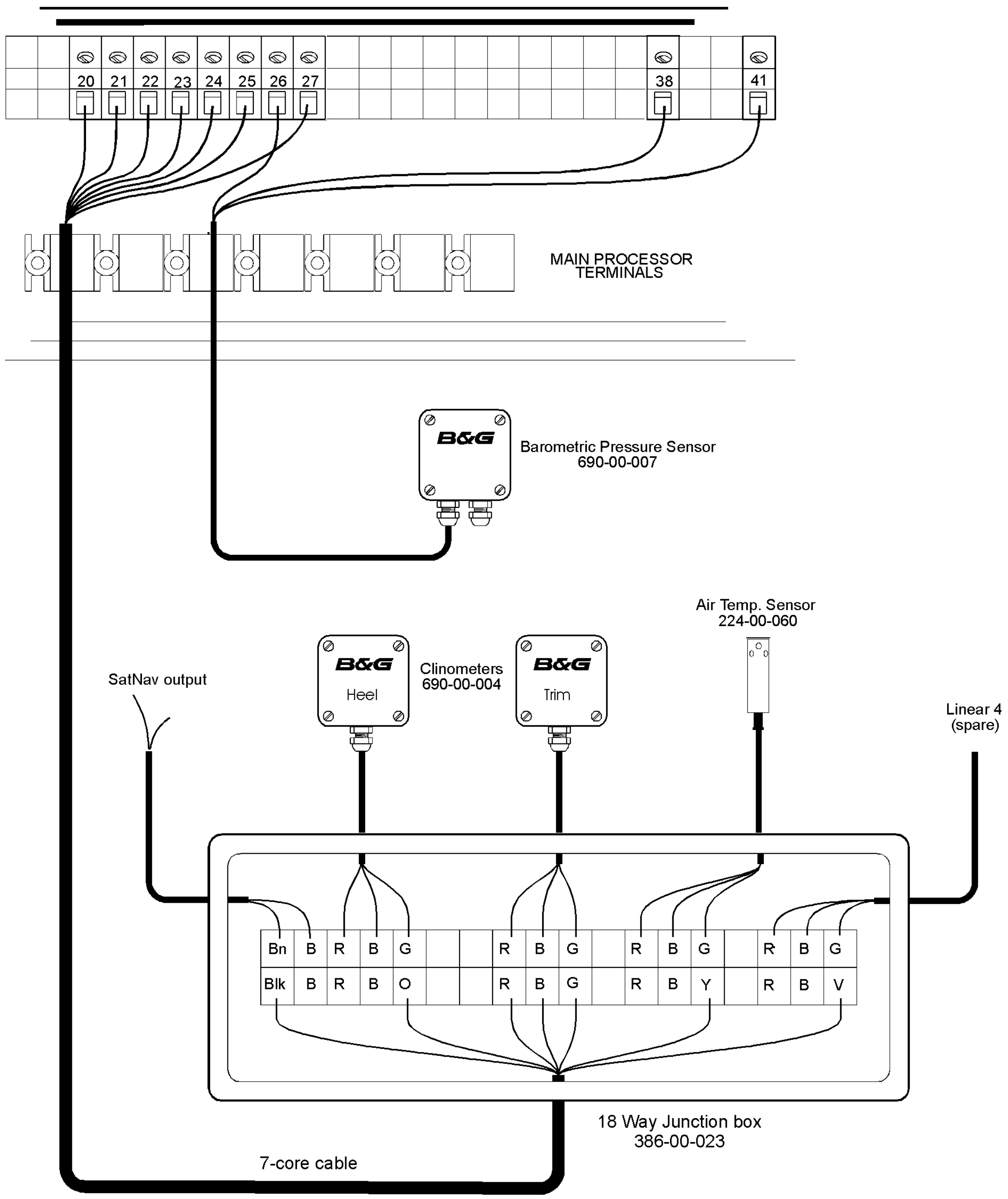
- To minimise interference the Sonic Speed Unit should be mounted away from high current carrying cables and components, e.g. starter motor, generators, etc.
- All cable screens must be connected as shown to minimise radio and radar interference
- The Sonic Speed installation must be setup and calibrated before use. The sonic tranducers must be in water to do this. Refer to Sonic Speed Handbook IH-0222 for details.
- All cable runs to be clear of depth cables or any other cables likely to cause interference.
- The Sonic Tranducer cables may be shortened as required (supplied length 5m).

DEPTH TRANSDUCER, SONIC SPEED AND SEA TEMPERATURE SENSOR INSTALLATION SHEET



TERMINAL	FUNCTION	CABLE & WIRE COLOUR
	DEPTH TRANSDUCER	16m CABLE ATTACHED
29	DEPTH -	BLACK
30	DEPTH +	BLUE
	SONIC SPEED SIGNAL	15m CABLE (135-0A-106)
31	BOATSPEED -VE	BLUE
32	BOATSPEED +VE	RED
		SCREEN NOT CONNECTED
33	GROUND	NO CONNECTION
	SEA TEMP. SENSOR	9m CABLE ATTACHED
34	SEA TEMP. SUPPLY	RED
35	SEA TEMP. INPUT	GREEN
		BLUE NOT CONNECTED

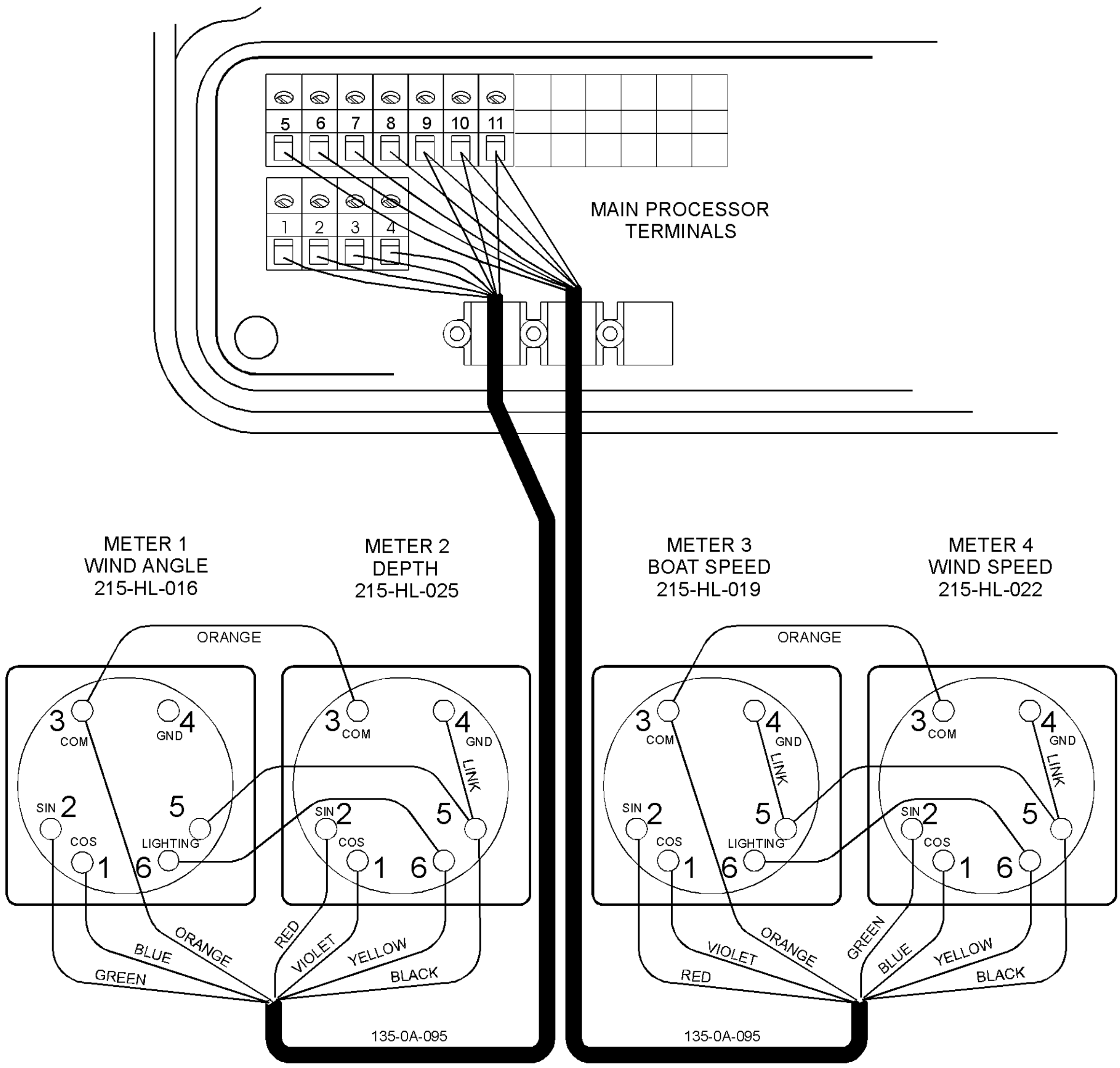
MULTIPLE LINEAR SENSOR INPUTS INSTALLATION SHEET



Notes
1. Inter-connect all sensor supply (Red wires) and sensor ground (blue wires) in the junction box. For clarity, these connections have been omitted from this diagram.
2. Rotary Mast Sensor (RRF-ACP) connections: Red=21; Blue=22, Green=27

Terminal	Function	Wire Colour	Cable
20	SatNav ouput	Black (Blk)	
21	Sensor ground	Blue (B)	Use 7-core
22	Sensor Supply 6.5V DC	Red (R)	from processor
23	Air temp. input	Yellow (Y)	to junction box
24	Heel sensor input	Orange (O)	
25	Trim sensor input	Green (G)	
26	Baro. sensor input	Green	Sensors have
27	Lin. 4 sensor (spare)	Violet (V)	cable attached
38	Baro./Compass ground	Blue	
41	Baro./Compass supply	Red	

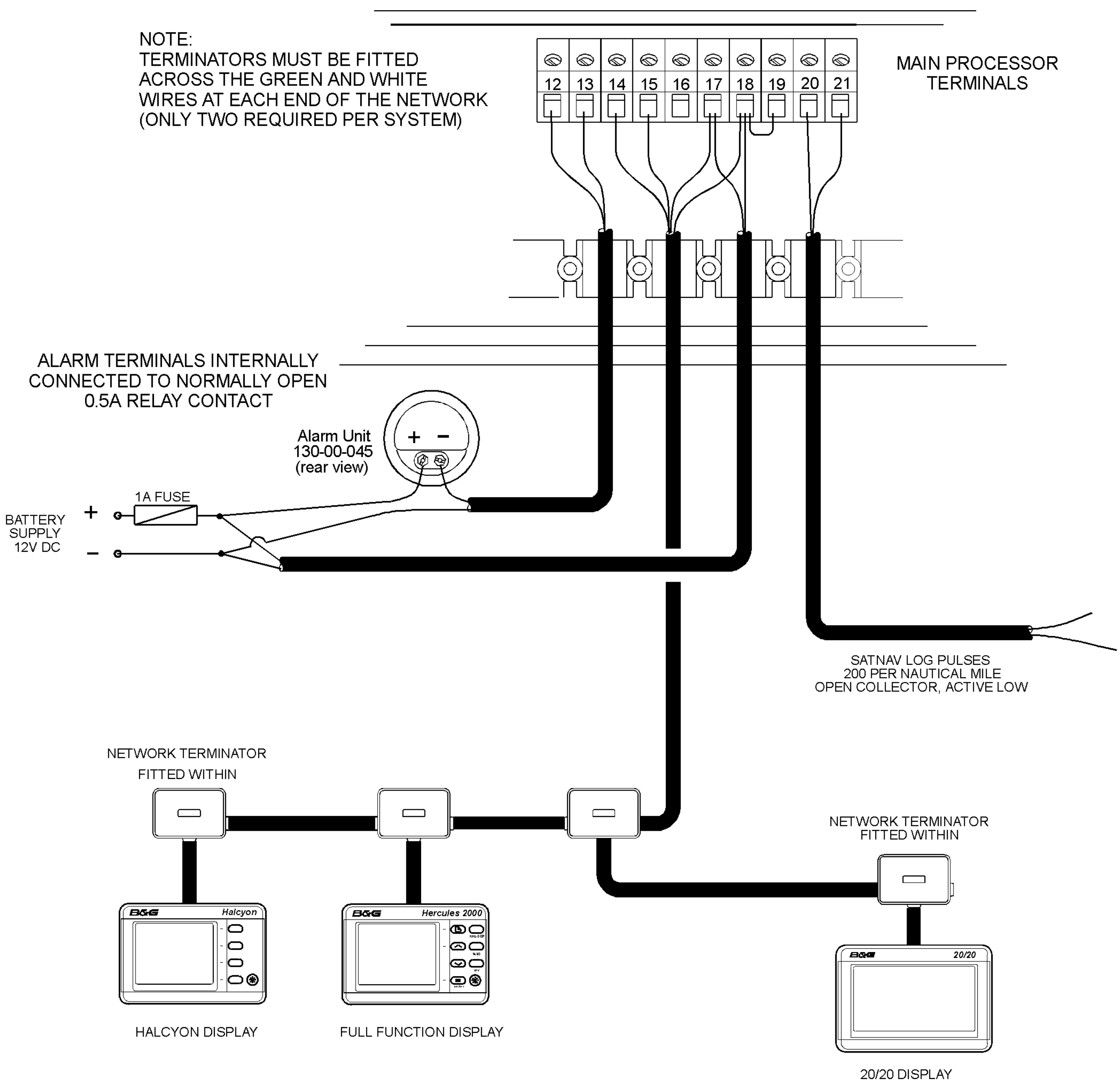
ANALOGUE METERS
ELECTRICAL INSTALLATION SHEET



TERMINAL	FUNCTION	CABLE & WIRE COLOUR
	METERS 1 & 2	PART OF 19m CABLE 135-0A-095
1	METER 1 SIN WIND ANGLE	GREEN
2	COS WIND ANGLE	BLUE
3	METER 2 SIN DEPTH	RED
4	COS DEPTH	VIOLET
	METERS 3 & 4	PART OF 19m CABLE 135-0A-095
5	METER 3 SIN BOAT SPEED	RED
6	COS BOAT SPEED	VIOLET
7	METER 4 SIN WIND SPEED	GREEN
8	COS WIND SPEED	BLUE
	ALL METERS COMMON	
9	METER LIGHTING 12V	2 x YELLOW
10	METER COMMON	2 x ORANGE
11	METER GROUND	2 x BLACK

- Meters are shown in Factory set configuration. To reconfigure refer to section 5 of the Manual.
- "Return to Zero" meters must have terminals 4 and 5 linked; i.e. Boat Speed, Wind Speed, Depth, Rudder Angle and Heel Angle.

ALARM UNIT, NETWORK AND POWER SUPPLY INSTALLATION SHEET



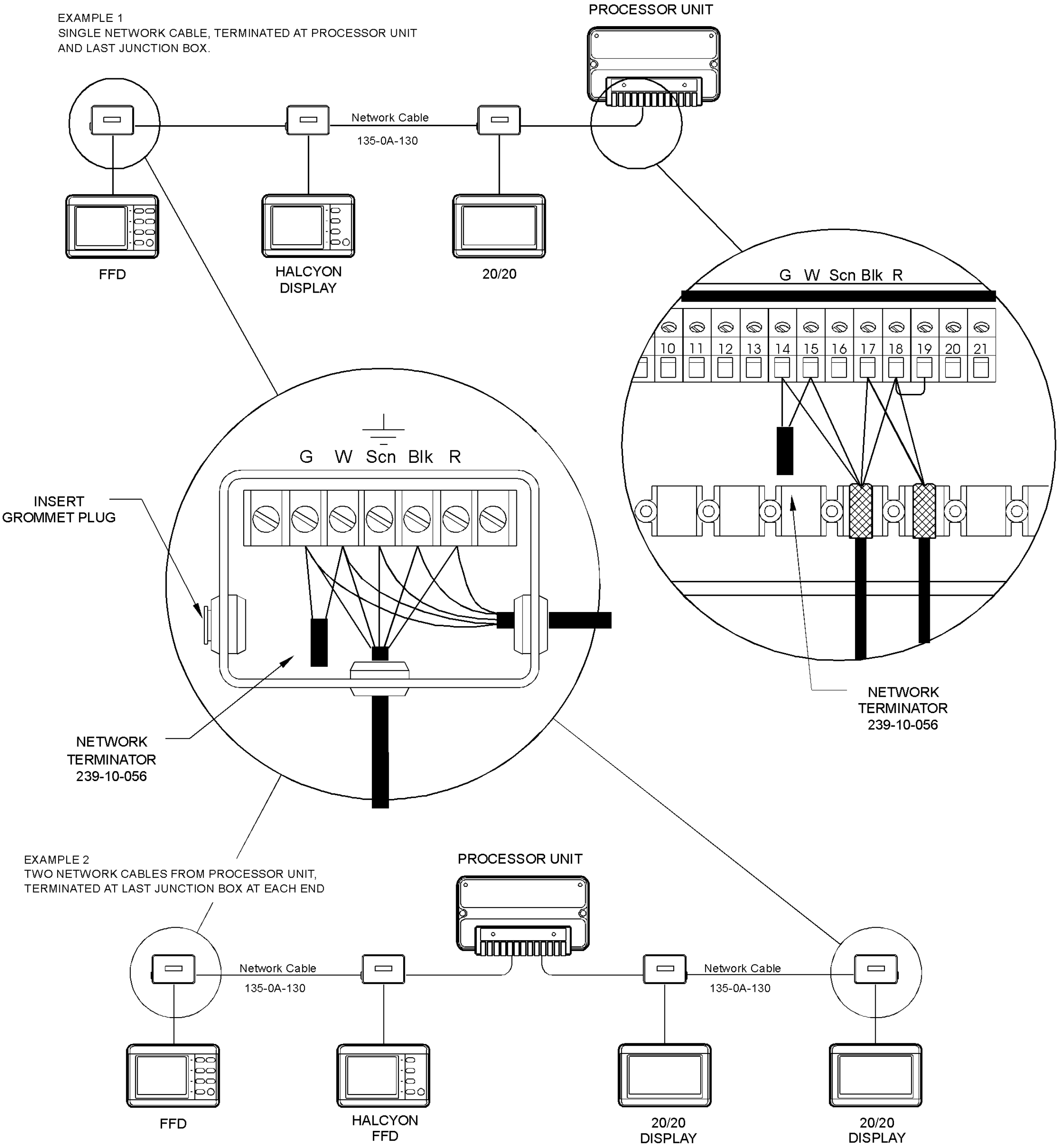
TERMINAL	FUNCTION	CABLE & WIRE COLOUR
	ALARM UNIT	3m CABLE 135-0A-096
12	ALARM	BLUE
13	ALARM	BROWN
	SYSTEM NETWORK	10m CABLE 135-0A-130
14	NETWORK DATA -	GREEN
15	NETWORK DATA +	WHITE
17	SUPPLY GROUND	BLACK
18	12V DC SUPPLY	RED
	POWER SUPPLY	3m CABLE 135-0A-096
17	GROUND	BLUE
18	+12V DC SUPPLY	BROWN (LINK)
19	BATTERY SENSE	(LINK)
	SATNAV PULSES	3m CABLE 135-0A-096
20	SATNAV PULSE OUTPUT	BROWN
21	GROUND	BLUE

NETWORK TERMINATOR INSTALLATION

THE NETWORK TERMINATOR 239-10-056 IS A BLACK TWO WIRED COMPONENT WITH A RESISTANCE OF 100 OHMS. TWO ARE SUPPLIED WITH INSULATING SLEEVING TO PREVENT SHORTING OF THE WIRES.

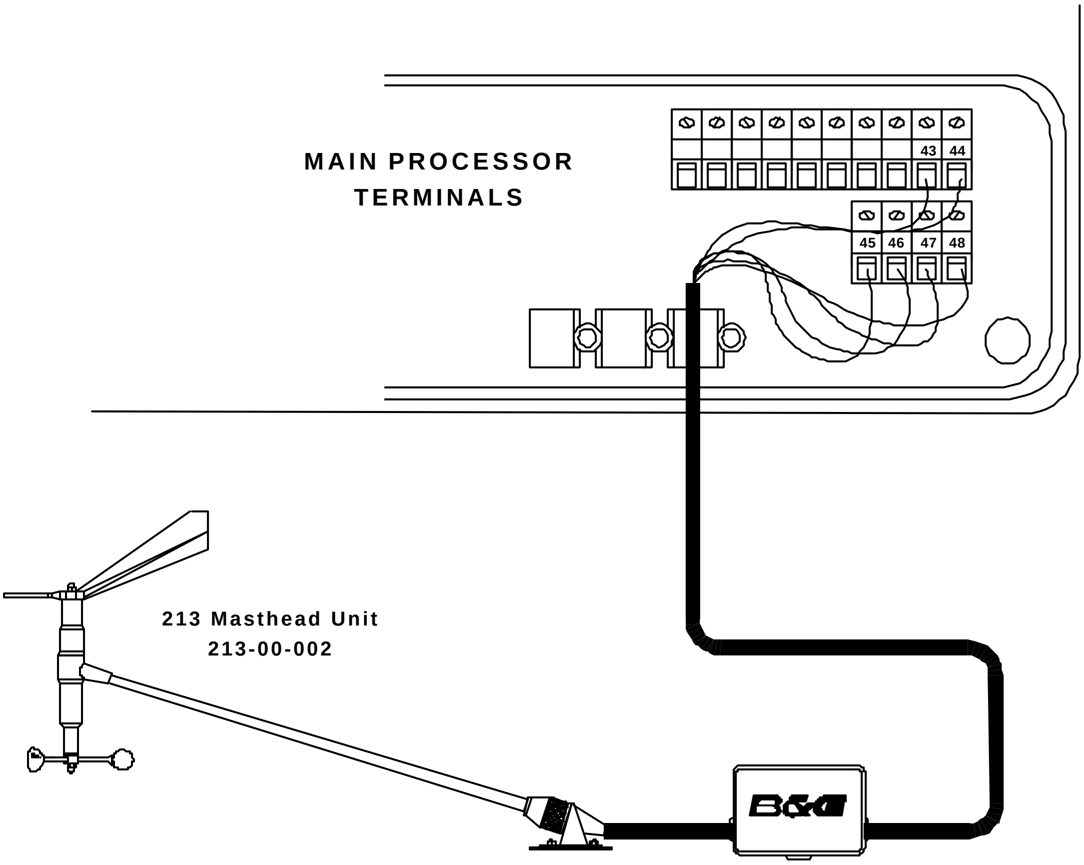
IMPORTANT NOTE
A NETWORK TERMINATOR MUST BE FITTED ACROSS THE GREEN AND WHITE NETWORK DATA WIRES OF THE LAST UNIT OR JUNCTION BOX AT EACH END OF THE NETWORK CABLE. (SEE EXAMPLES BELOW)

WHEN ADDING MORE DISPLAYS OR UNITS TO THE NETWORK, ENSURE THAT THE TERMINATOR IS MOVED TO THE ENDS OF THE NETWORK CABLE. NEVER FIT MORE THAN TWO TERMINATORS ON THE NETWORK.



