NAVIGATOR VMG

Installation and Operating Instructions

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SECTION 3 - SAILING WITH THE NAVIGATOR VMG (SEE ALSO APP 1)

The main application of this instrument is to help the helmsman optimise his course and/or sail trim on a given tack, so that the boat makes maximum speed towards the true wind, and hence the windward mark.

The way that this is achieved is by making alterations to the course and/or sail trim and observing the effect of this on the VMG display. An increase in VMG means that the speed at which the boat is travelling towards the wind is increasing and that this course and sail combination