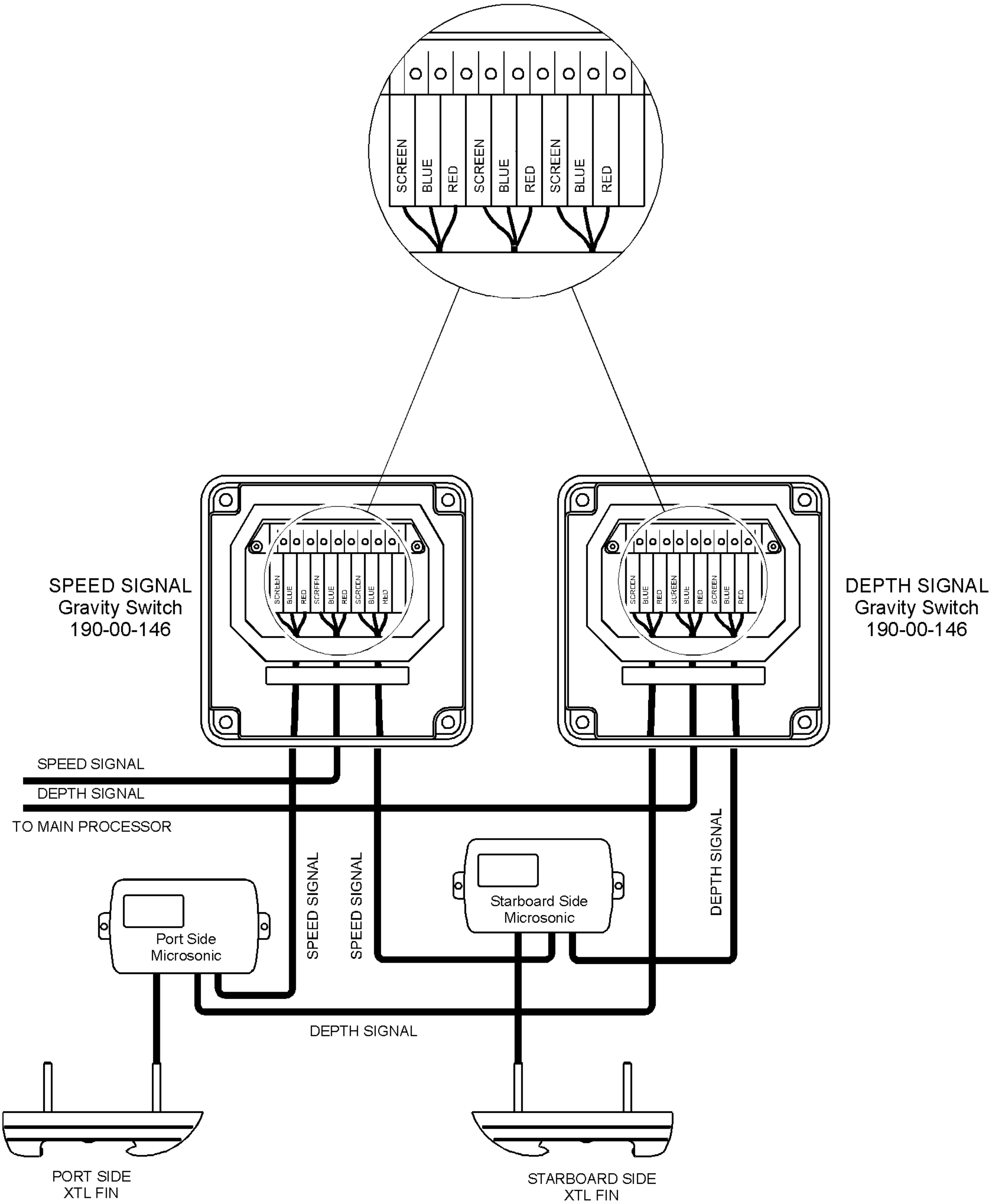
UNITS AND DISPLAYS MAY BE FITTED IN ANY ORDER ON THE NETWORK

213 MASTHEAD UNIT ELECTRICAL INSTALLATION SHEET

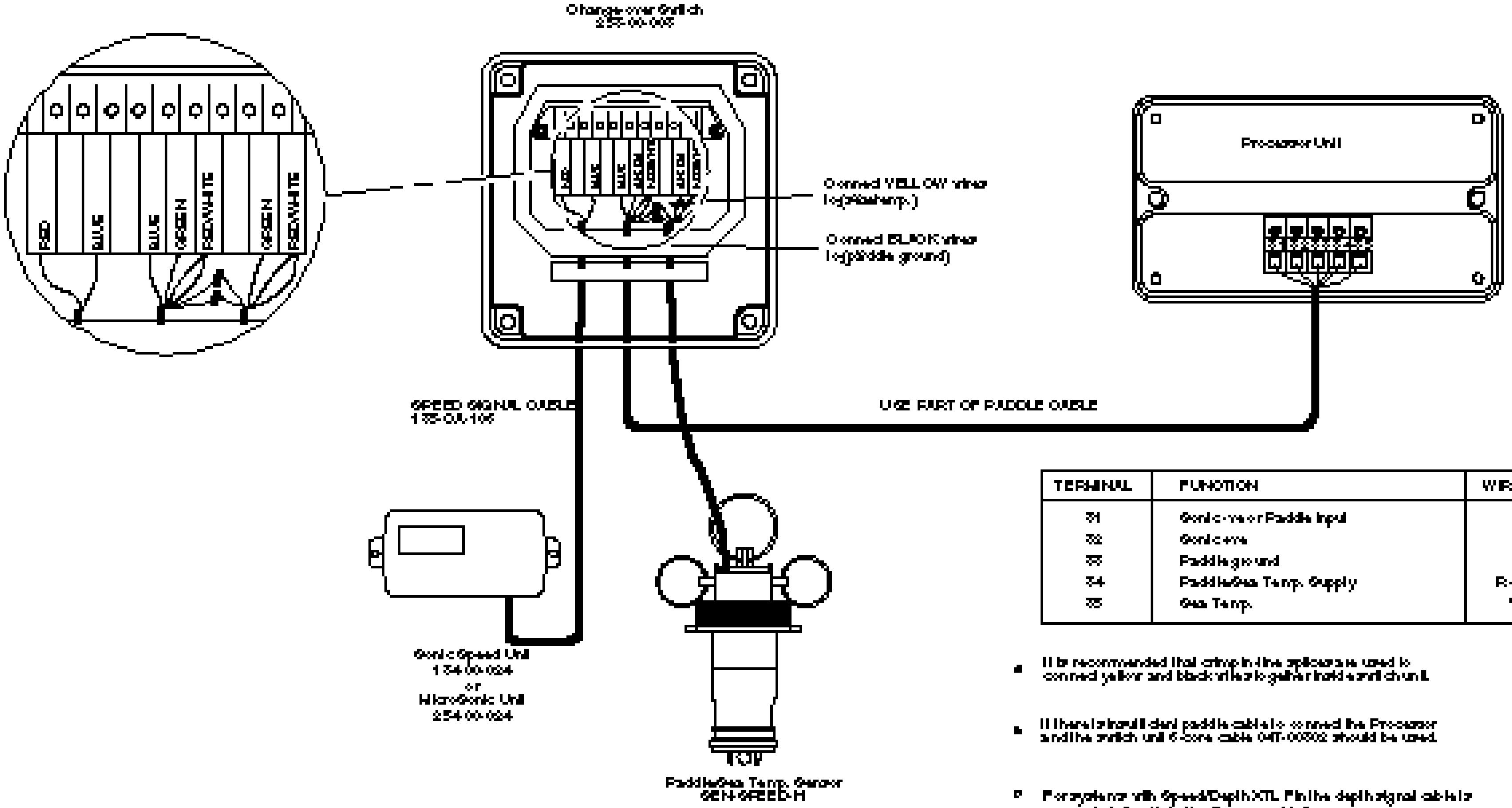


TERMINAL	FUNCTION	WIRE COLOUR
43	MHU SUPPLY	ORANGE
44	WIND SPEED INPUT	VIOLET
45	MHU GROUND	BLACK
46	WIND ANGLE BLUE	BLUE
47	WIND ANGLE GREEN	GREEN
48	WIND ANGLE RED	RED

TWIN XTL FINS GRAVITY SWITCH INSTALLATION



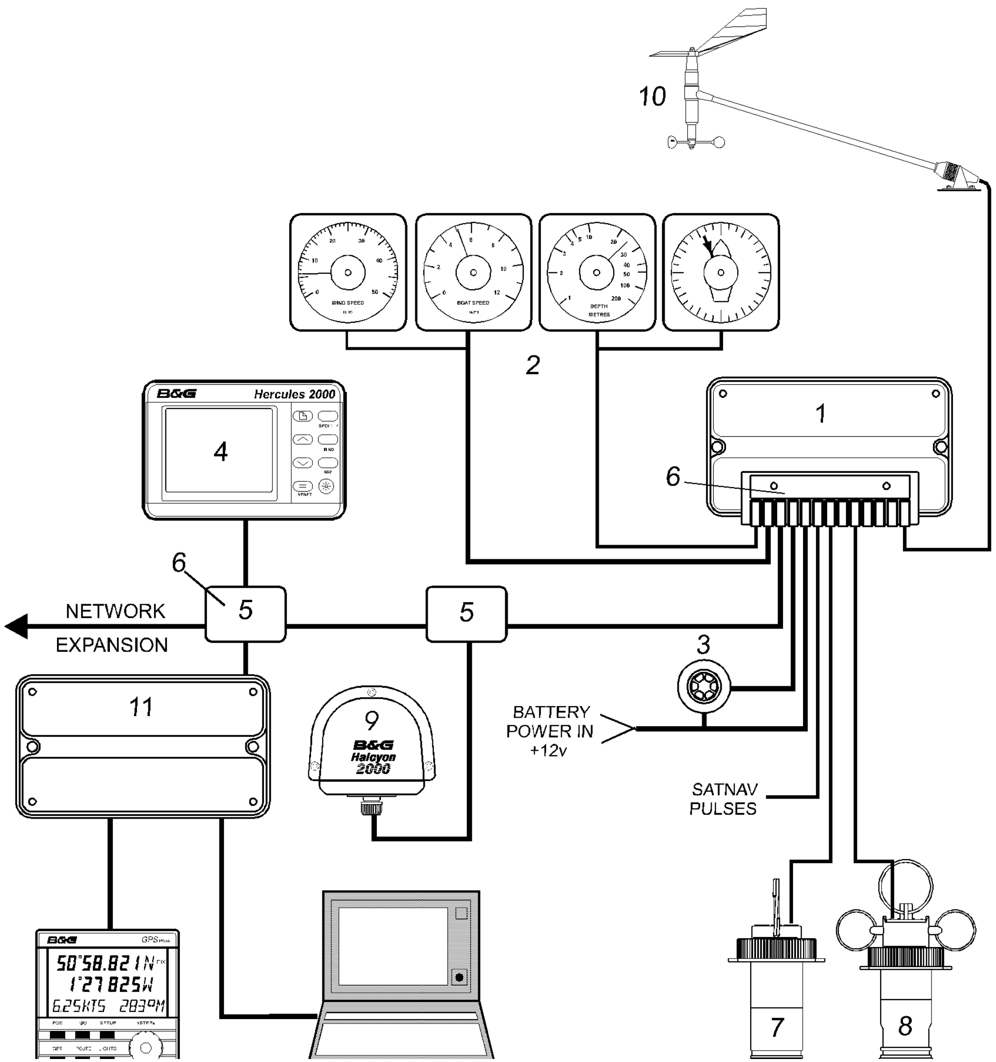
PADDLEWHEEL / SONIC
CHANGE-OVER SWITCH INSTALLATION SHEET



TERMINAL	FUNCTION	WIRE COLOUR
31	Sonic-ve or Paddle input	Green
32	Sonic +ve	Blue
33	Paddle ground	Black
34	Paddle/Sea Temp. Supply	Red/White
35	Sea Temp.	Yellow

- It is recommended that crimp in-line splices are used to connect yellow and black wires together inside switch unit.
- If there is insufficient paddle cable to connect the Processor and the switch unit 6-core cable 04T-00002 should be used.
- For systems with Speed/Depth XTL Fit the depth signal cable is connected directly to the Processor Unit.

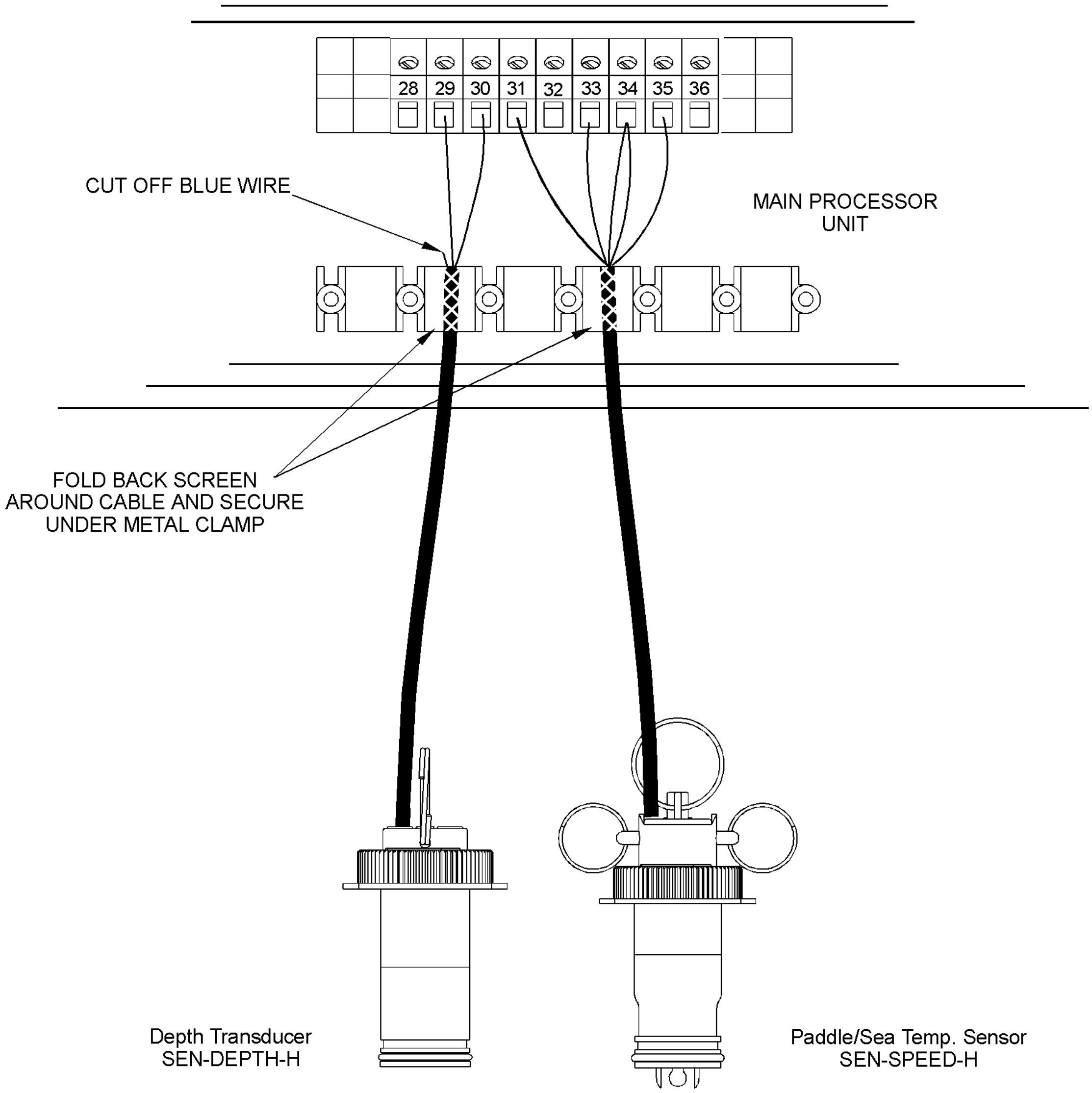
HERCULES 2000 SYSTEM EXAMPLE
INSTALLATION REFERENCE SHEET



ITEM	UNIT		B&G PART No.
1	MAIN PROCESSOR UNIT		330-00-005
2	ANALOGUE INDICATORS		
	Meter 1	Wind Angle	215-HL-016
	Meter 2	Depth	215-HL-025
	Meter 3	Boat Speed	215-HL-019
	Meter 4	Wind Speed	215-HL-022
3	ALARM UNIT		130-00-045
4	STANDARD FFD		240-00-026
	BEZEL		890-00-017
5	JUNCTION BOX		288-00-001
6	NETWORK TERMINATOR		239-10-056
7	DEPTH TRANDUCER		SEN-DEPTH-H
8	YACHT PADDLE		SEN-SPEED-H
9	HALCYON 2000 COMPASS		486-00-009
10	213 MASTHEAD UNIT		213-00-002
11	PERFORMANCE PROCESSOR		690-00-002

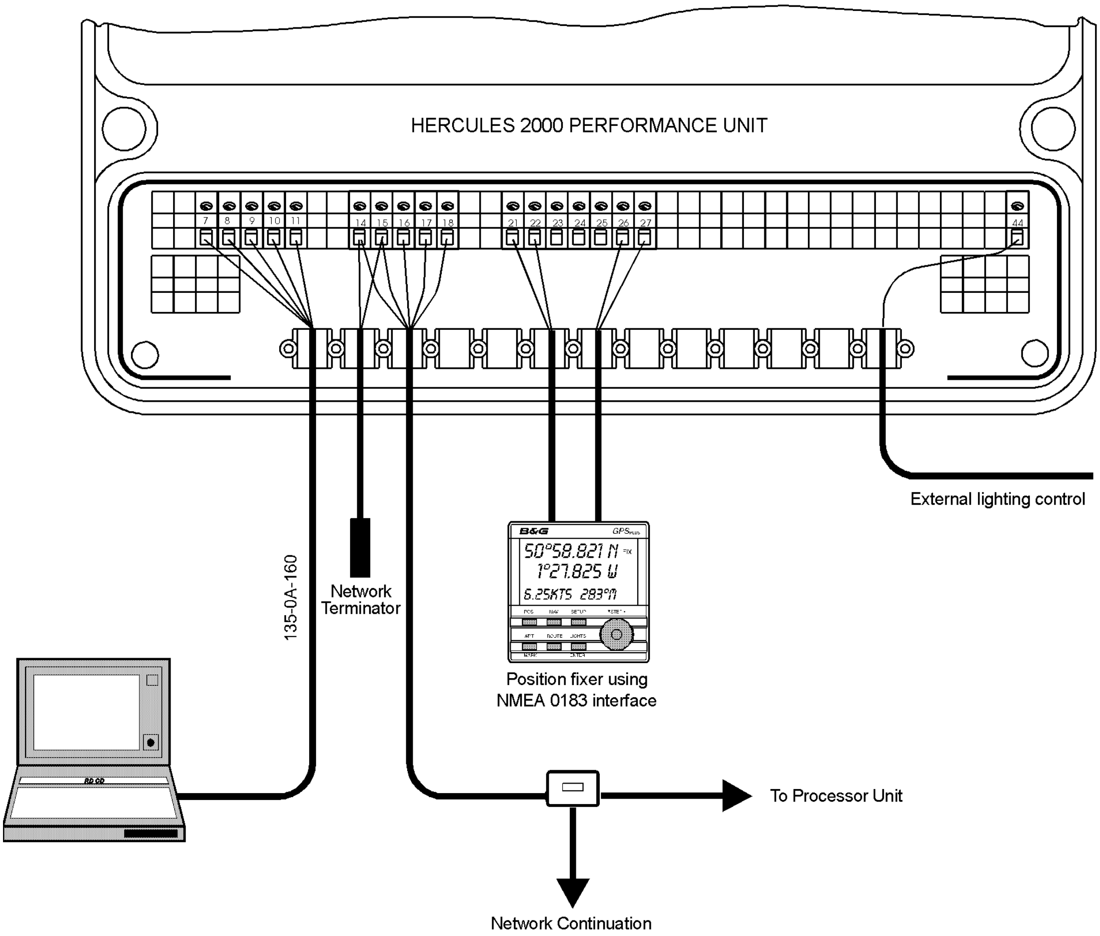
OPTIONAL UNITS (NOT SHOWN)	B&G PART NO.
ANALOGUE EXPANSION UNIT	340-00-009
NMEA FFD	240-00-028
BEZEL	890-00-017
HALCYON DISPLAY	240-00-031
BEZEL	890-00-019
20/20 DISPLAY	332-00-004
BEZEL	890-00-037
REMOTE CONTROLLER	302-00-007
SONIC SPEED UNIT	184-00-024
FWD/AFT SONIC TRANSDUCER PACK	184-00-081
SEA TEMP. SENSOR	224-00-065
GPS SYSTEM	NET-GPDU-SY
UNDERWATER UNIT AND IMPELLER	117-00-120
GRAVITY CHANGEOVER SWITCH	190-00-146
CLINOMETER (HEEL/TRIM)	690-00-004
BAROMETRIC SENSOR	690-00-007
MAST ANGLE ROTATION	RRF - ACP
RUDDER/TRIM TAB ANGLE	RRF - ACP
AIR TEMPERATURE SENSOR	224-00-066

DEPTH AND PADDLE ELECTRICAL INSTALLATION SHEET



TERMINAL	FUNCTION	CABLE WIRE COLOUR
	DEPTH TRANSDUCER	16m CABLE ATTACHED
29	DEPTH -	BLACK
30	DEPTH +	BLUE
	PADDLE/SEA TEMP. SENSOR	16m CABLE ATTACHED
31	PADDLE INPUT	GREEN
32	NO CONNECTION	
33	GROUND	BLACK
34	SEA TEMP./PADDLE SUPPLY	RED AND WHITE
35	SEA TEMP. INPUT	YELLOW

2000 PERFORMANCE PROCESSOR INSTALLATION SHEET

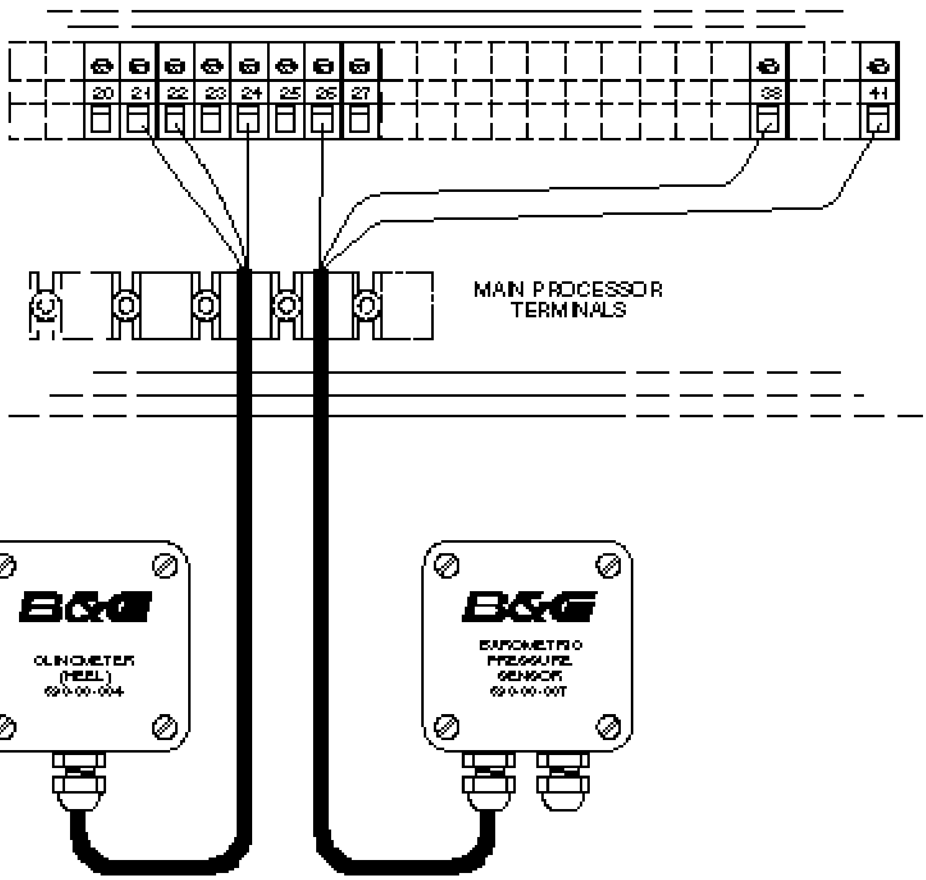


NOTES: 1. A Network Terminator 239-10-056 must be installed across the Green and White wires of the last Unit or Network junction box.

2. Any compatible NMEA Position Fixer may be connected.

Terminal	Function	Wire Colour		Cable
7	RS232 CTS	Green		135-0A-133 25 way D - Type Socket Fitted or 135-0A-160 9 way D- Type
8	RS232 RTS	Violet		
9	RS232 Rx	Red		
10	RS232 Tx	Blue		
11	RS232 Ground	Black		
14	Network data -	Green		135-0A-130 4 cores/screen
15	Network data +	White		
16	No Connection	No Connection		
17	Supply ground	Black		
18	Supply +ve (12V nom.)	Red		
		NMEA 1	**NMEA 2**	
21	NMEA ground	Blue	Blue	Use 135-0B-098 2 cores/screen for each pair of NMEA signals 4 cables total
22	NMEA output 1	Red		
23	NMEA output 2		Red	
24	NMEA input 2 return		Blue	
25	NMEA input 2 signal		Red	
26	NMEA input 1 return	Blue		
27	NMEA input 1 signal	Red		
44	Lighting control input	Red		

CLINOMETER AND BAROMETRIC PRESSURE SENSOR INSTALLATION SHEET



TERMINAL	FUNCTION	CABLE & WIRE COLOUR
	CLINOMETER SENSOR	CABLE ATTACHED
21	GROUND	BLUE
22	SENSOR SUPPLY 6.5 VDC	RED
23	AIR TEMP. INPUT	
24	LINEAR 1 INPUT (HEEL)	GREEN
25	LINEAR 2 INPUT (TRIM)	
	PRESSURE SENSOR	CABLE ATTACHED
26	LINEAR 3 INPUT (BARO)	GREEN
27	LINEAR 4 INPUT (SPARE)	
38	BARO. SENSOR GROUND	BLUE
41	BARO. SENSOR SUPPLY	RED

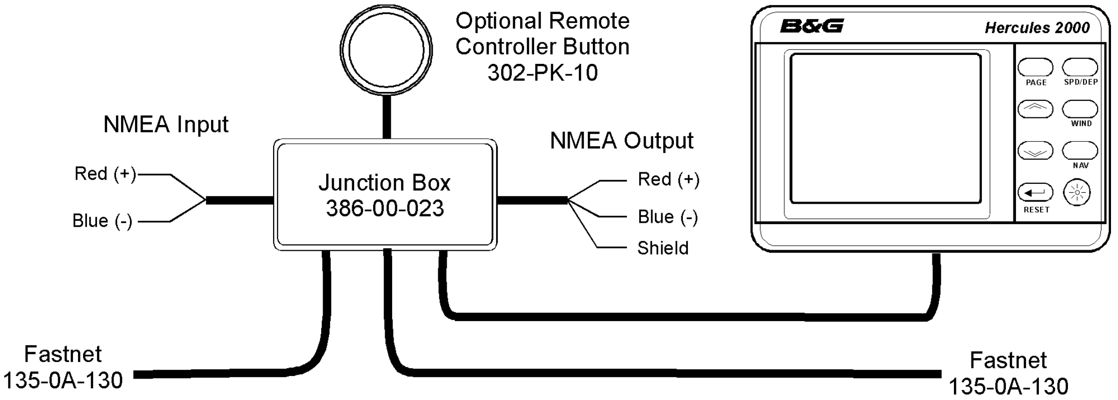
CLINOMETER INSTALLATION

- Ensure the boat is level and steady, a sheltered berth is required for best results.
- For HEEL angle sensor select a transverse vertical bulkhead.
- For TRIM angle sensor select a longitudinal vertical bulkhead.
- For correct indication of port or starboard heel angle, mount the unit so that the top surface is horizontal and level, with the lid of the unit (labelled) facing aft.
- Heel angle calibration should be carried out to ensure accuracy. Refer to Manual, Section 4.

BAROMETRIC PRESSURE SENSOR INSTALLATION

- Mount the unit on a suitable vertical bulkhead, in a dry location, protected from the direct influences of the elements ie. rain, salt spray and extremes of temperature.
- Do not mount the sensor in a sealed compartment.

8-BUTTON NMEA FULL FUNCTION DISPLAY INSTALLATION SHEET



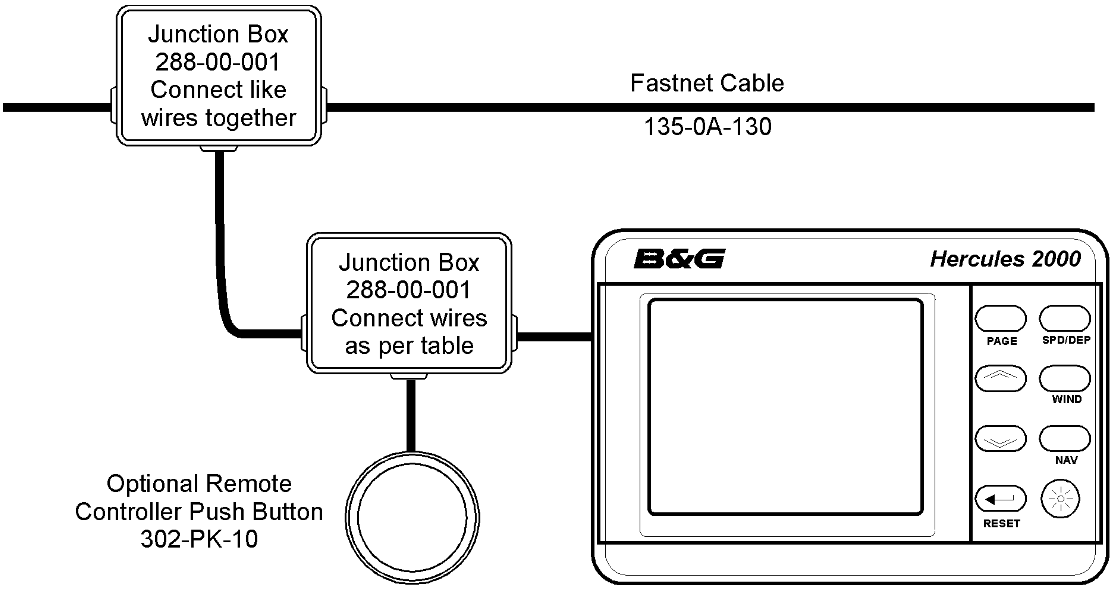
NMEA FFD CABLE FUNCTION	FFD CABLE COLOUR	SYSTEM NETWORK	NMEA INPUT	NMEA OUTPUT	REMOTE BUTTON
Network Data -ve	Green	Green			
Network Data +ve	White	White			
Network Cable Shield	Shield	Shield		Shield	
Ground	Black	Black		Blue	Blue
Supply +ve	Red	Red			
NMEA Input Signal	Brown		Red		
NMEA Input Return	Blue		Blue		
NMEA Output Signal	Violet			Red	
Remote Control Button	Yellow				Red

INSTALLATION NOTES
- An NMEA FFD can be connected at any point on the system network. Typically an NMEA FFD is mounted close to the NMEA device, e.g. at the chart table next to the GPS, thus minimising the NMEA cable routes.
- NMEA FFD's can be used in combination with all other display types, i.e. standard FFD's, Halcyon displays, 20/20 and Pilot displays.
- To prevent water intrusion into the display, do not cut the cable shorter than marked by the yellow band. If it is necessary to cut cables, then the wires MUST be tinned with a soldering iron to ensure a proper seal around the wires.

SCREENED CABLES
- Shielded NMEA cables are supplied to provide protection against unwanted emissions (EMC) and must be connected in accordance with these instructions.
- NMEA cable shields must be connected at the TRANSMITTING end.
- The NMEA output cable shield should be connected to the other cable shields in the junction box supplied.

NETWORK TERMINATION
- If the NMEA FFD is the last unit on the system network a network terminator MUST be fitted across the network data wires, i.e. between the green and white wires. Only two network terminators are required per system.

*8 BUTTON FULL FUNCTION
DISPLAY WIRING DETAILS*



FFD CABLE FUNCTION	FFD CABLE COLOUR	SYSTEM NETWORK	REMOTE BUTTON
Network Data -ve	Green	Green	
Network Data +ve	White	White	
Network Cable Shield	Shield	Shield	
Ground	Black	Black	Blue
Supply +ve	Red	Red	
Remote Control Button	Yellow		Red
Not used	Brown		

INSTALLATION NOTES FOR HERCULES 2000

- The system requires at least one FFD.
- An FFD can be connected at any point on the system network.
- Multiple FFD's can be used on the system network. Each can control and enter data into the system processor memory.
- FFD's can be used in combination with all other display types i.e. NMEA FFD's, Halcyon displays, 20/20 and Pilot displays.
- To prevent water intrusion into the display, do not cut the cable shorter than marked by the yellow band. If it is necessary to cut cables, then the wires MUST be tinned with a soldering iron to ensure a proper seal around the wires.

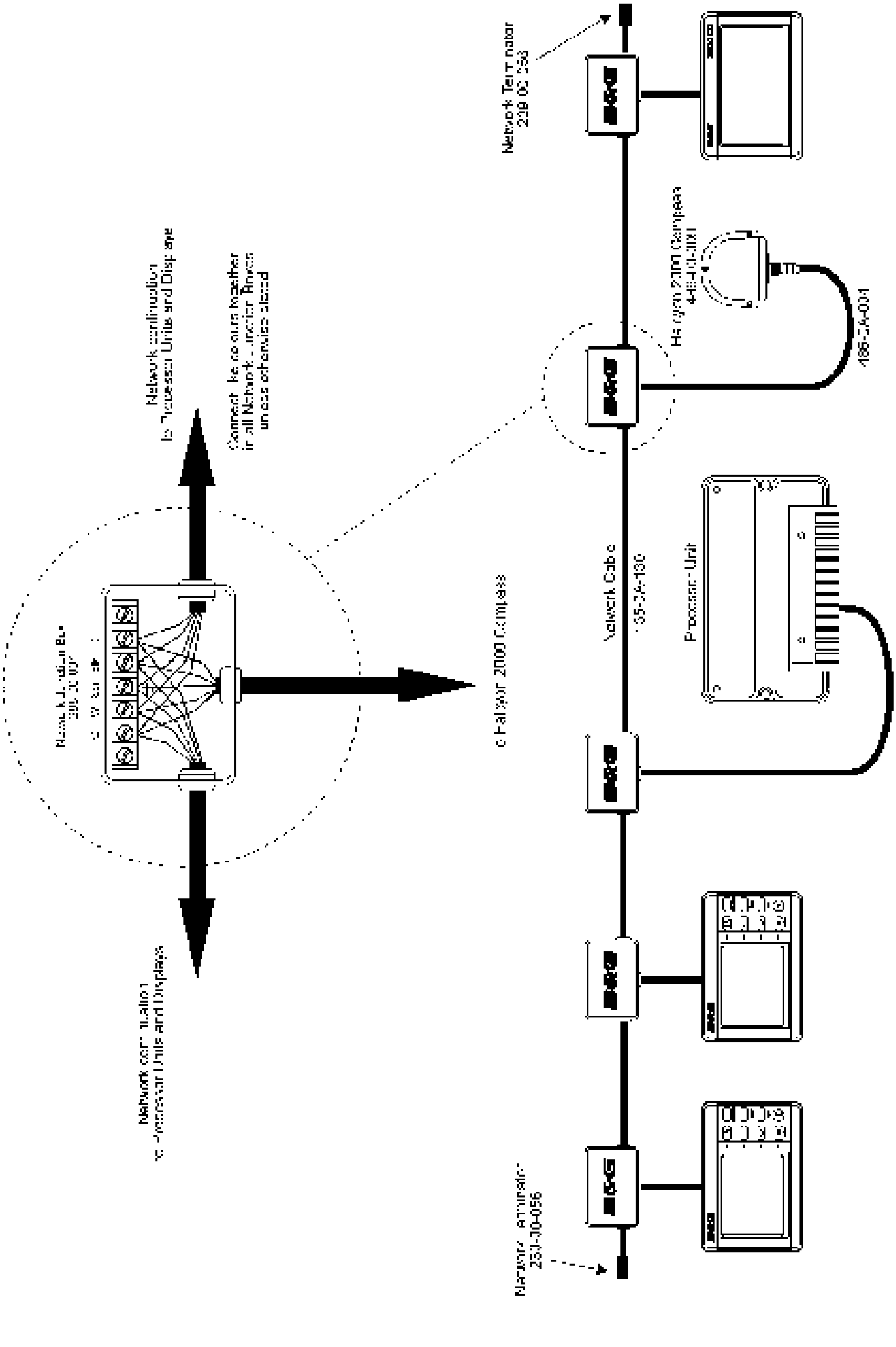
SCREENED CABLES

- Shielded cables are supplied to provide protection against unwanted emissions (EMC) and must be connected in accordance with these instructions.

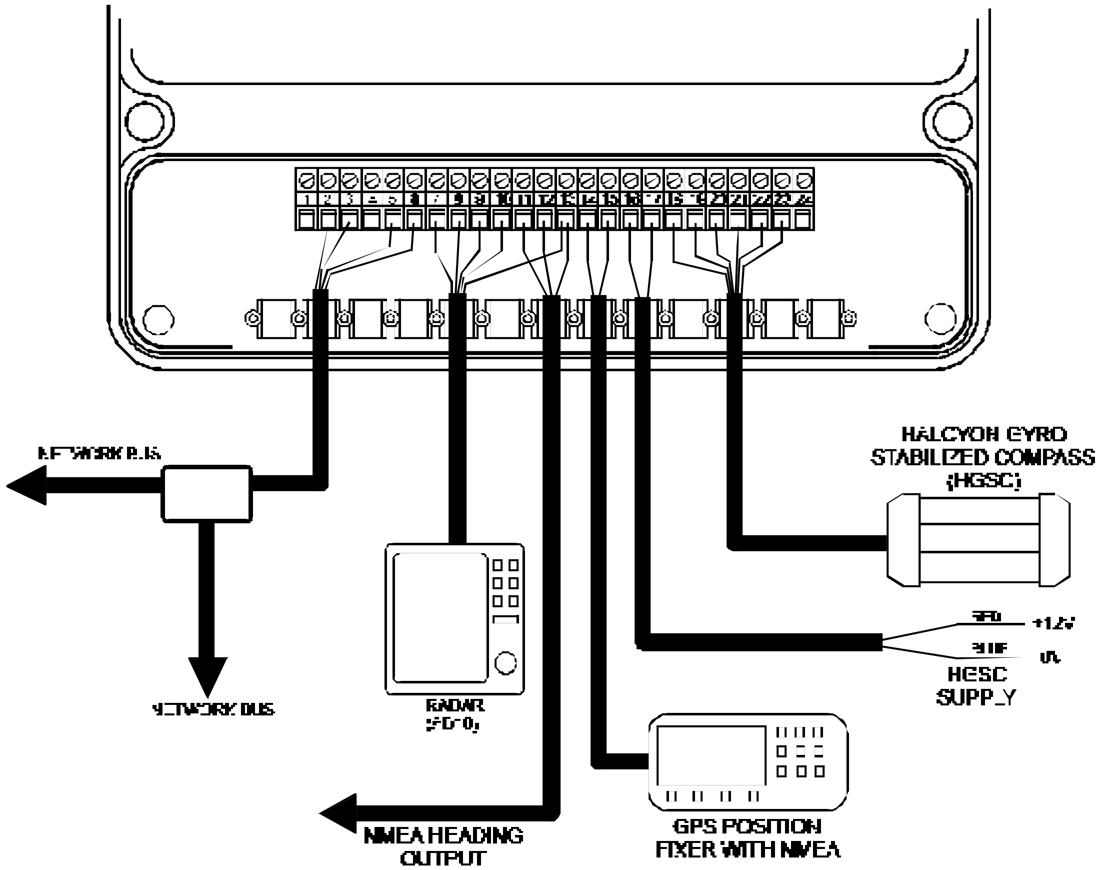
NETWORK TERMINATION

- If the FFD is the last unit on the system network a network terminator MUST be fitted across the network data wires, i.e. between the green and white wires.

Halcyon 2000 Connection Diagram



HALCYON GYRO PROCESSOR WITH HALCYON GYRO STABILISED COMPASS



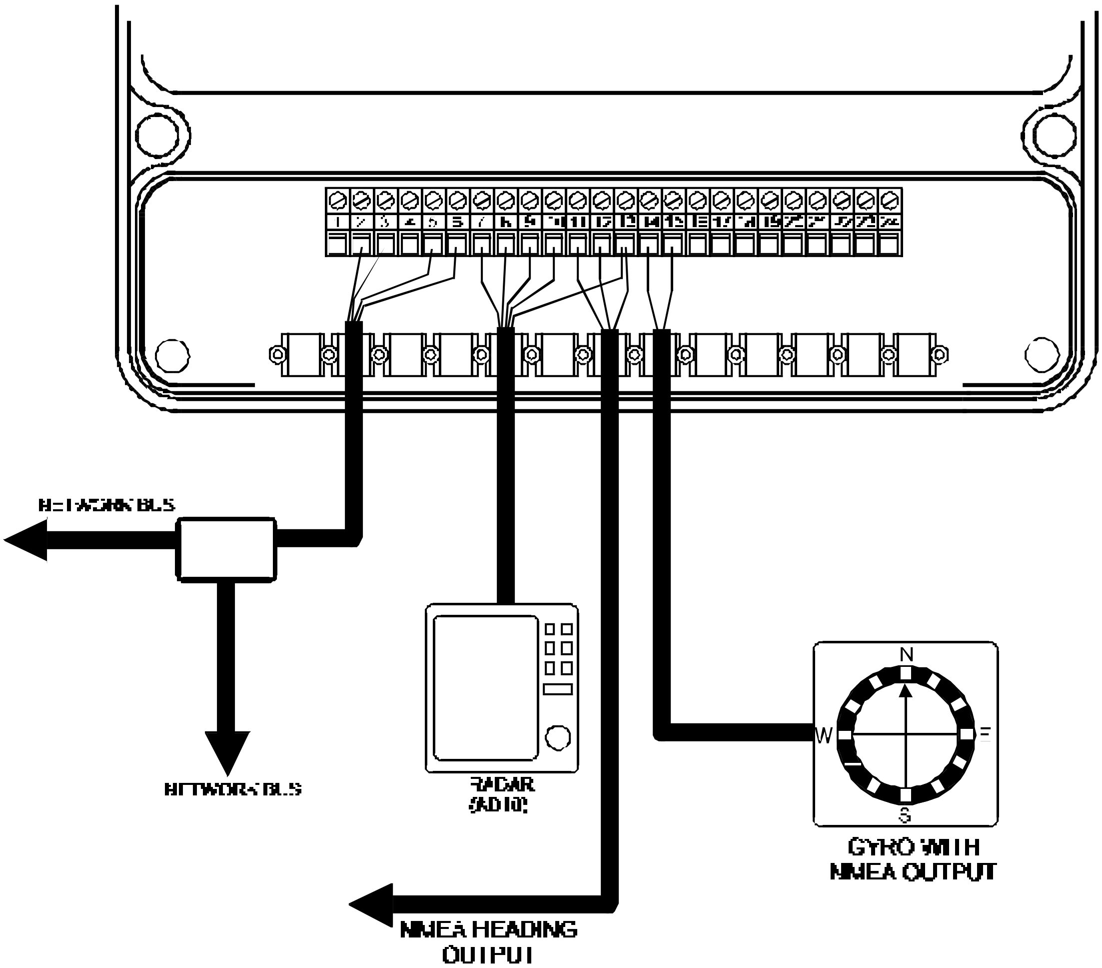
Notes: 1. All screened wires must have their screen attached to the clamp bar across he front case.

2. The Halcyon Gyro Stabilised Compass (HGSC) has a separate supply and does not take power from the Network Bus. The HGSC sensor supply must be taken from a source rated at 2 amps.

Terminal	Function	Wire Colour	Cable
2 3 5 6	Network Data - Network Data + Supply Ground Supply +ve (12V nom.)	Green White Black Red	135-0A-130 4 cores/screen
7 8 9 10 13	AD10 Clock Low (-) AD10 Clock High (+) AD10 Data Low (-) AD10 Data High (+) Ground		
11 12 13	NMEA Out - (V2.0) NMEA Out +(V1.5 & 2.0) Ground	Blue Red Blue	135-0A-098 2 cores/screen
14 15	NMEA In + NMEA In -	Red Blue	135-0A-098 2 cores/screen
16 17	HGSC Power in + HGSC Power in -	Red Blue	135-0A-098 2 cores/screen
18 19 20 21 22	HGSC Supply - HGSC Supply + HGSC Data in + HGSC Data in - HGSC Data out +	Black Red White Yellow Green	BGH063001

23	HGSC Data out -	Blue	

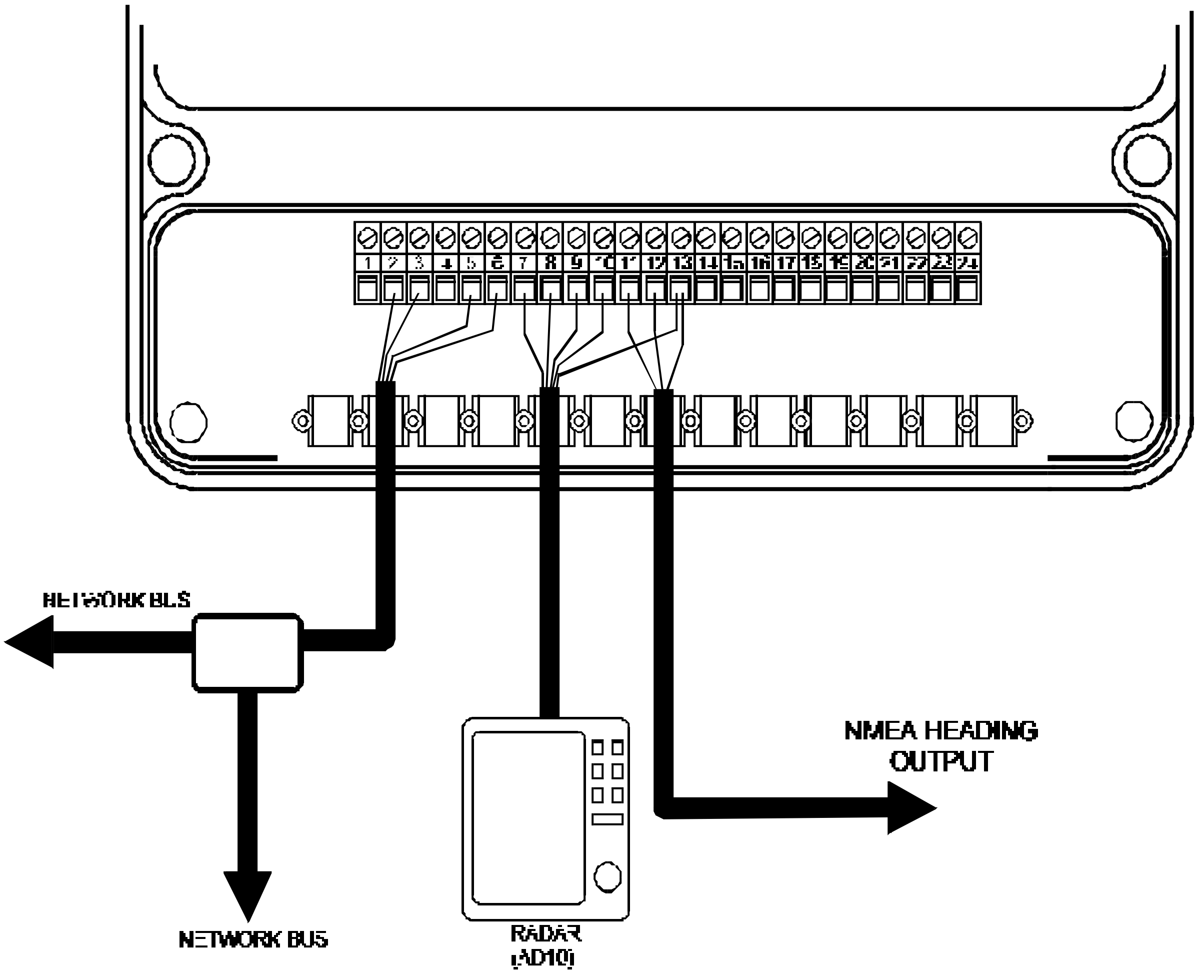
HALCYON GYRO PROCESSOR WITH NMEA GYRO INPUT



Notes: 1. All screened wires must have their screen attached to the clamp bar across the front case.

Terminal	Function	Wire Colour	Cable
2 3 5 6	Network Data - Network Data + Supply Ground Supply +ve (12V nom.)	Green White Black Red	 135-0A-130 4 cores/screen
7 8 9 10 13	AD10 Clock Low (-) AD10 Clock High (+) AD10 Data Low (-) AD10 Data High (+) Ground		
11 12 13	NMEA Out - (V2.0) NMEA Out +(V1.5 & 2.0) Ground	Blue Red Blue	135-0A-098 2 cores/screen
14 15	NMEA In + NMEA In -	Red Blue	135-0A-098 2 cores/screen

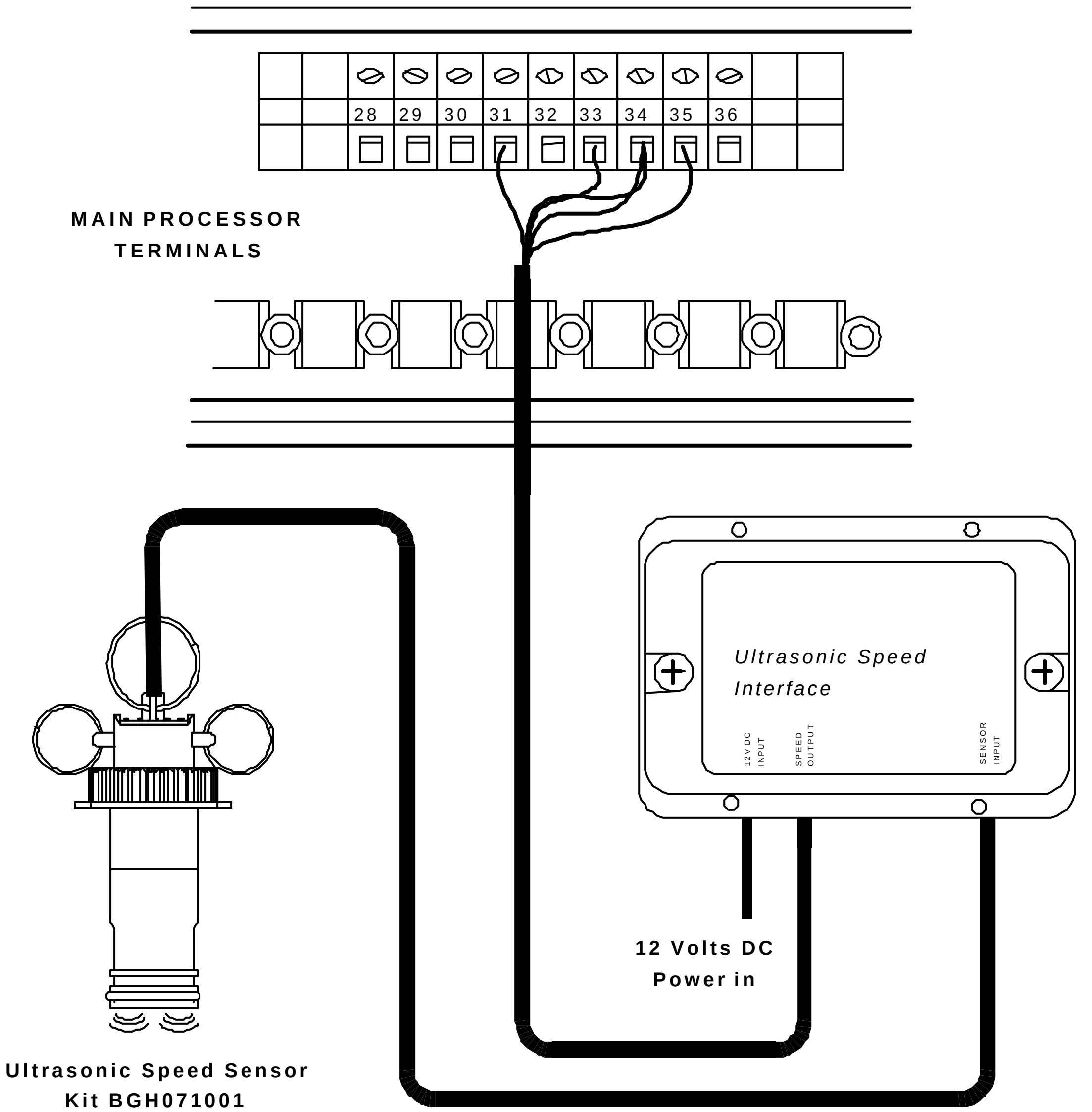
HALCYON GYRO PROCESSOR AS OUTPUT INTERFACE



Notes: 1. All screened wires must have their screen attached to the clamp bar across the front case.
2. Heading source must be either a Halcyon 2000, B&G Pilot or 4 wire input to the Processor Unit (Super Halcyon 3).

Terminal	Function	Wire Colour	Cable
2	Network Data -	Green	
3	Network Data +	White	135-0A-130
5	Supply Ground	Black	4 cores/screen
6	Supply +ve (12V nom.)	Red	
7	AD10 Clock Low (-)		
8	AD10 Clock High (+)		
9	AD10 Data Low (-)		
10	AD10 Data High (+)		
13	Ground		
11	NMEA Out - (V2.0)	Blue	135-0A-098
12	NMEA Out +(V1.5 & 2.0)	Red	2 cores/screen
13	Ground	Blue	

ULTRASONIC SPEED SENSOR UNIT
INSTALLATION SHEET



Notes: 1. All screened wires must have their screen attached to the clamp bar across the front case.

Terminal	Function	Wire Colour	Cable
31	Boatspeed Input	Green	135-0A-097 6 cores/screen
32	No Connection	-	
33	Ground	Black	
34	Sea Temperature/Paddle Supply	Red/White	
35	Sea Temperature Input	Yellow	

PART 5 - OPTIONS
CONTENTS

CONTENTS (Contd.)

CONTENTS (Contd.)

ILLUSTRATIONS

TABLES

TABLES (Contd.)

PART 5 - OPTIONS

5.1 SYSTEM EXPANSION

The Hercules 2000 System may be expanded to provide a wider range of facilities and features by the addition of further displays, sensors, and interfaces. These Options are described in the following Paragraphs 5.2 - SENSORS.

Further sensors can be added to improve the accuracy of the data already available and to supply new information.

5.2. SENSORS

5.2.1 Heel Angle Sensor

The addition of heel to the system provides display of Heel Angle and increases the accuracy of the following functions:

Apparent Wind Angle
Apparent Wind Speed
True Wind Angle
True Wind Speed
True Wind Direction
Course
Dead Reckoning
Tidal Set and Drift

5.2.2 Mast Rotation Sensor

This is essential if your mast rotates, otherwise the wind data will become inaccurate as the mast rotates away from the centreline. The addition of this unit gives two new functions, the Wind Angle to the Mast (W/A MAST) and Mast Angle (MAST ANG).

5.2.3 Trim Angle Sensor

Provides display of Trim Angle and increases the accuracy of the following functions:

Apparent Wind Angle
Apparent Wind Speed
True Wind Angle
True Wind Speed
True Wind Direction

5.2.4 Barometric Pressure Sensor

Measures the atmospheric pressure, allowing the Main Processor to record atmospheric pressure changes over varying periods of time.

5.2.5 Rudder Angle Sensor

The addition of a Rudder Angle can be very useful, indicating how the boat is balanced.

5.2.6 Sea Temperature Sensor

Measures the sea water temperature.

5.2.7 Air Temperature Sensor

Measures the air temperature.

5.2.8 Load Cells

Up to 12 B&G loadcells can be added to the Hercules 2000 system via the FastNet databus (refer to the B&G Loadcell Installation/Calibration Manual). If desired, loadcells may be connected as non-networked devices and wired directly to the linear inputs of the Hercules Main Processor. These loadcells should provide a linear output voltage in the range of 0 to 6.5 volts.

5.2.9 Sensor Input Configuration

Additional sensors can be added to the system connecting to one of the four linear inputs on the main processor. Linear channels 5 to 16 are available with the addition of an Expansion Processor. These can be configured to take different sensors. If you connect the sensor to the linear input that B&G have anticipated then you need take no action beyond the connection itself, since the default linear input configuration will be the right one. The default settings for the four inputs are as follows:

Linear 1 = Heel Angle
Linear 2 = Trim Angle
Linear 3 = Barometric Pressure
Linear 4 = 0 to 1000 format

Should you wish to connect one of the other sensors, then you will have to reconfigure the input linear channel that you are connecting it to. This is done by following the menu path:

MISC ® LINEAR X, **CALBRATE ® CAL VAL1**

The number you enter to CAL VAL1 should correspond to the sensor you are connecting as follows:

1 = Normal Linear output 0-1000
2 = 152 Wind Speed (together with normal linear output 0- 1000)
3 = Rotating Mast Correction (output Mast Angle and Wind Angle to Mast)
4 = Heel Angle
5 = Trim Angle
6 = Barometric Pressure and Pressure Trend
7 = Rudder Angle

Note
Do not select the same number on more than one linear input, otherwise the selection will be ignored (no function can be connected to more than one input except the Normal Linear input which is not limited).

5.2.10 Tank Sensors

Up to 12 tanks can be monitored on the B&G system, using non-mechanical penetration assemblies. Fuel, potable and grey water tanks can be monitored for level or volume. Any individual tank shape can be accommodated for by utilising a PC software package to calibrate the Tank Sensor system to output real volumes, not fluid levels.

5.3 DISPLAYS

Further displays can be added to the system. These include additional FFDs, the 20/20 or 40/40 Display (see Paragraph 5.4 and 5.5), the Halcyon Display, and all the different types of analogue indicators.

5.3.1 Halcyon Display

The Halcyon display is a digital display dedicated to compass heading. It incorporates a graphic analogue indicator which shows clearly whether you are higher or lower than the set heading. This can be used in two ways:

(a) As an off course indicator which many people find easier to steer to than either a conventional card compass or numerical display.

(b) As a tactical race compass - showing whether you are headed or lifted.

You can fit as many of these displays as you require.

Two analogue indicators are available specifically for these functions (Off Course and Trend), see below.

5.3.2 Analogue Indicators

Up to four analogue indicators can be added to the basic system. If more are required then an Expansion Unit can be used allowing another four analogue indicators onto the system. The four indicators can be selected from the following list:

Boatspeed	Depth
Windspeed	Apparent Wind Angle
Magnified Wind Angle	Compass Heading
Cross Track Error	Trend*
Rudder	Heel
Off Course*	True Wind Angle

Note
Items marked with * are only available with the Halcyon Display.

5.3.3 Analogue Indicator Configuration

If meters other than the defaults are chosen then it is necessary to reconfigure the meter drive outputs from the Computer Unit. This is done from any FFD as follows:

(1) Power up the system with the **Enter** Key pressed, DIAGNOST appears.

(2) Press **Scroll Up**, CNFG SYS appears, press **Enter** to select this option, now press **Enter** again to select the METERS option.

(3) With OPTIONS flashing, press **Enter**, METER 1 appears, the **Scroll Up** Key is now used to scroll through the meter drives (Refer to the installation sheet to determine the meter options and their respective meter drives).

(4) With the appropriate meter drive flashing in the top display, press **Enter** to reveal the current option assigned to that meter. Pressing **Scroll Up** at this stage, and then **Enter** again, will reveal the METER 2 option. Repeating this process will reveal the METER 3 and METER 4 options as required.

(5) With the meter number and option on display, press **Enter**, the lower text will flash. Use **Scroll Down** to scroll through the options until the appropriate one (e.g. DEPTH) is shown. Pressing **Enter** will select that option, and the meter drive will be configured to drive a DEPTH meter.

(6) Press **Page** to return to normal operation.

Note
It is possible to configure more than one meter drive to the same meter option (e.g. BOAT SPD on METER 1 and METER 2).

5.3.4 Meter Scaling

Meter scaling can also be varied for boat speed and wind speed. For example, if a 25 knot full scale Boatspeed Meter is required, this can be done as follows:

(1) Follow steps (1) and (2) as detailed in Para 5.3.3.

(2) With OPTIONS flashing, press **Scroll Up** to reveal SCALING, press **Enter**, BOAT SPD will appear. A further press of **Enter** will reveal the current maximum meter scale value for the Boatspeed Meter.

(3) To change this (e.g. to 25 knots) press **Enter** and then **Scroll Up** to increase the number to 25.0. A final press of **Enter** will then enter the new maximum scale. The Boatspeed Meter will read between 0 and 25 knots.

(4) Press **Page** to return to normal operation.

5.4 20/20 DISPLAY

5.4.1 The Display

The 20/20 is a fully programmable, single function, large digit, display which may be installed anywhere in the yacht.

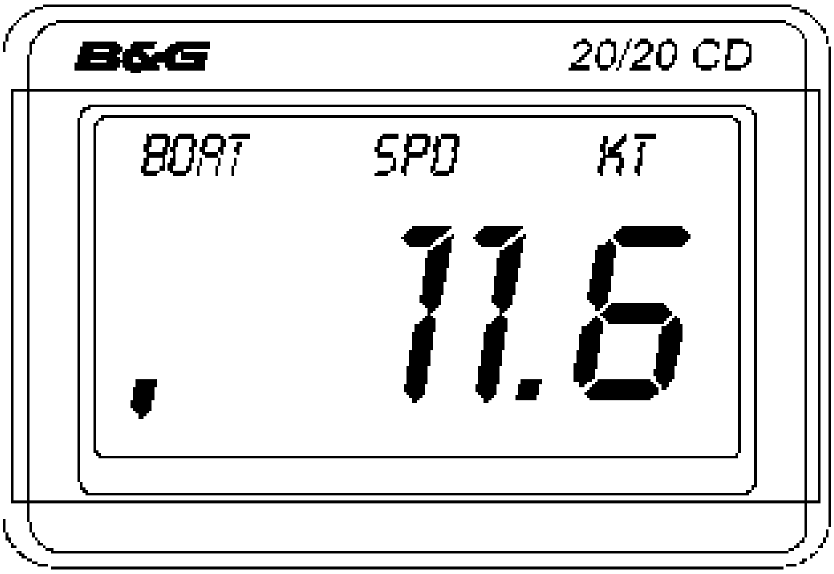


Fig 5.1 - 20/20 Display

5.4.2 Display Configuration

The 20/20 may be configured to display any function available on your Hercules 2000 System**.** It is however provided with 14 pre-set functions which may be selected by use of a Remote Button connected to the display or via any FFD on the system.

The pre-set functions are as follows:

Boatspeed	Depth m
Depth ft	Apparent Wind Speed
Apparent wind Angle	True Wind Speed
True Wind Angle	Velocity Made Good
Compass heading	Timer Count Up/Down
Bearing to Waypoint*	Course Over Ground*
Speed Over Ground*	True Wind Direction

Note
Functions marked with an * are NMEA Functions and are available only when a suitable Position Fixer is interfaced with the system.

5.4.3 Function Selection - Remote Pushbutton

If a Remote Button is connected to a 20/20 Display any one of the 14 pre-set functions may be selected by pressing and holding down the associated Button. The Display will then cycle through the functions. When the required function is displayed, release the Button.

If the Button is held down too long and the required function is missed, press and hold down the Button again. The Display will then cycle though the functions in reverse order. When the required function is displayed, release the Button.

5.4.4 Function Selection - FFD

An alternative to using a dedicated Remote Pushbutton, is to control the 20/20 using any one of the standard FFDs on the system. Any 20/20 can be controlled from any FFD.

To change the function displayed on a 20/20 using a standard FFD, proceed as follows:

(1) At the FFD, press and hold down the **Page** Key for approximately 3 seconds. The FFD display will change to show the function displayed on the 20/20 together with the display number. The selected 20/20 display will start to flash.

(2) Using the **Scroll Down** Key cycle through the 20/20 numbers and select the required Display Number, the selected 20/20 will flash.

(3) Using the **Scroll Up** Key cycle through the 14 pre-set functions until the required function is displayed on the FFD. Release the **Scroll Up** Key.

(4) If the function is missed, press and hold down the **Scroll Up** Key and the functions will cycle through in reverse order. Release the **Scroll Up** Key when the required function is displayed.

(5) Press the **Page** Key. The FFD will now return to normal operation and the 20/20 will display the selected function.

5.4.5 Re-configuring 20/20 Display

In addition to the 14 pre-set functions, any one of the 20/20 Displays may be re-configured to show any other function available to the system. This feature allows any 20/20 to be set-up to show the information most useful to the user at that station in the yacht.

The procedure for re-configuring a 20/20 function is as follows:

(1) At the FFD, press and hold down the **Page** Key for at least 3 seconds. The FFD will change to show the function displayed on the 20/20 together with the display number.

(2) Using the **Scroll Down** Key, cycle through the 20/20 numbers and select the one required.

(3) Using the **Scroll Up** Key select the function you wish to change.

(4) Press the **Enter** Key and the function currently being displayed on the 20/20 will commence to flash.

(5) Press and hold down the **Scroll Up** Key and cycle through the normal FFD Menu until the required function choice is displayed (e.g. NAVIGATE).

(6) Press and hold down the **Scroll Down** Key until the required operational choice is displayed (e.g. COURSE).

(7) Press the **Enter** Key to accept the selection.

(8) Press the **Page** Key and the FFD will return to normal operation and the 20/20 displays the newly configured page.

5.5 40/40 DISPLAY

5.5.1 The Display

The 40/40 is a fully programmable, single function, large digit, display which may be installed anywhere in the yacht.

Fig 5.2 - 40/40 Display

5.5.2 Display Configuration

The 40/40 may be configured to repeat any function (except latitude/longitude) available on your Hercules 2000 System**.** It is however provided with 14 pre-set functions that may be selected by use of a remote push-button connected to the display or via any FFD on the system.

The pre-set functions are as follows:

Boat Speed	Depth m
Depth ft	Apparent Wind Speed
Apparent wind Angle	True Wind Speed
True Wind Angle	Velocity Made Good
Compass heading	Timer Count Up/Down
Bearing to Waypoint*	Course Over Ground*
Speed Over Ground*	True Wind Direction

Note
Functions marked with an * are NMEA Functions and are available only when a suitable Position Fixer is interfaced with the system.

5.5.3 Function Selection - Remote Push-Button

If a remote push-button is connected to a 40/40 display any one of the 14 pre-set functions may be selected by pressing and holding down the associated button. The display will then cycle through the functions. When the required function is displayed, release the button.

If the button is held down too long and the required function is missed, press and hold down the button again. The display will then cycle through the functions in reverse order. When the required function is displayed, release the button.

5.5.4 Function Selection - FFD

An alternative to using a dedicated remote push-button, is to control the 40/40 using any one of the standard FFDs on the system. Any 40/40 can be controlled from any FFD.

To change the function shown on a 40/40 using an FFD, proceed as follows:

(1) At the FFD, press and hold down the **Page** Key for at least 3 seconds. The FFD display will change to show the function displayed on the 40/40 together with the display number. The selected display will start to flash.

(2) Using the **Scroll Down** Key cycle through the 40/40 numbers and select the required display number.

(3) Using the **Scroll Up** Key cycle through the 14 pre-set functions until the required function is displayed on the FFD. Release the **Scroll Up** Key.

(4) If the function is missed, press and hold down the **Scroll Up** Key and the functions will cycle through in reverse order. Release the **Scroll Up** Key when the required function is displayed.

(5) Press the **Page** Key. The FFD will now return to normal operation and the 40/40 will display the selected function.

5.5.5 Re-configuring the 40/40 Display

In addition to the 14 pre-set functions, any 40/40 pre-set function may be re-configured to show any other function available to the system. This feature allows any 40/40 to be set-up to show the information most useful to the user at that station in the yacht.

The procedure for re-configuring a 40/40 function is as follows:

(1) At the FFD, press and hold down the **Page** Key for at least 3 seconds. The FFD will change to show the function displayed on the 40/40 together with the display number.

(2) Using the **Scroll Down** Key, cycle through each 40/40 display in turn (display flashes) and stop at your desired choice.

(3) Using the **Scroll Up** Key select the function you wish to change.

(4) Press the **Enter** Key and the function currently being displayed on the 40/40 will start to flash.

(5) Press and hold the **Scroll Up** Key and cycle through the normal FFD Menu until the required function choice is displayed (e.g. NAVIGATE).

(6) Press and hold the **Scroll Down** Key until the required operational choice is displayed (e.g. COURSE).

(7) Press the **Enter** Key to accept the selection.

(8) Press the **Page** Key and the FFD will resume normal operation and the 40/40 displays the newly configured page.

5.6 GRAVITY SWITCH

In installations where two speed sensors or depth transducers are fitted a gravity change over switch can be fitted to automatically select the leeward sensor. A switch on the outside of the unit over rides the automatic selection if required, for example when calibrating the individual speed sensors.

5.7 AUDIBLE ALARM

The main processor contains a relay switch for an external audible alarm.

Note
The current drive capacity of any alarm connected to the system must not exceed 0.5 Amps.

5.8 NMEA INTERFACE

A NMEA Full Function Display (FFD) can be used to interface NMEA 0183 data to a Hercules system. The Performance Processor can also be used as an interface for NMEA 0183 data to the Hercules System.

The Performance Processor has two NMEA inputs and outputs, (one of which is disabled if the RS232C interface is required).

In the case of multiple NMEA inputs and outputs it should not be assumed that data input to one device will be available for output from any other device,. E.g. Inputting Latitude and Longitude to the NMEA FFD will not ensure it is output from the performance unit.

If the Performance Processor is installed on the system it should be used as the primary NMEA input.

5.8.1 Displaying NMEA Functions

Depending on the device connected to the NMEA interface the following functions may be displayed by the Hercules System:

Bearing to waypoint, true, rhumb.	(BTW RMB T)
Bearing to waypoint, magnetic, rhumb.	(BTW RMB M)
Bearing to waypoint, true, great circle.	(BTW GC T)
Bearing to waypoint, mag., great circle.	(BTW GC M)
Bearing from waypoint to waypoint, true.	(BRG W/W T)
Bearing from waypoint to waypoint, mag.	(BRG W/W M)
Distance to waypoint, rhumb line, Nm.	(DTW RMB NM)
Distance to waypoint, great circle, Nm.	(DTW GC NM)
Distance to layline, Nm.	(LAYLINE NM)
Course over ground, true.	(CRSE O/G T)
Course over ground, magnetic.	(CRSE O/G M)
Speed over ground in knots.	(SPD O/G KT)
Velocity made good to waypoint in knots.	(VMG WPT KT)
Time to waypoint.	(TTG WPT MS)
Time to Layline	(TTG L/L MS)
Cross track error Nautical miles.	(CROSS TR NM)
Local time.	(LOC TIME MS)
Universal Coordinated Time	(UTC TIME MS)

In addition there are also a number of functions that can be input through the NMEA interface that duplicate other Hercules 2000 functions. Details of all the input functions are given in Table 5.7.

The NMEA functions may be called up to display in the same manner as any Hercules 2000 function, see Part 2 - Operating Information. Most of the NMEA functions are to be found in the WAYPOINT Menu, but the time functions (LOC TIME and UTC TIME) are in the TIME Menu. Only those functions that are received by the Hercules 2000 System will appear in the display menu and it may be necessary to wait a while after the NMEA device has been switched on before the menu is complete. If no data is received for a selected function after 15 seconds then the display will show OFF.

5.8.2 Selection of Equipment

When planning the purchasing of equipment to interface to the Hercules 2000 System it is most important to check that it is NMEA 0183 compatible and the required data is transmitted or received by it.

The 0183 standard defines data sentences which are identified by three letter mnemonics. Tables 5.2 and 5.3 list the sentences and their mnemonics that are input and output by the Hercules 2000 NMEA interface. Para 5.8.10 gives the detailed information on the data and format of the sentences.

Note
If you have any doubt about your equipment compatibility then please consult your dealer.

Table 5.1 - NMEA FFD - Input Sentence Summary

Mnemonic	Description
APB	Autopilot format B
BOD	Bearing to destination Waypoint from origin Waypoint.
BWC	Bearing and Distance to Waypoint, Great Circle, measured.
BWR	Bearing and Distance to Waypoint, Rhumb, measured.
BWW	Bearing to Waypoint from Waypoint.
DBT	Depth below transducer.
GGA	Global Positioning System Fix data
GLL	Latitude and Longitude.
HDG	Heading, Deviation and Variation
HDM	Present Heading, Magnetic
HDT	Heading, True
HSC	Heading Steering Command
HVD	Magnetic Variation – Derived
HVM	Magnetic Variation Manually Set
MTA	Air Temperature, Celsius
MTW	Water Temperature, Celsius
MWD	Surface Wind Direction and Velocity
MWV	Wind Speed and Angle
RMB	Recommended minimum implementation sentence, Generic navigation information.
RMC	Recommended minimum implementation sentence, GPS, Transit specific.
VHW	Heading and Water Speed
VLW	Log mileage, water referenced
VMG	Velocity Made Good
VPW	Velocity Parallel to True Wind, Device Measured
VTG	Actual Track and Ground Speed.
VWR	Wind Relative Bearing and Velocity
VWT	Wind True Bearing and Velocity
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.

Table 5.1 - NMEA FFD - Input Sentence Summary (cont.)

Mnemonic	Description
ZDA	Time and Date
ZDL*	Time and Distance to Layline.
ZLZ	Local Time Zone.
ZTG	Time to Waypoint.

*Non-standard NMEA sentence.

Note
The Hercules 2000 system will not necessarily extract data from every NMEA field. This avoids the same information being repeated twice on the system.

Table 5.2 - NMEA FFD - Output Sentence Summary

Mnemonic	Description
DBT	Depth Below Transducer
GLL	Latitude and Longitude
HDM	Present Heading, Magnetic
HSC	Heading Steering Command
HDT	Heading, True
MTA	Air Temperature, Celsius
MTW	Water Temperature, Celsius
MWD	Surface Wind Direction and Velocity
MWV	Wind Speed and Angle
VHW	Heading and Water Speed
VLW	Log Mileage, Water Referenced
VPW	Velocity Parallel to True Wind, Device Measured
VTG	Actual Track and Ground Speed
VWR	Wind Relative Bearing and Velocity
VWT	Wind True Bearing and Velocity
XTE	Cross Track Error, Measured

Table 5.3 – Performance Processor - 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 Line, Dead Reckoned
BOD	Bearing to destination Waypoint from origin Waypoint.
BWC	Bearing and Distance to Waypoint, Great Circle, measured.
BWR	Bearing and Distance to Waypoint, Rhumb, measured.
BWW	Bearing to Waypoint from Waypoint.
DBT	Depth below transducer.
GGA	Global Positioning System Fix data
GLL	Latitude and Longitude.
GLP	Loran C Present Fix
HDG	Heading, Deviation and Variation
HDM	Present Heading, Magnetic
HDT	Heading, True
HVD	Magnetic Variation – Derived
HVM	Magnetic Variation Manually Set
MTA	Air Temperature, Celsius
MTW	Water Temperature, Celsius
MWD	Surface Wind Direction and Velocity
MWV	Wind Speed and Angle
RMA	Recommended minimum implementation sentence, Loran-C specific.
RMB	Recommended minimum implementation sentence, Generic navigation information.
RMC	Recommended minimum implementation sentence, GPS, Transit specific.
VHW	Heading and Water Speed
VLW	Log mileage, water referenced
VPW	Velocity Parallel to True Wind, Device Measured
VTG	Actual Track and Ground Speed.
VWR	Wind Relative Bearing and Velocity
VWT	Wind True Bearing and Velocity
WBD*	Bearing and Distance to Waypoint
WCV	Waypoint Closure Velocity.
WDC	Next Waypoint Distance, Great Circle.

Table 5.3 – Performance Processor - Input Sentence Summary (cont.)

Mnemonic	Description
WDR	Next Waypoint Distance, Rhumb.
XTE	Cross Track Error, Measured.
XTR	Cross Track Error, Dead Reckoned.
ZDA	Time and Date
ZDL*	Time and Distance to Layline.
ZLZ	Local Time Zone.
ZTG	Time to Waypoint.

*Non-standard NMEA sentence.

Table 5.4 – Performance Processor – NMEA Output Sentence Summary

Mnemonic	Description
DBT	Depth Below Transducer
GLL	Latitude and Longitude
HDM	Present Heading, Magnetic
HDT	Heading, True
MTA	Air Temperature, Celsius
MTW	Water Temperature, Celsius
MWD	Surface Wind Direction and Velocity
MWV	Wind Speed and Angle
VHW	Heading and Water Speed
VLW	Log Mileage, Water Referenced
VPW	Velocity Parallel to True Wind, Device Measured
VTG	Actual Track and Ground Speed
VWR	Wind Relative Bearing and Velocity
VWT	Wind True Bearing and Velocity
XTE	Cross Track Error, Measured

Table 5.5 – Halcyon Gyro Processor – NMEA Input Sentence Summary

Mnemonic	Description
GGA	Latitude, Longitude
GLL	Latitude, Longitude
HDG	Heading Magnetic with variation
HDM	Heading Magnetic
HDT	Heading True
HVD	Magnetic Variation
HVM	Magnetic Variation
RMC	Latitude, Longitude, Date & Magnetic Variation

Table 5.5 – Halcyon Gyro Processor – NMEA Input Sentence Summary (cont.)

Mnemonic	Description
VHW	Heading True & Magnetic
ZDA	Date
DBT	Depth Below Transducer
GLL	Latitude and Longitude
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
VTG	Time to Waypoint
VWR	Wind Relative Bearing and Velocity
VWT	Wind True Bearing and Velocity
XTE	Measured Cross Track Error

Table 5.6 – Halcyon Gyro Processor – NMEA Output Sentence Summary

Mnemonic	Description
HDG	Heading Magnetic with variation
HDM	Heading, Magnetic
HDT	Heading, True

Note
Sentences are only output if data is available.

5.8.3 Performance Processor NMEA Input and Output Configuration

The Performance Processor has two NMEA inputs and two NMEA outputs. However if the RS232 interface is required then only one NMEA input and output can be used. The inputs are optically isolated, as required by the standard, so there is no direct electrical connection between the talker device and the Hercules System. The input requirement is half the minimum drive capacity of a standard NMEA output.

The two outputs are identical and are capable of driving at least two NMEA inputs each (four in total). If data is available then NMEA information is output once a second.

5.8.4 Changing NMEA/RS232 Configuration

Changing the NMEA/RS232 configuration is carried out by adjusting the calibration on Cross Track Error as follows:

(1) Select Cross Track Error on the display. If a page has not already been set up to display cross track error, then it can be found by cycling through the options in the WAYPOINT Menu.

(2) Using the **Scroll Up** and **Scroll Down** Keys scroll to "CALBRATE" on the other half of the display. Press **Enter** twice to show the current configuration number (NMEA MDE).

(3) Press **Enter**, the configuration number flashes.

(4) Use the **Scroll Up** and **Scroll Down** Keys to change the number as follows:

Mode	Input 1	Output 1	Input 2	Output 2
0	183	183	RS232	RS232
1	183	183	-	183
4	-	183	183	183

The default setting is 0 for RS232 capability.

(5) Press **Enter** to accept the new configuration

5.8.5 Fast HDM Output Option

The two NMEA ports may be configured independently to output HDM sentences ten times a second for the benefit of other NMEA instruments that may require a rapid heading update. To set this up, proceed as follows:

(1) Select the MISC Menu and cycle through the options to find NMEAPORT 1 or NMEAPORT 2 as appropriate.

(2) Using the **Scroll Up** and **Scroll Down** keys scroll to CALBRATE on the other half of the display. Press **Enter** twice to show the current HDM output rate (HDM RATE HZ).

(3) Press **Enter**, the output rate flashes.

(4) Use the **Scroll Up** and **Scroll Down** keys to adjust the output rate: the only rates that are valid are 1 (for output once a second) and 10 (for output ten times a second).

(5) Press **Enter** to accept the new output rate.

When fast HDM output has been selected on a given NMEA port HDM will be the only sentence output on that port.

5.8.6 True/Magnetic Reference Selection

When an NMEA heading source is used to drive the B&G network the heading data may be referenced to either true North or magnetic North. In some cases the heading source will output both types of data, and it is necessary for the user to select the desired reference. To do this, proceed as follows:

(1) On the NAVIGATE Menu, select HEADING.

(2) Using the **Scroll Up** and **Scroll Down** keys scroll to CALBRATE on the other half of the display. Press **Enter** twice to select CAL VAL 1 (TRUE/MAG). The current selection is shown as 0 for magnetic, 1 for true.

(3) Press **Enter**, the TRUE/MAG selection flashes.

(4) Use the **Scroll Up** and **Scroll Down** keys to adjust the 0/1 selection.

(5) Press **Enter** to accept the new reference.

If on pressing **Enter** in step (2) the display shows anything other than TRUE/MAG it means that there is another heading source on the network. To eliminate the other source, go to the COURSE function (also on the NAVIGATE Menu) and select CAL VAL 1 (HDG NODE). Ensure that this is set to the node number of the Performance Unit, and then restart the instrument system. The unwanted heading source will no longer appear in the NAVIGATE menu.

When the heading reference is changed the text for the HEADING function will automatically be set to show °T or °M as appropriate. A similar change will also be made to other functions that are heading dependent, namely COURSE, TWD, REQD CRSE, DR CRSE and TIDE SET.

A similar procedure may be used to select the reference for CTS (Course To Steer), which is derived from the *Heading-to-steer to destination waypoint* field in the APB sentence. As with HEADING, the text for CTS is updated automatically when the reference is changed.

5.8.7 Handling of NMEA Alarm Conditions

Several NMEA sentences contain fields that indicate the validity of the data. For example, GLL, RMA, RMB and RMC contain a *data valid* or *navigation receiver warning* flag, and GGA contains a quality indicator.

When input sentences containing these indicators are decoded by the Performance Unit the status of the indicators is checked. If an invalid status is found then all the data in that sentence is marked as invalid when stored internally.

When output sentences are being constructed the validity of the data for each field is checked, and if any field is found to be invalid the invalid indicator is set in the output sentence.

If no valid data has been received for a period of 15 seconds the corresponding B&G function will display ‘OFF’.

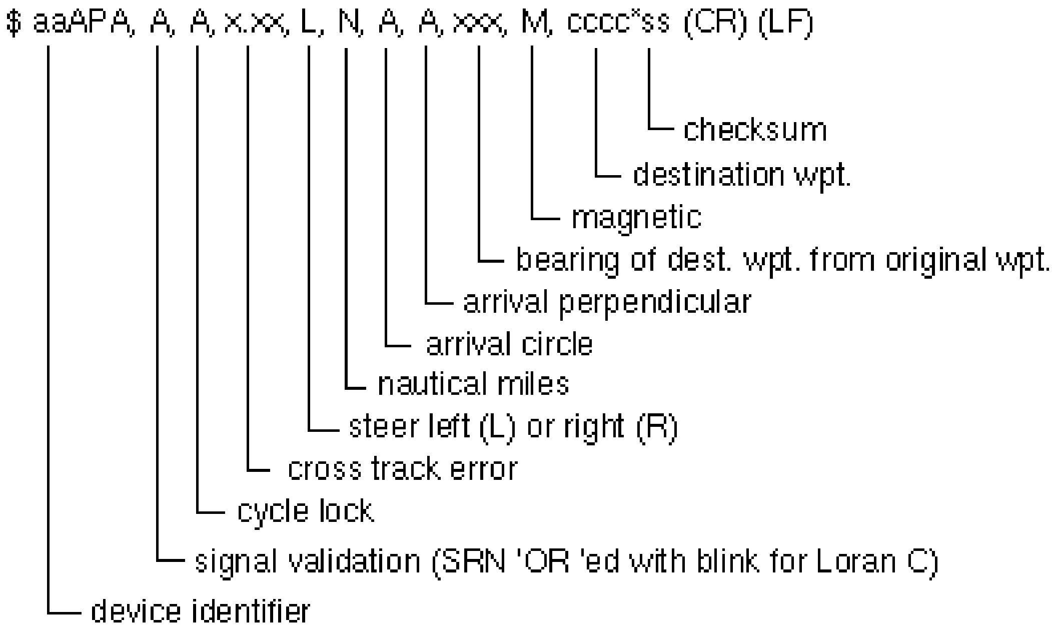
5.8.8 NMEA-based Data on the B&G Network

Data derived from NMEA sources is normally transmitted on the B&G network once a second. However, in the case of heading, if the incoming data is being rapidly updated the network data will be sent at up to four times a second. This allows improved performance to be obtained from the Hydra autopilot, if fitted.

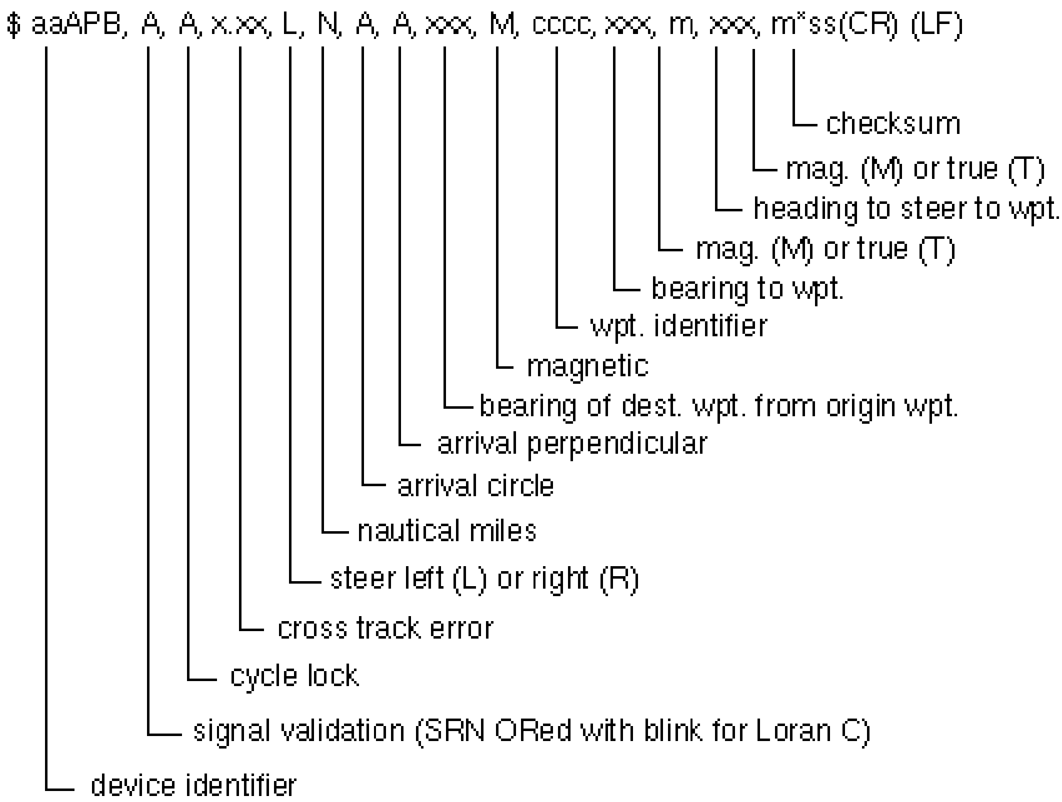
5.8.9 NMEA 0183 Sentences

The following diagrams show the structure of the various NMEA sentences.

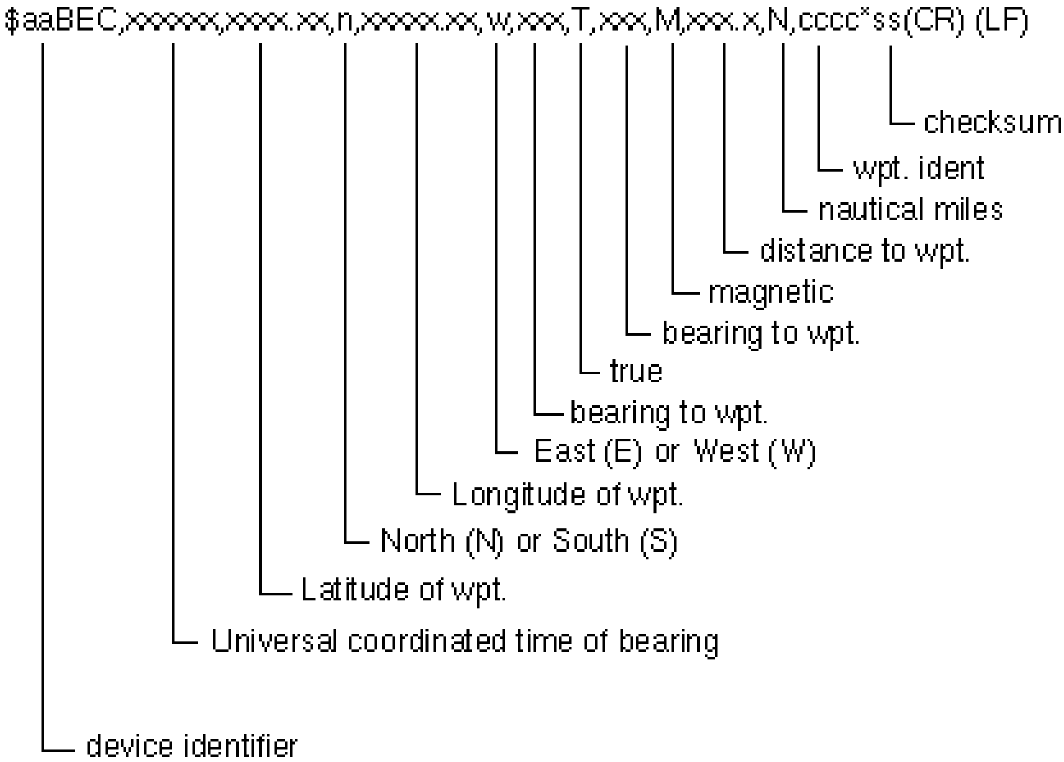
1 Autopilot format A (APA)



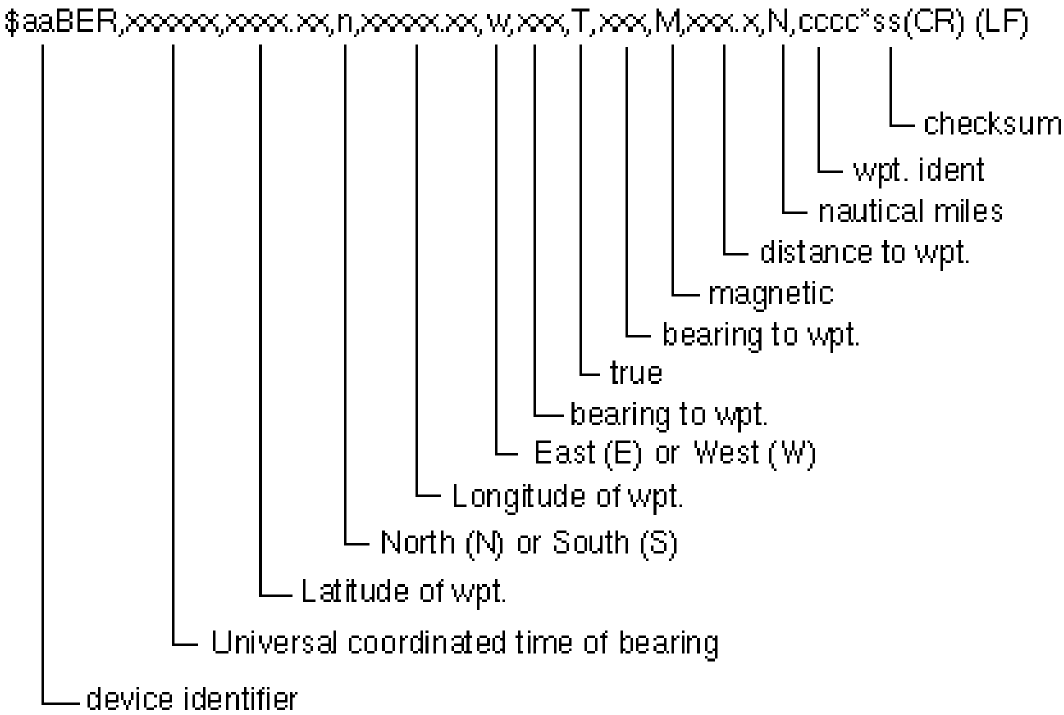
2 Autopilot format B (APB)



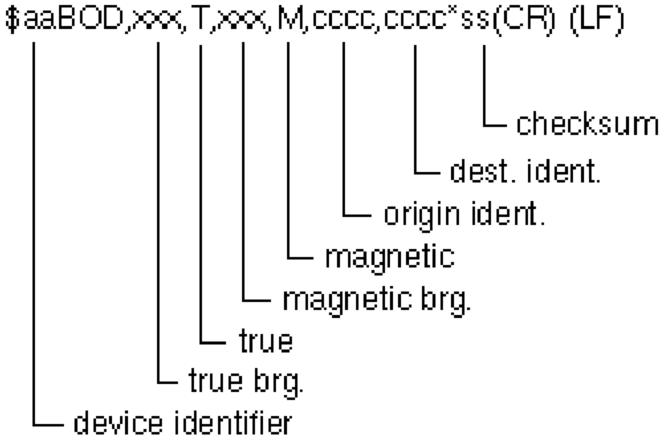
3 Bearing and distance to waypoint, great circle, dead reckoned (BEC)



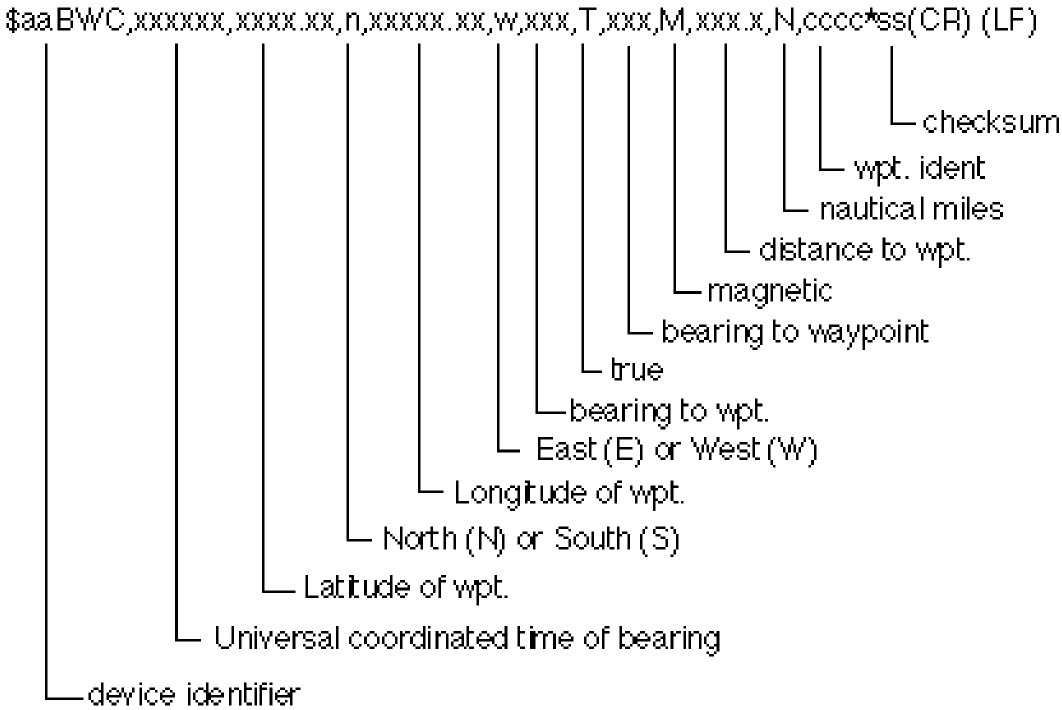
4 Bearing and distance to waypoint, rhumb, dead reckoned (BER)



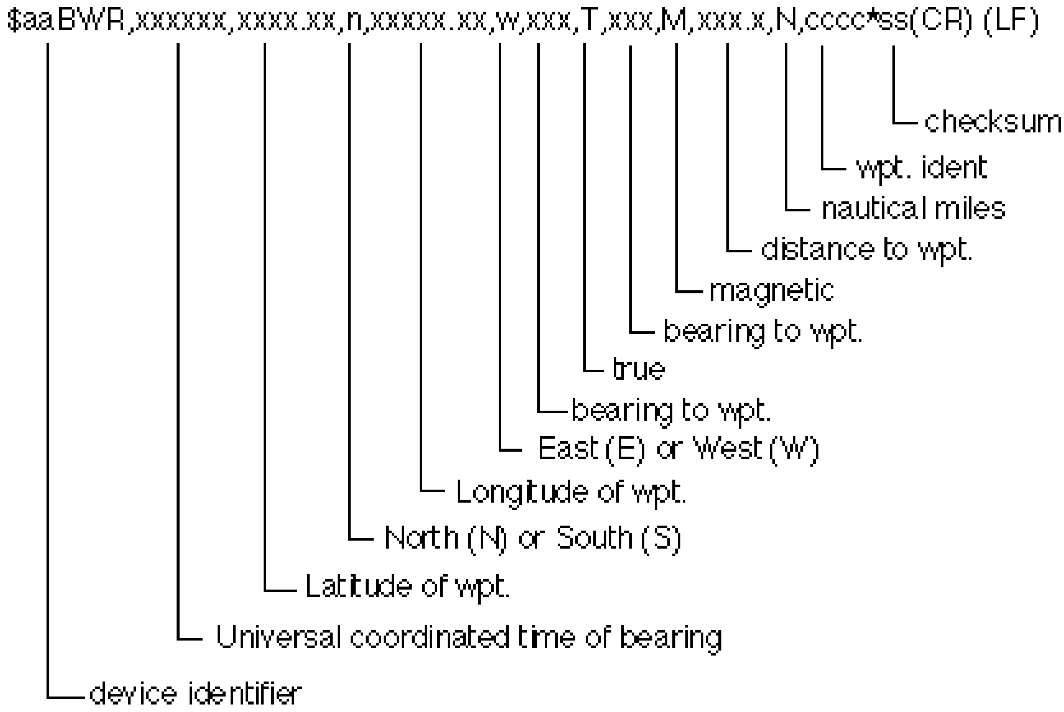
5 Bearing to destination waypoint from origin waypoint, true or magnetic (BOD)



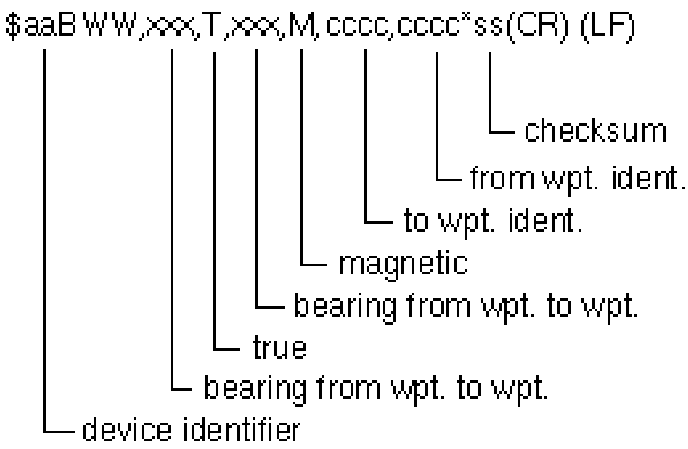
6 Bearing and distance to waypoint, great circle, measured (BWC)



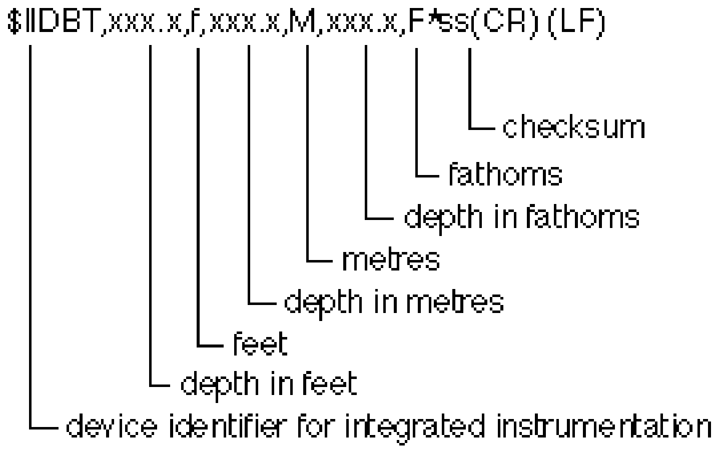
7 Bearing and distance to waypoint, rhumb line, measured (BWR)



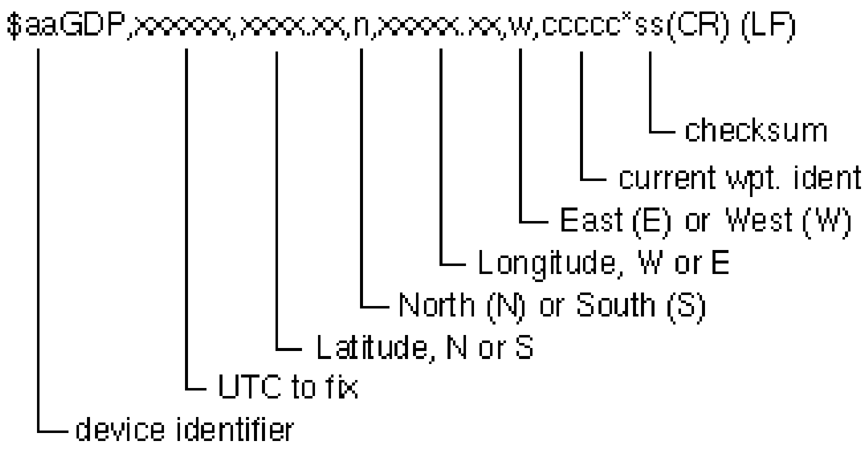
8 Bearing to waypoint from waypoint, true and magnetic (BWW)



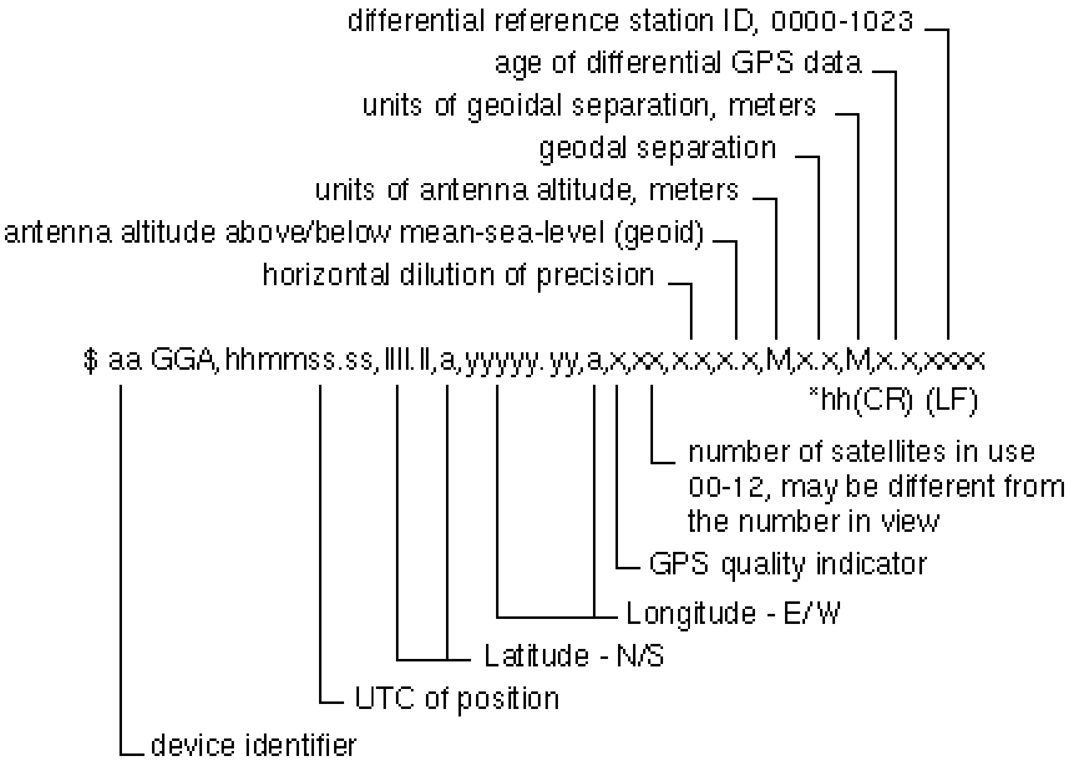
9 Depth of water below transducer (DBT)



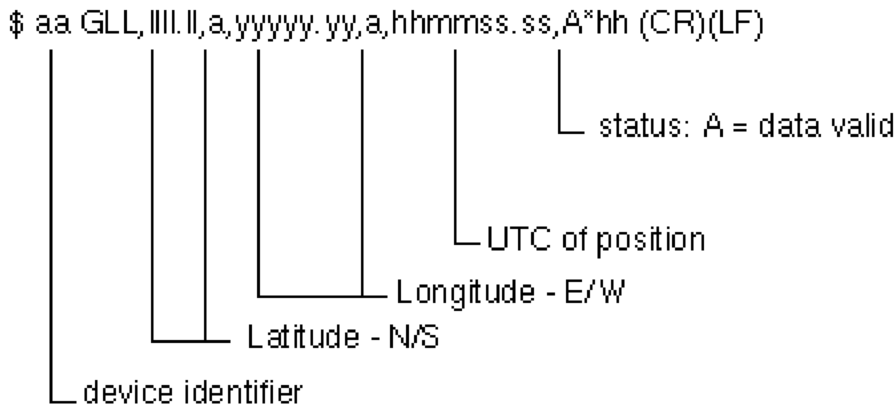
10 Present position fix, dead reckoned (GDP)



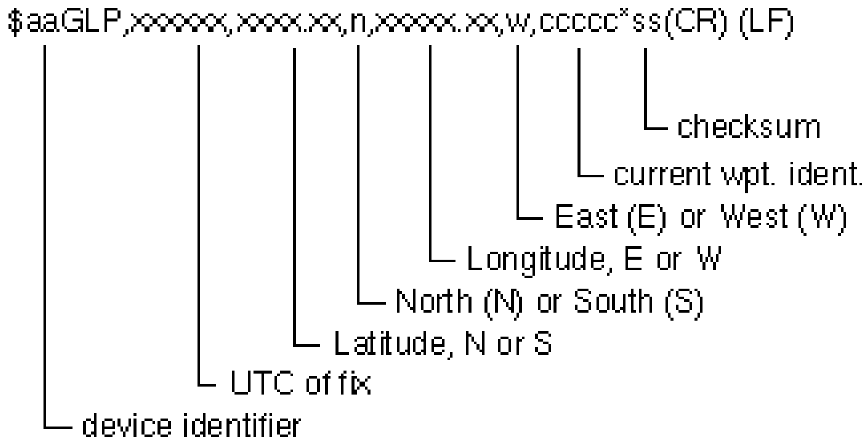
11 Global positioning fix data (GGA)



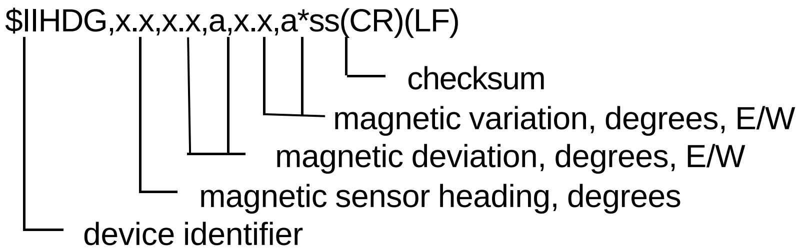
12 Present fix position (GLL)



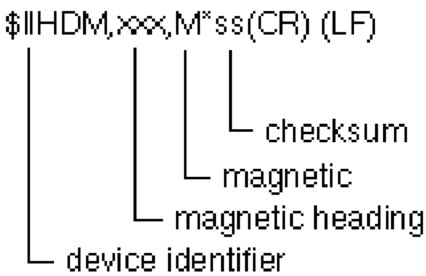
13 Present position fix, Loran -C (GLP)



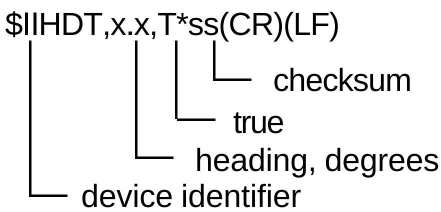
14 Heading, deviation and variation (HDG)



15 Present heading magnetic (HDM)



16 Heading, true (HDT)



17 Air temperature, Celsius (MTA)

```
$IIMTA,xxx,C*ss(CR) (LF)
 |        |   |  |
 |        |   |  └ checksum
 |        |   └ Celsius
 |        └ air temperature in degrees Celsius
 └ device identifier
```

18 Water temperature (MTW)

```
$IIMTW,xxx,C*ss(CR) (LF)
 |        |   |  |
 |        |   |  └ checksum
 |        |   └ Celsius
 |        └ water temperature in degrees Celsius
 └ device identifier
```

19 Surface wind, direction and velocity (MWD)

```
$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 identifier
```

20 Wind, Speed and Angle (MWV)

$IIMWV,xx.x,xxx,xx.x,xxx,A,*hh(CR)(LF)

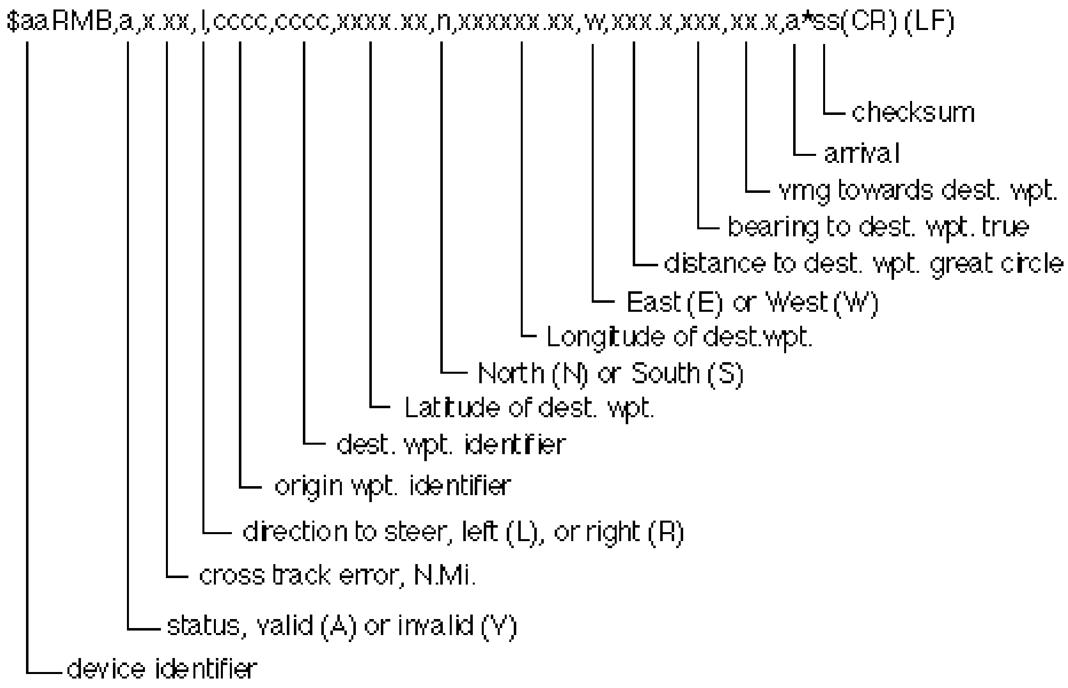
- status, A = valid, V = invalid
- wind speed units, K/M/N/S
- wind speed
- reference, R = Relative, T = Theoretical
- wind angle, 0 to 359 degrees

21 Recommended minimum implementation sentence, Loran -C (RMA)

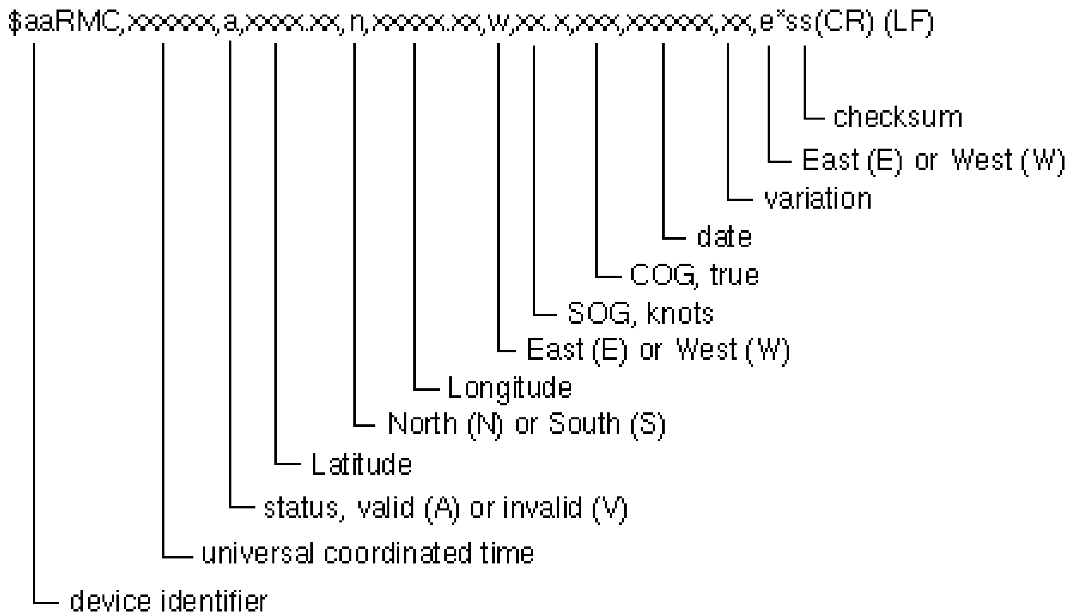
$aaRMA,a,xxxx.xx,n,xxxxx.xx,w,xxxxx.x,xxxxx.x,xx.x,xxx,xx,e*ss(CR) (LF)

- checksum
- East or West
- variation
- COG, true
- SOG, knots
- time differences for pair used in position calculation
- East (E) or West (W)
- Longitude
- North (N) or South (S)
- Latitude
- status, valid (A) or invalid (V)
- device identifier

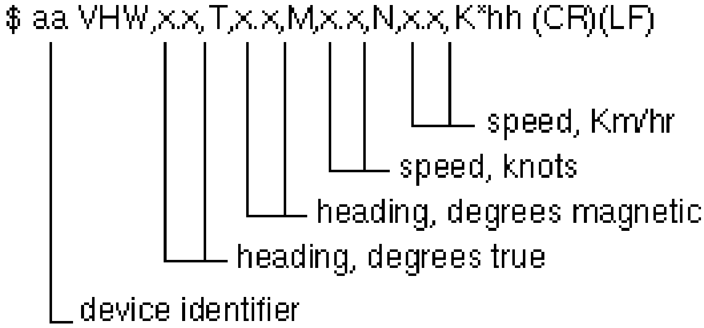
22 Recommended minimum implementation sentence, navigation information (RMB)



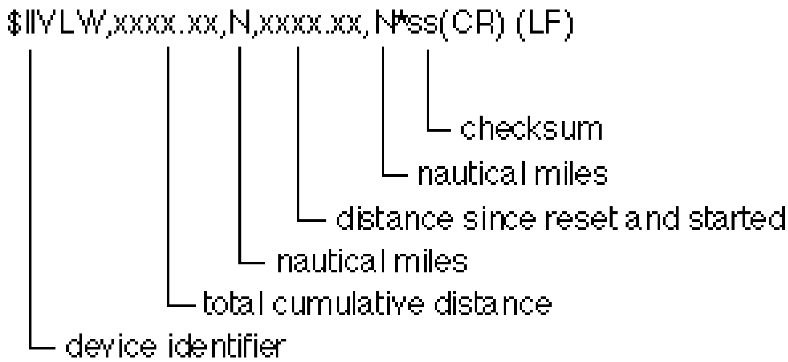
23 Recommended minimum implementation sentence, GPS or transit specific (GPS) (RMC)



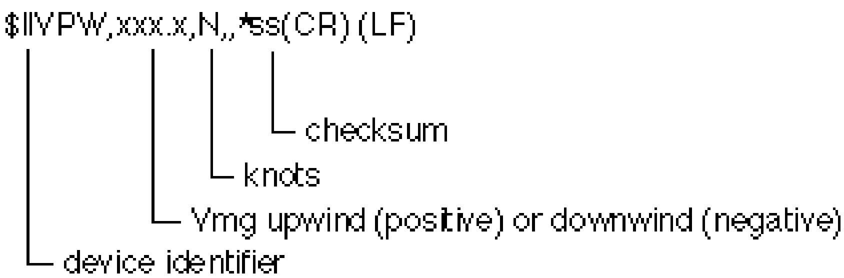
24 Water speed and heading (VHW)



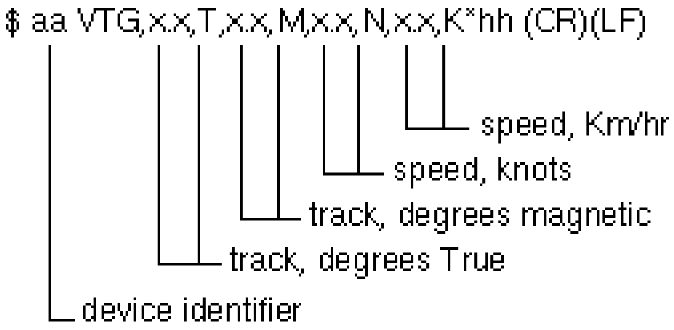
25 Water referenced log mileage (VLW)



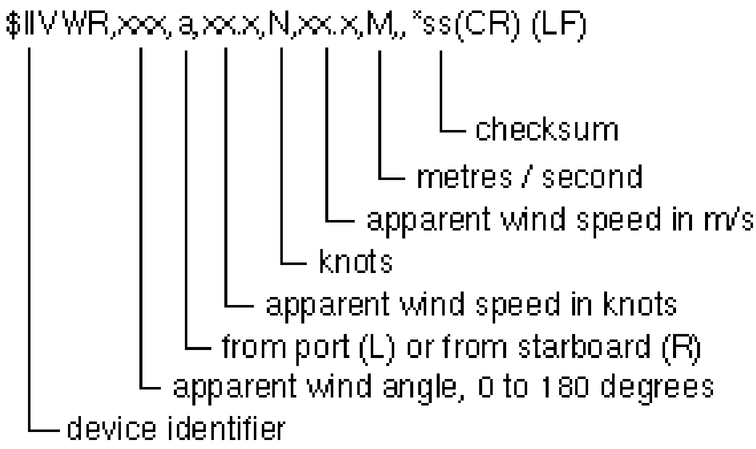
26 Device measured velocity parallel true wind (VPW)



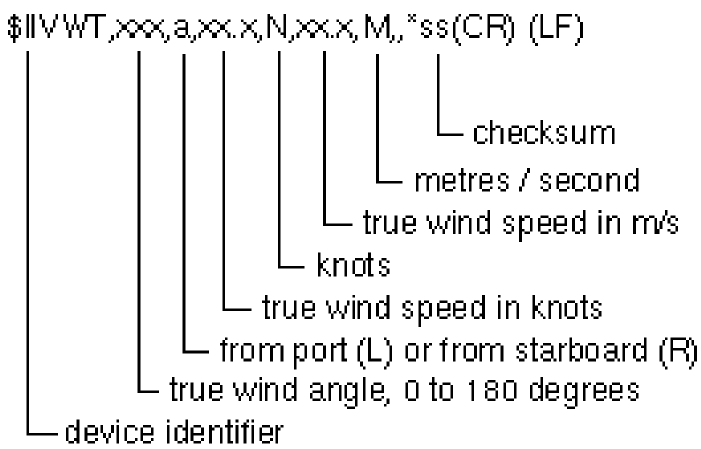
27 Actual track and ground speed (VTG)



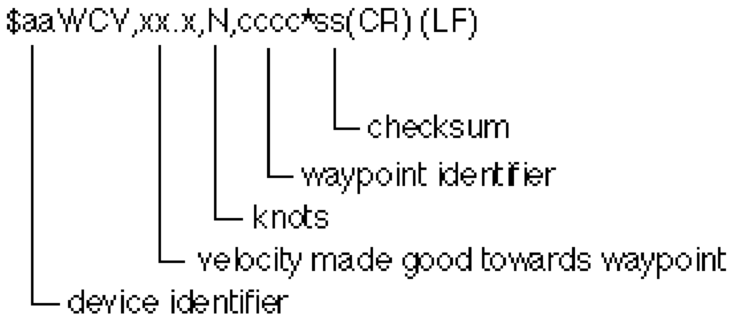
28 Wind relative bearing and velocity (VWR)



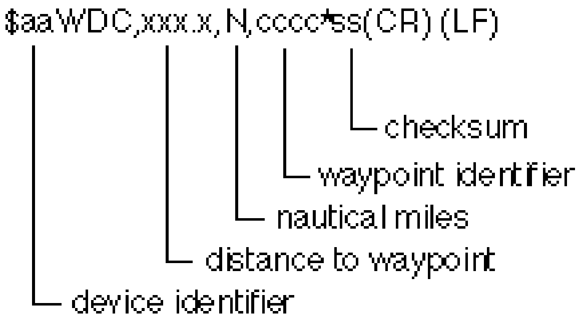
29 True wind relative bearing and velocity (VWT)



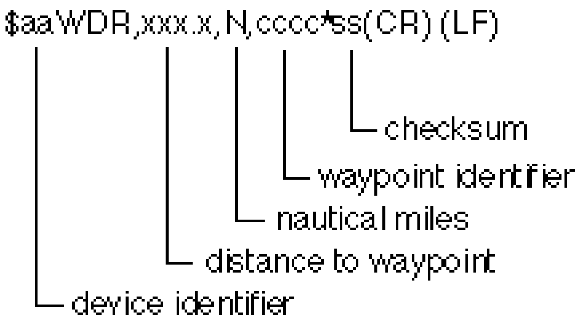
30 Waypoint closure velocity (WCV)



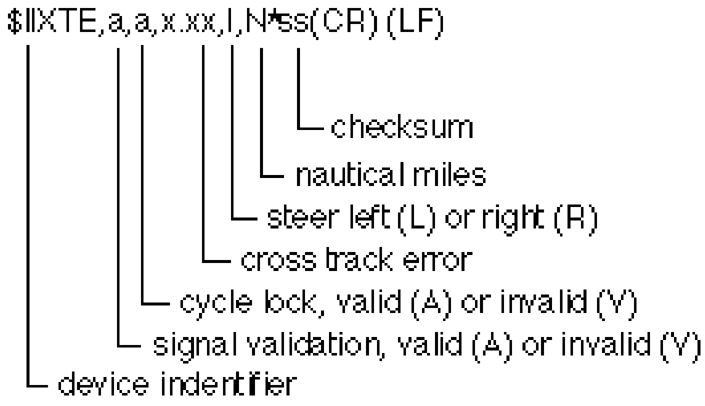
31 Distance to waypoint, great circle (WDC)



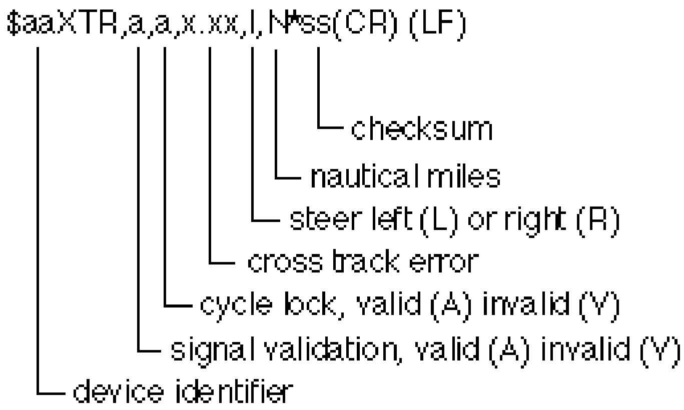
32 Distance to waypoint, Rhumb Line (WDR)



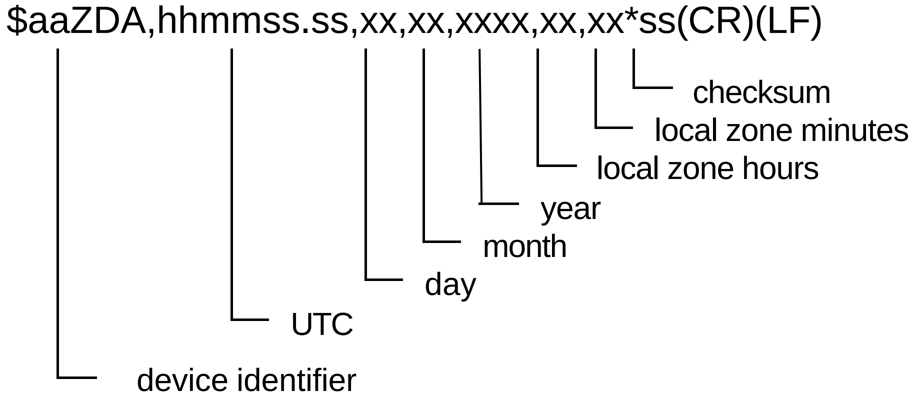
33 Measured cross track error (XTE)



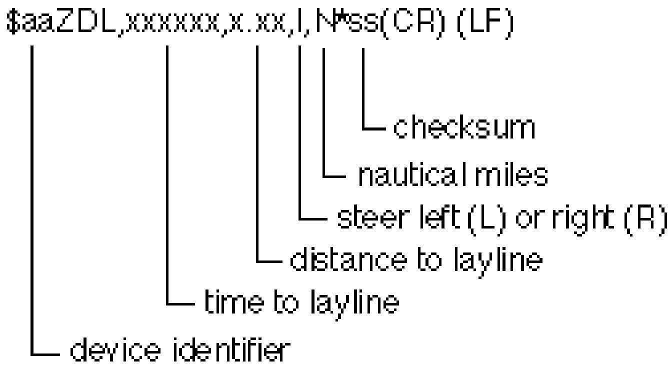
34 Dead reckoned cross track error (XTR)



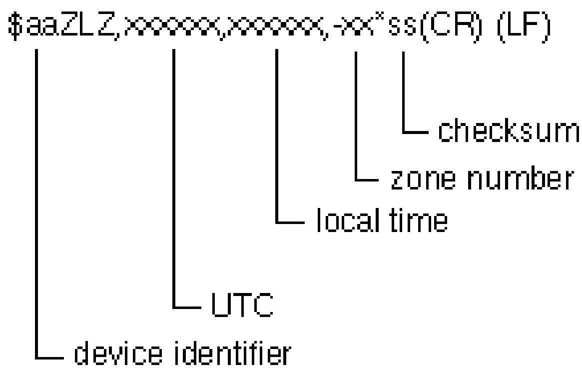
35 Time and date (ZDA)



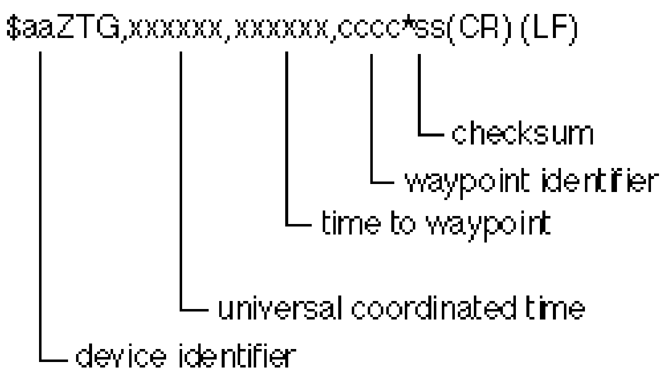
36 Time and distance to layline (ZDL)



37 Time of day (ZLZ)



38 Time to waypoint (ZTG)



5.9 RS232 INTERFACING

The RS232C is an internationally used electrical standard for communications between computers of all different makes and sizes. It is widely used in the personal computer market to allow the transfer of files and other information between PC's or from PC's to printers. Using the RS232C interface on the Hercules 2000 you will be able to send data to an on-board tactical computer, or use a personal computer with B&G's software to update your polar tables.

The RS232C differs from the NMEA standards in that it only provides the electrical specifications and not the data format standard. Your external device will have to be programmed to send and receive the information according to the format of the B&G data. The remainder of this section is dedicated to the commands and data sentences understood by the Hercules 2000 with its RS232C port. Many of the commands have been designed to be compatible with those used in the Hercules 290 and 390 Systems. Therefore only minor changes will be required when using software designed for those systems with the Hercules 2000.

5.9.1 RS232C Input and Output Configuration

The Hercules Performance Unit has two serial input output channels, one is used just for NMEA and the other can be configured for NMEA or RS232C.

5.9.2 Changing NMEA/RS232 Configuration

Changing the NMEA/RS232 configuration is done by adjusting two calibrations on cross track error. The first of these determines if RS232C can be used and the second determines the RS232C baud rate and format.

To configure the Performance Unit for RS232C, NMEA MDE must be set to 0 (default). NMEA MDE can be found as follows:

WAYPOINT → CROSS TR,
CALBRATE ® CAL VAL1 (NMEA MDE)

Full details of the meaning of other values of NMEA MDE are given in the NMEA interfacing Para 5.8.4

To adjust the RS232C baud rate and format select BAUD RTE as follows:

WAYPOINT → CROSS TR,
CALBRATE → CAL VAL2 (BAUD RTE)

The units digit is the Baud Rate as follows :

1 = 300 Baud
2 = 600 Baud
3 = 1200 Baud
4 = 2400 Baud
5 = 4800 Baud
6 = 9600 Baud
7 = 19200 Baud

The tenths digit controls the format for input as well as output as given in Table 5.4. The default setting is 6.2 (9600 Baud, 7 data bits, RTS/CTS). All data has at least 1 stop bit.

Table 5.7 - RS232 Format

	INPUT	OUTPUT
0	8 data bits (bit 7 ignored) no parity, RTS handshake	7 data bits, even parity, CTS Handshake
1	8 data bits (bit 7 ignored) no parity, RTS handshake	7 data bits, odd parity, CTS handshake
2	7 data bits, even parity RTS handshake	7 data bits, even parity, CTS handshake
3	7 data bits, odd parity RTS handshake	7 data bits, odd parity, CTS handshake
4	8 data bits (bit 7 ignored) no parity, RTS handshake	7 data bits, even parity, no handshake (CTS ignored)
5	8 data bits (bit 7 ignored) no parity, RTS handshake	7 data bits, odd parity, no handshake (CTS ignored)
6	7 data bits, even parity RTS handshake	7 data bits, even parity, no handshake (CTS ignored)
7	7 data bits, odd parity RTS handshake	7 data bits, odd parity, no handshake (CTS ignored)

5.9.3 Command Syntax

Commands are input as a string of ASCII characters starting with a **#** character and a two character command mnemonic followed by data fields separated by commas. The command is terminated and execution initiated by a carriage return (CR).

A command line may not contain more than 88 characters including the start **#** and the terminating carriage return (CR). Data parameters may be omitted provided that if a following parameter is needed the separating commas are included.

For example:

#IR,0,,NO DATA,(CR)

Would just input the text "NO DATA" to display on remote 0.

Characters received after the terminating (CR) of a command line and before the **#** of the next command will be ignored. This allows comment lines to be inserted between commands if required.

5.9.4 Channel Numbers

To maintain compatibility with previous Hercules 290 and 390 Systems it has been necessary to allocate the functions that were available in 290/390 channel numbers (see Tables 5.5 and 5.6) and in the case of NMEA or remote functions have a means of changing the allocations. This is done by setting CAL VAL3 for the function to the required channel number or using the **#**RC,nn,cc(CR) command.

Table 5.8 - Channel Numbers for 290/390 Functions

Channel	Function	Output Rate Hz	Format
00	heel angle	1	H0.00 or 0.00H
01	Boatspeed	4	,0.00 or 20.00
02	stored log	0.25	00.00
03	heading, true	2	359
04	reset log	0.25	00.00
05	heading, magnetic	2	359
06	dead reckoning	0.25	00.00 or 359
07	battery volts	0.5	12.00
08	depth feet	0.5	99.9' or 999'
09	optimum wind angle	0.5	-00 or 00
10	apparent windspeed	1	A 0.0 or A99.9
11	depth metres	0.5	30.2d or 304d
12	True windspeed	1	T 0.0 or T00.0
13	apparent wind angle	2	-179 or 00-
14	True wind angle	1	=179 or 179=
15	true wind direction	1	359.
16	reaching performance	0.5	P000
17	tacking performance	0.5	t000
18	linear 4	1	0 to 1000
19	velocity made good	1	U4.63 or D4.63
20	linear 2	1	0 or 1000
21	target boat speed	0.5	t0.00 or 10.00
22	-	1	-
23	Leeway	0.5	L 0.0 or L10.0
24	-	1	-
25	Course	0.5	C000
26	linear 3	1	0 to 1000
27	sea temperature	0.25	-9.9C or 49.9 C

Table 5.8 - Channel Numbers for 290/390 Functions (cont.)

Channel	Function	Output Rate Hz	Format
28	linear 1	1	0 to 1000
29	-	1	-
30	Timer	1	00.00
31	-	1	-

An output rate of 0.25Hz means one reading every 4 seconds.

Table 5.9 - Default Channel Numbers for Remote Functions

Channel (default)	Function	Format
00	Remote 0	x...x
01	Remote 1	x...x
02	Remote 2	x...x
03	Remote 3	x...x
04	Remote 4	x...x
05	Remote 5	x...x
06	Remote 6	x...x
07	Remote 7	x...x
08	Remote 8	x...x
09	Remote 9	x...x
10	-	-
11	Bearing to Waypoint Rhumb True	x.xT
12	Brg to Waypoint Rhumb Magnetic	x.xM
13	Bearing to WPT Great Circle True	x.xT
14	Bearing to WPT Great Circle Mag.	x.xM
15	Distance to Waypoint Rhumb	x.x
16	Distance to Waypoint Great Circle	x.x
17	Course over ground True	x.xT
18	Course over ground Magnetic	x.xM
19	Speed over ground	x.x
20	VMG to Waypoint	x.x
21	Time to Waypoint	x.x
22	Cross Track Error	x.xL or x.xR
23	Bearing WPT to WPT True	x.xT
24	Bearing WPT to WPT Magnetic	x.xM
25	Distance to Layline	x.xL or x.xR
26	Latitude	x.xN or x.xS
27	Longitude	x.xE or x.xW

Table 5.9 - Default Channel Numbers for Remote Functions (cont.)

Channel (default)	Function	Format
28	Tide Set	x.xT or x.xM
29	Tide Drift	dx.x or xx.x
30	Next Leg App. Wind Angle	-xxx or xxx-
31	Next Leg App. Wind Speed	x.x

5.9.5 Automatic Output Enable/Disable

#OE,nn,s,h(CR)

nn = 00 to 31 channel number
s = 0 for automatic output of channel disabled
s = 1 for automatic output of channel enabled
h = H indicates reference to Hercules channel
h = R indicates reference to NMEA or Remote channel.

The data output rate depends on the channel number, as shown in Table 5.5.

5.9.6 Automatic Output Start/Stop

#OS,s(CR)

s = 0 to stop all RS232 automatic output.
s = 1 to start all RS232 automatic output which has been enabled.

When an automatic start command is executed, all Hercules and remote channels that have been enabled using the **#**OE command will be output regularly.

Data for Hercules functions is output as follows:-

nn,x...x(CR)

nn = channel number (00 to 31).
x...x = ASCII data.

Data for NMEA or Remote channels is output as follows:-

rnn,x...x(CR)
nn = Remote channel number (00 to 31).
x...x = ASCII data.

Examples:

00,19.8H(CR)Heel angle
01, 8.35(CR) Boatspeed
r00,1234(CR)
r01,45.88(CR)

If no data is available for a selected channel the text ‘OFF’ will be substituted.

5.9.7 Input Remote Channel Data and Text

#IR,nn,a...a,c...c,d...d(CR)

nn = Remote channel number (00 to 31). This must be allocated to the REMOTE 0 - 9 function by adjusting its CAL VAL3 or using the **#**RC,nn,cc(CR) command.

EXTERNAL → REMOTE 0, **CALBRATE ® CAL VAL3(CHAN NO**)

or

using the **#**RC,nn,cc(CR) command.

a...a = Remote channel data which will be output on the FFD or 20/20CD digits.

c...c = Text to be displayed on the FFD or 20/20CD. Up to 16 characters may be sent but only 10 are used.

d...d = Page Text, ignored (was used in 290 & 390 Systems)

If only data is to be input the command may be terminated with a (CR) after the data parameter as follows:

#IR,nn,a...a(CR)

Note

This command has no effect on remote channels currently assigned to NMEA functions.

5.9.8 Automatic Output of Basic Data

Basic data consists of the values obtained from the boat speed, wind speed, wind angle and heading sensors without damping or calibration.

#OB,s(CR)
s = 0 for automatic output disabled
s = 1 for automatic output enabled at 2Hz
s = 2 for automatic output enabled at 4Hz

Sets or resets automatic output flag for basic raw data. Automatic output is started using the **#**OS,1(CR) command. Basic data is then output every half second as follows:

B,w...w,x...x,y...y,z...**z(CR)**

www.w = Boatspeed in Hz uncalibrated, 5 characters
xxx.x = Apparent Windspeed in Hz uncalibrated, 5 characters.
yyy.y = Apparent Wind Angle in degrees no offset, 5 characters
zzz.z = Heading in degrees after application of offset, 5 characters

If #OS,2(CR) is used basic data will be output every quarter of a second.

5.9.9 Immediate Output of Basic Data

#OB(CR)

This command stops all automatic output of other data and outputs basic data immediately. Data is output using the same format as automatic output of basic data.

Note
After automatic data has been stopped by this command it can be restarted using the **#**OS,1(CR) command.

5.9.10 Immediate Output of Channel or Remote Data

#OI,nn,s(CR)

nn = channel number 00 to 31. For NMEA and Remote 0 to 9 functions channel numbers must be allocated by setting CAL VAL3 on those functions or using the **#**RC,nn,cc(CR) command. Table 5.5 gives the channel numbers for other functions.

s = 0 (or H) for Hercules data output
s = 1 (or R) for NMEA or Remote data output

This command stops all other automatic output, and outputs as follows:

Inn,xxxxx(CR) - Hercules data requested
Rnn,xxxxx(CR) - if remote data requested
nn = channel number
xxxx = data (see Tables 5.6 and 5.7 for examples).

Note

If Hercules data is required, s may be omitted and the command will be:

#OI,nn(CR)

If remote data is required, the command will be:

#OI,nn,1(CR)

Note

After automatic output has been stopped by an output immediate command it can be re-started using the **#**OS,1(CR) command.

Examples	I00,H19.8	Heel angle	channel 00
	I01,21.35	Boatspeed	channel 01
	I10,A9.9	Apparent wind speed	channel 10
	I14,179=	true wind angle	channel 14

5.9.11 Output Latitude and Longitude

#OL(CR)

Stops all other automatic output and outputs the last value for latitude and longitude received via NMEA as follows:

```
L,ddmm.hhh,n,dddmm.hhh,e(CR)
      l            l
      latitude     longitude
```

dd = degrees
mm = minutes
hhh = hundredths of minutes
n = n for north or s for south
e = e for east or w for west

#OL,s(CR)

s = 0 for automatic output of lat. and long. disabled.
s = 1 for automatic output of lat. and long. enabled.

Automatic output must be started using the **#**OS,1(CR) command.

5.9.12 Assign Remote Channels

#RC,nn,cc(CR)

nn = 00 to 31 Remote channel number
cc = Item number, see Table 5.7

5.9.13 Trip Control

#TC,t,l,d(CR)

t = 0,-5,-10,-15 to start Timer Countdown
= 1 to leave Timer running or unfreeze
= 2 to freeze Timer
l = 0 to reset Trip Log to zero
= 1 to start Trip Log or leave running
= 2 to freeze Trip Log
d = 0 to reset Dead Reckoning to zero
= 1 to start Dead Reckoning or leave running
= 2 to freeze Dead Reckoning

#TC(CR)

Stops automatic output and returns the current states as follows:

S,t,l,d,(CR)

Table 5.10 - Item Numbers for Remote Functions

Number	Remote Function
01	Bearing to Waypoint True Rhumb
02	Bearing to Waypoint Magnetic Rhumb
03	Bearing to Waypoint True Great Circle
04	Bearing to Waypoint Magnetic Great Circle
05	Distance to Waypoint Rhumb
06	Distance to Waypoint Great Circle
07	Course Over Ground True
08	Course Over Ground Magnetic
09	Speed Over Ground
10	VMG to Waypoint
11	Time to Waypoint
12	Cross Track Error
13	Bearing Waypoint to Waypoint, True
14	Bearing Waypoint to Waypoint, Magnetic
15	Distance to Layline, Nautical Miles
16	Latitude
17	Longitude
18	Tide Set, Magnetic
19	Tide Drift
20	Next leg Apparent Wind Angle
21	Next leg Apparent Wind Speed
22	Remote 0
23	Remote 1
24	Remote 2
25	Remote 3
26	Remote 4
27	Remote 5
28	Remote 6
29	Remote 7
30	Remote 8
31	Remote 9

Table 5.11 - Polar Table Example

		TWS (KNOTS)									
	TWA	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0
02	20	1.56	2.70	3.57	4.10	4.50	4.80	5.00	5.20	5.50	5.40
03	30	1.87	3.04	4.04	4.88	5.30	5.66	5.95	5.99	6.15	6.20
04	40	2.08	3.29	4.40	5.49	5.99	6.54	6.78	6.87	6.86	6.75
05	50	2.13	3.52	4.67	5.90	6.50	6.95	7.23	7.33	7.35	7.29
06	60	2.19	3.75	4.95	6.09	6.69	7.07	7.36	7.45	7.51	7.50
07	70	2.10	3.83	5.22	6.18	6.79	7.22	7.48	7.58	7.67	7.72
08	80	2.02	3.91	5.40	6.27	6.88	7.30	7.61	7.73	7.89	7.95
09	90	2.00	3.90	5.45	6.31	7.02	7.45	7.74	7.88	8.11	8.18
10	100	1.98	3.85	5.40	6.39	7.10	7.59	7.87	8.03	8.30	8.39
11	110	1.99	3.76	5.26	6.39	7.11	7.65	7.96	8.19	8.40	8.50
12	120	1.97	3.65	5.08	6.30	7.06	7.65	8.00	8.30	8.43	8.53
13	130	1.90	3.50	4.90	6.00	6.87	7.51	7.96	8.21	8.36	8.48
14	140	1.87	3.25	4.60	5.67	6.67	7.38	7.80	8.10	8.28	8.42
15	150	1.84	3.01	4.20	5.23	6.30	7.04	7.56	7.93	8.19	8.37
16	160	1.80	2.80	3.90	4.80	5.80	6.60	7.20	7.70	8.05	8.27
17	170	1.75	2.60	3.65	4.50	5.50	6.31	6.96	7.53	7.93	8.22
18	180	1.70	2.40	3.42	4.30	5.29	6.02	6.83	7.44	7.88	8.17
19	OPT VMG UPWIND	1.80	2.85	3.79	4.34	4.69	5.00	5.23	5.33	5.37	5.32
20	OPT TWA UPWIND	40	39	38	37	36	35	34.5	34	34	33.5
21	OPT VMG DOWNWIND	1.80	2.70	3.70	4.80	5.80	6.20	6.80	7.40	7.80	8.10
22	OPT TWA DOWNWIND	157	158	160	161	162	163	165	168	170	172

5.9.14 Polar Table Manipulation

A special set of RS232 commands are available for the manipulation of polar performance data. Using these commands it is possible to read and adjust individual elements of the polar table or scale the whole polar table.

An example of the polar table format is shown in Table 5.8. The syntax and function of each command is as described in the following Paragraphs.

5.9.15 Output Polar Table Value

#PO,s,nn(CR)

s = single digit number between 0 and 9 which represents a row in the Polar Table (see Table 5.9). Each row of the table has a true wind speed associated with it.
nn = two digit value between 02 and 22 which represents a column in the Polar Table.
Rows 02 to 18 represent true wind angles from 20 to 180 degrees in increments of 10 degrees.
Row 19 represents the optimum upwind VMG.
Row 20 represents the true wind angle associated with 19.
Row 21 represents the optimum downwind VMG.
Row 22 represents the true wind angle associated with 21.

Issuing this command will cause the following message to be output:

P,xx.x,yy.yy(CR)

where:

xx.x = three digit value representing true wind speed associated with row 's' of polar table
yy.yy = boat speed in knots if 'nn' = 02-18
optimum upwind VMG in knots if 'nn' = 19
true wind angle associated
with above if 'nn' = 20
optimum downwind VMG in knots if 'nn' = 21
true wind angle associated
with above if 'nn' = 22

Example:

The command **#PO,3,08(CR)** will cause the message:

```
P,10.0,07.25(CR) to be output.
    |     |
    true  boat
    wind  speed
    speed
```

Likewise command **#PO,4,20(CR)** will cause the message:

```
P,12.0,042(CR) to be output.
  |     |
  true  true
  wind  wind
  speed angle
```

The command may also be used to output a complete row, or the entire table, by omitting one or more parameters. For example, the command:

#PO,3(CR)

will cause the whole of row 3 to be output in the format:

PR,r,cc,uu.u,cc,vv.vv,...cc,vv.vv,cc,ww.ww,cc,xxx,cc,yy.yy,cc,zzz

where	r	is the row number (0..9)
	cc	is the column number (01..22)
	uu.u	is the true wind speed set for this row
	vv.vv	is the boat speed
	ww.ww	is the optimum upwind vmg
	xxx	is the true wind angle for upwind vmg
	yy.yy	is the optimum downwind vmg
	zzz	is the true wind angle for downwind vmg

Because output lines can only be a maximum of 80 characters it takes several lines to output a complete row. Each line begins with

PR,r,cc....

to indicate which row and column follows.

In a similar way, the command:

#PO(CR)

outputs the entire table, row by row, in the above format.

5.9.16 Input Polar Table Value

#PI,s,nn,yy.yy(CR)

s = 0 - 9 (as in previous command)
nn = 02 - 22 (as in previous command)

This command permits any single element of the polar table to be changed.

Example:

The command **#PI,7,05,07.45(CR)**

Will cause the polar table element corresponding to a wind speed of 20 knots and a true wind angle of 50 degrees to be changed from 7.40 Knots to 7.45 Knots.

Likewise command **#PI,0,22,150(CR)**

Will cause the true wind angle associated with the optimum down wind VMG in a true wind speed of 4.0 knots to be changed from 130 degrees to 150 degrees.

5.9.17 Output Polar Table Type and Rating

The command **#PR(CR)**

Will cause the current polar table type and its associated rating to be output in the following format:

W,s,xx.xx(CR)

s = single digit 0, 1, 2 or 3 representing the polar table type currently being used.

xx.xx = Four digit number between 16.50 and 99.99 representing the IOR rating. This rating value is used when the entire polar table is scaled.

5.9.18 Input Polar Table Type and Rating

The command **#PR,s,xx.xx(CR)**

This command selects a polar table from the three available in the Performance Unit and then scales it for a new rating value.

s = Polar table type (0, 1 or 2) to be selected. All adjustments to the previously selected polar table will be lost. If the 's' parameter is omitted then the currently selected polar table will be adjusted to the new rating value.

xx.xx = four digit number between 16.50 and 99.99 Representing the IOR rating. When a new rating is entered using this command, all the elements (apart from optimum angles) will be scaled in the following way:

$$\text{New value} = \text{old value} \times \sqrt{\frac{\text{new rating}}{\text{old rating}}}$$

Each of the three polar tables stored within the Performance Unit has its own associated default rating value:

TYPE	NO.	RATING
Masthead rig	0	26.20 IOR rated feet
Fractional rig	1	22.50 IOR rated feet
ULDB	2	29.50 IOR rated feet

5.9.19 Input Polar Table Wind Speed

#PW,s,xx.x(CR)

This command permits values in the wind speed column of the currently selected Polar Table to be altered.

s = single digit value 0 to 9 representing a row in the Polar Table (see Table 5.8)
xx.x = wind speed in knots of 00.0 to 99.9

Notes

1. It is important that the wind speeds in the polar table lie in ascending order, i.e. s = 0 corresponds to the smallest wind speed value, s = 9 corresponds to the largest wind speed value. If, by

using the **#**PW command, the wind speed values become disordered then 'Err 5' will be displayed on Reaching and Tacking performance.

2. Duplicate non-zero values for wind speed must not exist in the wind speed column of the polar table. If duplicate values are introduced using the PW command then 'Err 6' will be displayed on Reaching and Tacking performance.

3. If less than ten Wind Speeds are required, the first values must be set to zero.

5.9.20 Output Apparent Wind Correction Table Values

The Hercules 2000 contains two tables that can be used to correct the measured apparent wind values which are to be used in further calculations. These do not affect the values of apparent wind speed or apparent wind angle displayed. Table 5.9 is an example of the apparent wind speed correction table and Table 5.10 is an example of the apparent wind angle table.

#TO,s,nn(CR)

s = 1 to 6 row number for 5,10,15,20,25 and 30 knots Apparent Windspeed respectively.
nn = 01 to 24 column number. Columns 01 to 12 are for 20, 25, 30, 35, 40, 60, 80, 100, 120, 140, 160 and 180 degrees Apparent Wind Angle respectively and contain apparent wind speed correction values. Columns 13 to 24 for 20, 25, 30, 35, 40, 60, 80, 100, 120, 140, 160 and 180 degrees Apparent Wind Angle respectively and contain apparent wind angle correction values.

The command stops all automatic output and returns:

U,s,nn,y...y(CR)

if nn = 01 to 12
yy.yy or -yy.yy = Windspeed correction value in knots

if nn = 13 to 24
yyy.y or -yyy.y = Wind Angle correction value in degrees.

The command may also be used to output a complete row, or the entire wind correction table (including the true wind correction values described in Para 5.8.42), by omitting one or more parameters. For example:

#TO,3(CR)

outputs the whole of row 3 in the format:

UR,r,cc,-ww.ww,...cc,-xxx.x,...cc,-yyy.y,...cc,zz.zz

where	r	is the row number (1..6)
	cc	is the column number (01..28)
	ww.ww	is the apparent wind speed correction
	xxx.x	is the apparent wind angle correction
	yyy.y	is the true wind angle correction
	zz.zz	is the true wind speed correction

In general, these values can be either positive or negative. Negative values will be preceded by a minus sign.

Because output lines can only be a maximum of 80 characters it takes several lines to output a complete row. Each line begins with

UR,r,cc....

to identify the row and column of the data that follows.

Table 5.12 - Apparent Wind Speed Correction

nn		01	02	03	04	05	06
AWA		20	25	30	35	40	60
S	Wind Speed						
1	5	-0.65	-0.40	-0.20	-0.10	-0.10	-0.20
2	10	-0.30	-0.10	0.20	0.20	0.10	-0.30
3	15	-1.20	-0.90	-0.45	-0.45	-0.45	-0.75
4	20	1.00	0.60	0.20	0.00	-0.40	-0.60
5	25	1.25	1.00	1.00	1.25	1.25	2.00
6	30	1.50	1.50	1.80	2.40	3.00	4.50

nn		07	08	09	10	11	12
AWA		80	100	120	140	160	180
S	Wind Speed						
1	5	-0.45	-0.60	-1.10	-0.75	-0.70	-0.60
2	10	-0.70	-1.10	-1.50	-1.50	-1.20	-0.80
3	15	-1.35	-1.95	-1.80	-1.65	-1.05	-1.05
4	20	-0.80	-1.20	-1.20	3.00	-0.60	-0.20
5	25	2.75	3.25	3.00	2.50	1.50	0.00
6	30	6.60	7.20	6.60	5.80	3.60	0.00

Table 5.13 - Apparent Wind Angle Correction

nn		13	14	15	16	17	18
AWA		20	25	30	35	40	60
S	Wind Speed						
1	5	-1.0	-2.0	-4.0	-4.5	-5.0	-6.0
2	10	-2.0	-4.5	-6.5	-7.5	-8.5	-8.5
3	15	-0.5	-0.5	-4.5	-5.5	-6.5	-7.5
4	20	0.0	-1.0	-3.0	-4.0	-5.0	-6.0
5	25	0.0	-0.5	-2.0	-3.0	-4.0	-5.0
6	30	0.0	0.0	-1.0	-2.0	-3.0	-4.0

nn		19	20	21	22	23	24
AWA		80	100	120	140	160	180
S	Wind Speed						
1	5	-7.0	-8.0	-7.5	-6.0	-4.5	0.0
2	10	-12.0	-14.0	-12.0	-10.5	-8.0	0.0
3	15	-8.5	-9.5	-8.5	-6.5	-4.0	0.0
4	20	-7.0	-8.0	-5.5	-12.0	-2.0	0.0
5	25	-6.0	-7.0	-4.0	-2.0	-1.0	0.0
6	30	-5.0	-6.0	-3.0	-1.0	0.0	0.0

5.9.21 Input Apparent Wind Correction Table Value

#TI,s,nn,y...y(CR)

s = 1 to 6 row number as in previous command.
nn = 01 to 24 column number as in previous command.
yy.yy or -yy.yy = Windspeed correction value in knots
yyy.y or -yyy.y = Wind Angle correction value in degrees.

This command permits any single element of the correction tables to be changed.

5.9.22 Output Apparent Wind Correction Status

#OC,15(CR)

This command will stop automatic output and reply with:
C,15,s(CR)

s = 0 for no corrections being applied to apparent wind values.
1 for corrections being applied to apparent wind values for use in further calculations.

5.9.23 Enable/Disable Apparent Wind Correction

#IC,15,s(CR)

s = 0 for no correction to be applied to apparent wind values.
1 for correction to be applied to apparent wind values used in further calculations.

5.9.24 Input Calibration Value

#IC,n,x...x(CR)

n = calibration number
x....x = calibration value

N	Calibration Type	Data Format	Max Value
1	Boatspeed (port)	x.xx	9.99
2	Boatspeed (stbd)	x.xx	9.99
3	Windspeed Hz/kt	x.xx	9.99
4	MHU Angle	xxx.x	359.9
5	Leeway	xx.x	99.9
6	True Wind Correction	ignored	
7	Zero Correction Angle	ignored	
8	Max Mast Twist	ignored	
9	Max Twist Angle	ignored	
10	Windspeed offset	x.xx	9.99
11	Depth datum m	xx.x	99.9
12	Depth datum ft	xx.x	99.9
13	Depth datum fm	xx.x	99.9
14	Compass offset	xxx.x	359.9
15	Apparent wind correction	x	2
16	Magnetic Variation	xxx.x	359.9
17	Next Leg Bearing	xxx.x	359.9
18	Tide On N/L Select	x	1

5.9.25 Output Calibration Value

#OC,n(CR)

n = calibration number as above

This command stops all automatic output and returns

C,n,x...x(CR)

5.9.26 Input Damping Value

#ID,n,xx(CR)

n = damping number
1 Boatspeed Damping
2 Heading Damping
3 Apparent Windspeed Damping
4 Apparent Wind Angle Damping
5 True wind speed damping
6 True wind angle damping
7 Tide Damping in minutes
xx = damping value in seconds (minutes if tide) 0 to 99.

5.9.27 Output Damping Value

#OD,n(CR)

n = damping number as in previous command.

This command stops all automatic output and returns

D,n,xx(CR)

xx = damping value 0 to 99

5.9.28 Input Hercules Channel Text

#IT,nn,c...c,d...d(CR)

nn = 00 to 31 - Hercules Channel Number (see Table 5.6)
c...c = channel text, up to 16 characters (only 10 displayed)
d...d = Page Text, ignored by Hercules 2000.

5.9.29 Output Text Immediately

#OT,nn,h(CR)

nn = 00 to 31 channel number
h = H for Hercules channel (see Tables 5.5 & 5.6)
R for NMEA or Remote channel.

Note
Remote channel numbers must be allocated by adjusting CAL VAL3 for the required function or using the **#**RC,nn,cc(CR) command.

This command stops all automatic output and outputs text as follows (page text is returned as spaces)

HT,nn,c...c, (CR) if Hercules channel text requested
RT,nn,c...c, (CR) if Remote Text requested.

5.9.30 Output Alarm

#OA,nn(CR)

nn = alarm number, see Table 5.12

This command stops all automatic output, and returns

Ann,xxxx,s(CR)

nn = Alarm Number
xxxx = Alarm Value
s = 0 for alarm OFF
s = 1 for alarm ON and not active
s = 3 for alarm ON and active

Table 5.14 - Alarm Numbers

Alarm No.	Description
01	Boatspeed High Alarm
02	Boatspeed Low Alarm
03	Heading Clockwise Alarm (calculated from Alarm Value and Sector Width)
04	Heading Anti-Clockwise Alarm (calculated from Alarm Value and Sector Width)
05	Apparent Wind Speed High Alarm
06	Apparent Wind Speed Low Alarm
07	Apparent Wind Angle Clockwise (calculated from Alarm Value and Sector Width)
08	Apparent Wind Angle Anti-Clockwise (calculated from Alarm Value and Sector Width)
09	Battery Volts High Alarm
10	Battery Volts Low Alarm
11	Depth Feet High Alarm
12	Depth Feet Low Alarm
13	Depth Fathoms High Alarm
14	Depth Fathoms Low Alarm
15	Depth Metres High Alarm
16	Depth Metres Low Alarm
17	Sea Temperature Centigrade High Alarm
18	Sea Temperature Centigrade Low Alarm
19	Sea Temperature Fahrenheit High Alarm
20	Sea Temperature Fahrenheit Low Alarm
21	Air Temperature Centigrade High Alarm
22	Air Temperature Centigrade Low Alarm
23	Air Temperature Fahrenheit High Alarm
24	Air Temperature Fahrenheit Low Alarm

5.9.31 Hercules 2000 General Purpose Input Value

#IV,nnn,mmm,fff,xx.xx,tttttttttt(CR)

nnn = node number to which value is to be sent

1	-	Depth Board
5 to 8	-	Wind Boards
9 to 12	-	RS232 or NMEA Board
255	-	Broadcast to all Boards

mmm = message type to be used

211	-	Calibration Value 1
212	-	Calibration Value 2
213	-	Calibration Value 3
214	-	Calibration Value 4
206	-	Damping Value
34	-	High Alarm Value
33	-	Low Alarm Value
32	-	Sector Alarm Value
1	-	Data Value
2	-	New text for an existing function

fff = function number see Table 5.15
xx.xx = Value value to be sent, or node number of function fff if mmm=2
tttttttttt = function text displayed on FFD, 20/20 or 40/40

This is a general purpose command for inputting values to other nodes.

5.9.32 General Purpose Output Value

#OV,nnn,mmm,fff,(CR)

nnn = number of node from which value is to be obtained.

1 for Depth Board
5 to 8 for Wind Board
9 to 12 for RS232 or NMEA Board
13 to 16 for Expansion Boards
17 to 18 for Pilot Boards
255 for Broadcast to all Boards

mmm = message type to be used

211	-	Calibration Value 1
212	-	Calibration Value 2
213	-	Calibration Value 3

214	-	Calibration Value 4
206	-	Damping Value
34	-	High Alarm Value
33	-	Low Alarm Value
32	-	Sector Alarm Value
1	-	Data Value

fff = function number of value to be sent

This is a general purpose command for getting values from any node (including the Performance Unit itself) and replies with the value as follows:

Vnnn,mmm,fff,xx.xx(CR)

xx.xx = value

5.9.33 NMEA Sentence Output Rate Selection

#NS,p,fff,r(CR)

can be used to set the output rate of a specified NMEA sentence, where:

p is the NMEA port number, 1 or 2
fff is the three-character NMEA sentence formatter
r is the desired output rate in Hz

Example:

#NS,1,HDM,10(CR)

sets the output rate of HDM on port 1 to ten times a second.

At present the only sentence formatter that is recognised is HDM, and the output rates can only be 0, 1, or 10. An output rate of 0 turns HDM off.

5.9.34 Displaying the Software Version Number

#RV,nn(CR)

causes the software version number of node nn to be output in the format:

RV,nn,vv(CR)

where nn is the node number
vv is the version number (in hexadecimal)

Example:
#RV,9(CR)
gives
RV,9,75(CR)
if version 7.5 software is fitted to the Performance Unit.

Not all Hercules units respond to version number requests, so some nodes will return version 00.

5.9.35 RS232 Error Messages

If a command is incorrectly entered or has a parameter out of range then an error message of the following form will be output on RS232:

***ERROR nn: <text>(CR)**

nn = error number
<text> = a text message describing the error

The error numbers are as follows:

01 = Invalid command mnemonic
02 = Command line too long, greater than 80 characters
03 = Invalid command syntax, missing parameter
04 = Invalid parameter
05 = Parity error
06 = Channel Number out of range

Table 5.15 - Hercules 2000 Function Numbers

FUNCTION DESCRIPTION	FUNCTION No.	NODE
Air Temperature degrees C	29	5
Air Temperature degrees F	28	5
Apparent Wind Angle	81	5
Apparent Wind Angle, raw	82	5
Apparent Wind Speed knots	77	5
Apparent Wind Speed m/s	79	5
Apparent Wind Speed, raw	78	5
Average Speed	100	1
Barometric Pressure	135	5
Barometric Pressure Trend	134	5
Battery Volts	141	5
Bearing to Waypoint, G.C. mag.	230	9
Bearing to Waypoint, G.C. true	229	9
Bearing to Waypoint, rhumb mag.	228	9
Bearing to Waypoint, rhumb true	227	9
Bearing Wpt. to Wpt., mag.	225	9
Bearing Wpt. to Wpt, true	224	9
Boatspeed	65	1
Boatspeed, raw	66	1
Course	105	5
Course Over Ground, Mag.	234	9
Course Over Ground, True	233	9

Table 5.15 - Hercules 2000 Function Numbers (cont.)

FUNCTION DESCRIPTION	FUNCTION No.	NODE
Cross Track Error (XTE)	238	9
Dead Reckoning Course	211	1
Dead Reckoning Distance	129	1
Depth Meters	193	1
Depth Feet	194	1
Depth Fathoms	195	1
Depth Sounder Receiver Gain	54	1
Depth Sounder Noise	55	1
Distance to Waypoint, G.C.	232	9
Distance to Waypoint, Rhumb	231	9
Fore/Aft Trim	155	5
Heading	73	N/A
Heading, Raw	74	N/A
Heading on Next Tack	154	N/A
Head/Lift Trend	39	48
Heel Angle	52	5
Leeway	130	5
Layline Distance	226	9
Linear 1	56	9
Linear 2	57	9
Linear 3	58	9
Linear 4	59	9
Linear 5	16	13
Linear 6	17	13
Linear 7	18	13
Linear 8	19	13
Linear 9	20	13
Linear 10	21	13
Linear 11	22	13
Linear 12	23	13
Linear 13	24	13
Linear 14	25	13
Linear 15	26	13
Linear 16	27	13
Local Time	220	9
Mast Angle	156	5
Next Leg Apparent Wind Angle	111	9
Next Leg Apparent Wind Speed	113	9
Next Leg Target Boat Speed	112	9
Next Waypoint Distance	250	9

Table 5.15 - Hercules 2000 Function Numbers (cont.)

FUNCTION DESCRIPTION	FUNCTION No.	NODE
Off Course	41	48
Optimum Wind Angle	53	9
Reaching Performance	51	9
Remote 0	239	9
Remote 1	240	9
Remote 2	241	9
Remote 3	242	9
Remote 4	243	9
Remote 5	244	9
Remote 6	245	9
Remote 7	246	9
Remote 8	247	9
Remote 9	248	9
Rudder Angle	11	5
Sea Temperature degrees °C	31	1
Sea Temperature degrees °F	30	1
Speed Over Ground	235	9
Stored Log	205	1
Tacking Performance	50	9
Target Boatspeed	125	9
Target TWA	83	9
Tidal Set	132	9
Tidal Drift	131	9
Timer	117	5
Time to Layline	251	9
Time to Waypoint	237	9
Trip Log	207	1
True Wind Angle	89	5
True Wind Direction	109	5
True Wind Speed, knots	85	5
True Wind Speed, m/s	86	5
VMG to Waypoint (VMC)	236	9
Velocity Made Good	127	5
Wind Angle to the Mast	157	5

5.9.36 RS232 Command Summary

#IC,n,x..x	Input calibration value
#ID,n,XX	Input damping value
#IR,nn,a...a,c...c	Input remote channel data and text
#IT,nn,c....c	Input text for Hercules channel
#IV,nnn,mmm,fff,xx.xx,t...t	Input Value
#NI,s,a...	Send network or NMEA message
#NO,s,a...	Output from network or NMEA
#NS,p,fff,r	NMEA output rate selection
#OA,nn	Output alarm
#OB	Output Basic Data Immediately
#OB,s	Automatic output of basic data enable/disable
#OC,n	Output calibration
#OD,n	Output damping value
#OE,nn,s,h	Automatic output enable /disable
#OI,nn,s	Output data immediately
#OL	Output Latitude and Longitude
#OS,s	Start/stop automatic output
#OT,nn,h(R)	Output text immediately
#OV,nnn,mmm,fff	Output value
#PI,s,nn,xx.xx	Polar input
#PO,s,nn	Polar output
#PR	Output table selection and rating
#PR,s,xx.xx	Input table selection and rating
#PW,s,xx.x	Enter polar windspeed
#RC,nn,cc	Assign remote channel
#RM,ssss,ffff	Display performance unit memory
#RV,nn	Display software version number
#TC,t,l,d	Trip Control
#TC	Output trip status
#TO,s,nn	Output wind correction
#TI,s,nn,y...y	Input wind correction

5.9.37 True Wind Correction

There are two tables that are used to correct the values of true wind angle and true wind speed before output to the display or use in calculation of true wind direction. These are the values that can be adjusted via the FFD when calibrating true wind angle and speed and are explained in Part 3 - Calibration

5.9.38 Output True Wind Correction Table Values

#TO,s,nn(CR)

s = 1 to 6 row number for 5,10,15,20,25 and 30 knots true wind speed respectively.
nn = 25 to 28 column number. Columns 25 to 27 contain the true wind angle correction values for Upwind, Reaching and Downwind sectors respectively. Column 28 contains true wind speed correction values for 180 degrees down wind. The wind speed correction values are interpolated to 0 at 90 degrees.

The command stops all automatic output and returns:

U,s,nn,y...y(CR)

if nn	=	25 to 27
yyy.y or -yyy.y	=	True wind angle correction value degrees.
if nn	=	28
yy.yy or -yy.yy	=	True wind speed correction value in knots.

5.9.39 Input True Wind Correction Table Values

#TI,s,nn,y...y(CR)

s	=1 to 6 row number as in previous command.
nn	=25 to 28 column number as in previous command.
yy.yy or - yy.yy	=True wind speed correction value in knots
yyy.y or - yyy.y	=True wind angle correction value in degrees.

Table 5.16 - True Wind Angle Correction Table

Wind Angle	True Wind Speed					
	5	10	15	20	25	30
Correction °						
Correction Angle						

Table 5.17 - True Wind Speed Correction Table

Wind Angle	True Wind Speed					
	5	10	15	20	25	30
Upwind						
Reaching						
Downwind						

5.10 EXPANSION PROCESSOR

5.10.1 The Expansion Processor

The Expansion Unit can be connected to the Hercules 2000 System via the Fastnet to drive four extra analogues (meters 5,6,7 and 8), and provide extra analogue inputs.

A new menu automatically appears on all FFDs called EXPAND when an Expansion Processor is added to the system. Up to twelve linear functions may be displayed numbered LINEAR 5 to LINEAR 16. Initially only LINEAR 5 is shown. A linear function by default shows a number between 0, representing 0 volts on its input and 1000 representing 6.5 volts on its input. The voltage change is assumed to be linear in relationship. Hence an external sensor, for example a load cell giving a linear change in voltage as the load increases, may be connected to a linear input.

LINEAR 5 has four calibration values, other linear functions have three calibration values found by selecting CALBRATE on the appropriate linear function.

5.10.2 Linear Function Settings

Altering calibration value 1 (CAL VAL 1) allows the correct input sensor to be selected. The different inputs available are shown below:

1 or 2	normal linear input 0 to 1000
3	rotating mast correction for apparent wind angle
4	heel angle input
5	trim angle input
6	barometric pressure
7	rudder angle
8	air temperature

The default factory setting for a linear input on the Expansion Processor is 1 (0-1000 format).

Note
Do not set different linear inputs to the same function (except type 1 for normal linear input) or the calibration value will be ignored. This ensures that no function uses no more than one analogue input. However, any one of the Linear 1 to 4 inputs from the main processor may be set to the same function as any one of the Linear 5 to 16 inputs.

Calibration value 2 (CAL VAL 2) displays MIN VAL with a number that can be adjusted between -999 and 9999. This is the number to be displayed for a 0V input. The default setting is 0.

Calibration value 3 (CAL VAL 3) displays MAX VAL with a number that can be adjusted between -999 and 9999. This is the number to be displayed for 6.5V input. The default setting is 1000.

5.10.3 Calibrating a Linear Channel

Adjusting the MIN and MAX values allows the displayed value to be scaled to the appropriate range for the sensor attached. Taking a load cell for example, if the zero load output is 0V, MIN VAL=000 and if maximum load is 650 KgF at 6.5V then MAX VAL=650.

Calibration value 4 is only available on Linear 5 and this displays a value between 05 and 16. This setting determines the number of linear inputs that are available. For example, changing this value to 10 would display a maximum of 10 linear inputs. The default value is 05.

Damping is adjustable between 00 and 99 seconds. The default setting is 01.

Notes

1. When calibration value 1 is changed to select a desired input sensor, the linear value is no longer updated and a constant value is displayed until the page key is pressed.
2. Extra functions selected, and then removed, remain in the display menu but with no data shown until the system is switched off and then back on again.
3. Linear functions will always be shown if selected by CAL VAL 4 on linear 5. They will show no data if the CAL VAL 1 is set to 1 or 2.

5.10.4 Expansion Processor Wiring

The Expansion Processor is connected to the system Fastnet for power and data requirements.

TERMINAL	FUNCTION	WIRE COLOUR
1	Meter 5 SIN	Green
2	Meter 5 COS	Blue
3	Meter 6 SIN	Red
4	Meter 6 COS	Violet
5	Meter 7 SIN	Red
6	Meter 7 COS	Violet
7	Meter 8 SIN	Green
8	Meter 8 COS	Blue
9	Meter Lighting	Yellow
10	Meter Common	Orange
11	Meter Ground	Black
12	N/C	
13	N/C	
14	Network Data -ve	Green
15	Network Data +ve	White
16	Network Screen	Screen
17	Battery Supply Ground	Black
18	Battery Supply 12V	Red
19	Battery Volts Sense	Link to 18
20	N/C	
21	Ground	Blue
22	Sensor Supply +6.5V	Red
23	Linear 5 Input	Green
24	Linear 6 Input	Green
25	Linear 7 Input	Green
26	Linear 8 Input	Green

TERMINAL	FUNCTION	WIRE COLOUR
27	Linear 9 Input	Green
28	N/C	
29	N/C	
30	N/C	
31	N/C	
32	N/C	
33	N/C	
34	N/C	
35	N/C	
36	N/C	
37	Linear 10 Input	Green
38	N/C	
39	Linear 11 Input	Green
40	Linear 12 Input	Green
41	+12V Switched Supply	Red
42	Linear 13 Input	Green
43	+6.5V Sensor Supply	Red
44	RPM Input	Green
45	Ground	Blue
46	Linear 14 Input	Green
47	Linear 15 Input	Green
48	Linear 16 Input	Green

PART 6 - DIAGNOSTIC DATA

CONTENTS

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PART 6 - DIAGNOSTIC DATA

6.1 FFD DIAGNOSTICS

The FFD contains a number of diagnostic functions. These allow the FFD's own keys, display and memory to be tested and also perform some checks on other parts of the system via the network. One of the more useful of these tests enables the user to determine the software version numbers of the processor units in the system. This information is often useful when contacting service agents.

6.1.1 Diagnostic Function Selection

To use the diagnostic functions they must be selected on the required FFD when the system is switched ON as follows:

(1) When switching ON the system press **Enter** and hold until DIAGNOST appears on the upper text in an otherwise blank display.

(2) Press **Enter** and the first test option appears which is KEYTEST.

(3) The required test can then be selected using the **Scroll Up** and **Scroll Down** Keys (see below for details of the tests).

(4) Press **Enter** to start the test.

(5) On completion of each test, press **Scroll Up** or **Scroll Down** to scroll to the next test. Press **Enter** to start the test.

(6) To return the display back to normal operation press the **Page** Key.

(7) Provided that the power is not switched off or a system reset performed, the diagnostics can be re-entered by holding **Enter** down and pressing the **On/Off Lights** Key.

The 12 Options in the DIAGNOSTICS Menu are described in the following paragraphs, 6.1.2 to 6.1.3.

6.1.2 RES-SYS

CAUTION: Do not use this option during normal operation as all calibration values will be lost.

This allows individual units or the entire system to be reset. The network node address of the unit to be reset is selected using the **Scroll Up** and **Scroll Down** Keys and then **Enter** pressed. The node allocations are as follows:

Individual Addresses

Node Address	Function
01_H to 04_H (Typ. 01_H)	Depth
05_H to 08_H (Typ. 05_H)	Wind
09_H to $0C_H$ (Typ. 09_H)	Performance/NMEA
$0D_H$ to $0F_H$ (Typ. $0D_H$)	Expansion
10_H	Halcyon 2000 Compass
11_H to 12_H (Typ. 12_H)	Auto-Pilot
20_H to $2F_H$	FFDs
30_H to $3F_H$	Halcyon FFDs
40_H to $4F_H$	20/20's
50_H to $5F_H$	Pilot FFDs
60_H to $6F_H$	NMEA FFDs
112_H to 127_H	Loadcell Amplifiers
128_H	Tank Level Sensor

Collective Addresses

FA_H	All 20/20s
FB_H	All Halcyon FFDs
FC_H	All Pilot FFDs
FD_H	All Processor Nodes
FE_H	All FFDs
FF_H	Entire System

Notes

1. When the system is reset, all calibration, damping and alarm values will be set back to default settings, all log values and trip functions will be reset to zero. All display units will reset to their default page settings. After a delay of about 20 seconds the system should be switched OFF and then back ON twice to complete the reset procedure.

2. If the Depth board is reset, the FILTER PC setting for boat speed calibration will need to be reset to 10% as follows:

   BOAT SPD > CALIBRATE > CORRECTION > FILTER PC > 10 (value)

6.1.3 Versions

This option allows the user to obtain the software version numbers for the FFD (DISPLAY), Depth Board (DEPTH), Wind Board (WIND), Expansion Unit (EXP UNIT) and Pilot, if fitted. With 'VERSIONS' flashing on the display, press **Enter**. Then use the **Scroll Up** Key to select the device whose version number is required and press **Enter** to display the software checksum of that device, in the bottom display. The last two digits of the checksum are the software version number.

6.2 HERCULES MAIN PROCESSOR

The main processor contains two circuit boards: the wind board and the depth board. The depth board is responsible for boat speed, sea temperature and depth measurement. The wind board is the main computer responsible for wind functions and also drives the analogue meters. It has special inputs for the mast head unit, Halcyon compass, air temperature, battery voltage and four linear inputs which can be connected to a variety of other sensors, see Part 4 - Installation Information.

6.2.1 Mast Head Unit

If there appears to be a problem with wind speed or wind angle first check the cable connections at the main processor and at the mast base junction box. The easiest way to test the mast head unit cable is by substituting a spare cable. If the cable is damaged in the mast the cause of the damage should be ascertained and the mast re-rigged or new conduit installed before replacing the cable. The mast head unit should always be removed before the mast is un-stepped to avoid damage. It should be stored in its original packing box with the vane and cups removed.

Note

The mast head unit's bearings should not be oiled as they are of a sealed pre-lubricated type and additional oil may cause chemical breakdown of the existing lubricant.

6.3 DEPTH SOUNDER

Fault finding on the depth sounder is often difficult as depth sounder performance is dependent on many factors: transducer type and installation, boat speed, electrical noise, sea state, sea bed conditions, air and plankton in the water. Indications of problems with the depth sounder normally manifest themselves in one of three ways: display shows four floating bars:

-
- -
-

The display locks down showing depths in the range 0 to 1.5m or display shows random deep depths. All of these symptoms can be caused by external conditions so care and additional tests should be performed before concluding the fault lies with the depth sounder. There are two values output by the depth sounder which can be of assistance in diagnosing problems, these are receiver gain and noise which can be found in the PARAMTR Menu on a FFD.

6.3.1 Yacht Stationary

Symptom: Display consistently shows:

-
- -
-

when well within the range of the sounder when the yacht is stationary in the water. This is an indication that no consistent signal is being received by the depth sounder.

Possible causes:

(a) The transducer is not connected.

(b) The transducer is not in its housing.

(c) If sounding through the hull there is not enough oil in the housing or the hull material is not suitable to sound through (wood, composite hulls with core material etc.).

(d) The transducer is receiving extra reflections off an adjacent pontoon or jetty.

(e) The transducer is receiving interference from another B&G system located in an adjacent yacht.

(f) The transducer is faulty or has been damaged. The transducer should be checked for any damage, barnacle growth or thick layers of paint. If it needs cleaning this should be done with a scrubbing brush. The face of the transducer may have a thin coat of anti-fouling applied to it making sure no air bubbles are trapped in the paint. The cable should be checked for damage. The resistance between the BLUE and BLACK cores should be in the region of 0.5 to 5 Ohms and resistance between the screen and the cores should be infinity.

CAUTION:
Resistance measurements should only be made with the transducer disconnected from the Processor Unit.

(g) The gain of the receiver has been set too low. It is possible to adjust the maximum gain via CAL VAL1 on gain. This is normally set to 30 and should not be adjusted.

6.3.2 Yacht Moving

Symptom: Display shows pattern below when yacht is moving:

```
-
  - -
      -
```

This is most often an indication of difficult sounding conditions, but can also indicate a poorly located transducer.

Possible causes:

(a) Difficult sounding conditions and/or depth sounder unable to track rapidly changing bottom. If coming into shallow water yacht should slow down and proceed with caution.

(b) Aeration in the water, most often caused by the wake of another vessel. This can persist in the water for a long period after the passing of the vessel. In some instances the depth sounder will indicate the depth of the aeration layer caused by a large vessel.

(c) Poorly located transducer. Determine what conditions cause the problem by doing some manoeuvring trials in an area which has a relatively uniform depth, a solid bottom and is clear of the wake from other boats.

First determine the maximum speed at which reliable soundings can be made when traveling in a straight line. Then repeat the tests when turning to port and starboard. If better results can be obtained when turning it is possible that there is something in front of the transducer causing aeration. This may be a hull fitting like a water outlet in which case the transducer or the hull fitting should be moved. If there seems little difference whether turning or not, the position of the transducer should be reviewed. It may be coming out of the water at high speed or in rough water. It is impossible to give specific instructions on where to re-site the transducer as it is so dependent on the design of boat; however generally better results will be obtained nearer the centre line of the boat. If there is only a problem when heeled, consider fitting two transducers with a changeover switch.

6.3.3 Consistently Shows Shallow Depth

Symptom: Display consistently shows a shallow depth between 0m and about 1.5m.

Possible causes:

(a) Faulty transducer. Transducer rings for too long after the transmit pulse is sent and the ringing is interpreted as a shallow return by the depth sounder. On a deep keeled yacht it may be possible to overcome this problem by increasing the minimum depth to just less than the draft of the yacht. The minimum depth is adjusted by changing CAL VAL1 on NOISE.

PARAMTR→NOISE, **CALBRATE→CAL VAL1** (**MIN DPTH M**)

The default setting for minimum depth is 0.7 metres.

(b) Keel echoes. If the transducer has been installed too close to the keel it is possible to get consistent echoes from the keel. The transducer should be re-located further away from the keel. If this is impossible then increasing the minimum depth to just below the keel can solve the problem but may result in poor performance when the bottom is shaded by the keel. Marginal cases are sometimes caused by side lobes from the main beam from the transducer and may be cured by rotating the transducer in the housing.

(c) Following or crossing the path of another vessel which has left an aerated layer in the water.

6.3.4 Random Deep Depths

Symptom: Display shows random deep depths.

Possible Causes:

(a) Electrical noise. The depth sounder contains circuits and software to reduce its susceptibility to electrical noise, however this can still be a problem if not installed carefully or other equipment is not correctly suppressed. The depth sounder measures the ambient noise and this can be found for display by looking under the PARAMTR Menu. When the boat is stationary electrical equipment should be switched ON and OFF in turn while looking at the depth and noise displays to try and determine the source of the problem.

(b) Acoustic Interference. Other depth sounders and sonar can cause problems. However this is generally only when very close to other boats for example when moored alongside in a crowded marina. Also acoustic noise can be generated by water flow past the transducer and various bits of mechanical machinery.

(c) Mid-water echoes. When outside the range of the depth sounder it is possible that random depths are displayed due to mid-water echoes from shoals of fish or aeration layers.

6.4 PERFORMANCE UNIT

The Performance Unit contains the NMEA and RS232 interfaces and also calculates the performance related functions.

6.5 ERROR MESSAGES

Following is a list of error messages output on the displays:

Er01	Error detected reading the analogue to digital converter on the depth sounder board. This can be an indication of a fault on the board or that the sea water temperature or the compass signals are outside their normal range. Try disconnecting the sensors in turn.
Er02	Error detected when writing to the analogue to digital converter on the depth sounder board. This can indicate the same problems as Er01.
Err.3	Syntax or parity error on received NMEA data.
Err.4	Checksum error on received NMEA 0183 data.
Err.5	Polar table wind speed values are disordered, see Part 2 - Operating Information.
Err.6	There are duplicate non-zero wind speed values in the Polar Table, Part 2 - Operating Information.
CAL	Alternating with a function value indicates that it has yet to be calibrated. This will happen after a system reset or if the internal battery is exhausted.

NO SPACE	**FFD** memory full, too many functions have been declared.
NOT FND	New function declared without text, can occur temporarily at start-up or after changing a system setting (e.g. True/Magentic reference).

6.6 HALCYON 2000 COMPASS

6.6.1 Shows Heading and CAL Flashing

Symptom: Display flashes a Heading and CAL

Possible Causes:

(a) The memory in the Halcyon 2000 is empty or has been corrupted. This may be due to a System Reset being performed or the first time the compass has been installed and not yet been calibrated. Perform a calibration swing to restore normal operation.

(b) After a calibration swing the result is always **FAIL**. There is a source of magnetic deviation near to the Halcyon 2000 compass. Try re-positioning the compass and perform the calibration.

6.6.2 Heading Shows Err

Possible Causes:

(a) The signal from the fluxgate sensor is too big or too small. Try re-positioning the compass. If still showing **Err** set NAVIGATE→COMP CAL, **CALBRATE⊗CAL VAL 2** (**RES CAL**) to 1. This will reset the compass. All previous calibrations will be lost.

6.6.3 Heading or COMP CAL Shows PHS

Possible Causes:

(a) The compass is in the middle of resetting, the display should show heading and CAL flashing after 20 seconds. A calibration swing will be required.

6.6.4 Two Headings Flashing Alternately

Symptom: Pilot or Halcyon Displays shows 2 headings flashing alternately

Possible Causes:

(a) The Pilot has not been set to use the Halcyon 2000 as its heading source. See using Halcyon 2000 with a B&G ACP Pilot. If the Halcyon 2000 is not to be the source of heading then it must be unplugged from the system.

6.6.5 True Wind Direction, Tide Set or DR Course Not Functioning Correctly

(a) The Main Processor has not been configured to use the Halcyon 2000 as the main heading source. Set NAVIGATE→COURSE, **CALBRATE®CAL VAL 1** (**HDG NODE**) to 16.

A1 HERCULES 2000 CALIBRATION DATA

A1.1 System Configuration Record

		Default Setting	User Setting
HEADING NODE		16 (HALCYON 2000)	
HALCYON MODE		0	
ANALOGUES	**1**	WIND ANG	
	2	DEPTH	
	3	BOAT SPD	
	4	WIND SPD	
	5	HEADING	
	6	MAG WIND	
	7	OFF CRSE	
	8	XTE	
LINEARS	**1**	4 (HEEL)	
	2	5 (TRIM)	
	3	6 (BAROMETER)	
	4	1 (0-1000 TYPE)	
NMEA MODE		0	
BAUD RATE		6.2	
SEA TEMP TYPE		1	

A1.2 Basic Calibration Record

FUNCTION	CALIBRATION	VALUE
MEAS W/A	OFFSET	
MEAS W/S	Hz/Kt	1.04 (default)
	OFFSET	1.04 (default)
APP W/A	OFFSET	
APP W/S	Hz/Kt	1.04 (default)
	OFFSET	1.04 (default)
BOAT SPD	STBD Hz/Kt	
	PORT H/Kt	
HEADING	OFFSET	
DEPTH	DATUM	
HEEL	OFFSET	
TRIM	OFFSET	
LEEWAY	COEFFICIENT	
MAST ANGLE	OFFSET	
RUDDER	OFFSET	

A1.3 True Wind Speed Correction Table

	TRUE WIND SPEED					
	5	10	15	20	25	30
CORRECTION º						
CORR. ANGLE						

A1.4 True Wind Angle Correction Table

WIND ANGLE	TRUE WIND SPEED					
	5	10	15	20	25	30
UPWIND						
REACHING						
DOWNWIND						

A1.5 Boat Speed Correction Table

HEEL ANGLE	BOAT SPEED (Kt)					
	5	10	15	20	25	30
0º						
10º						
20º						

A1.6 Damping Record

FUNCTION	DAMPING	DYN DAMP
APP W/A		
APP W/S		
HEADING		
BOAT SPD		
HEEL		
TRIM		
LEEWAY		
MAST ANGLE		
RUDDER		
TRUE W/A		
TRUE W/S		
TRUE DIR		
TIDE		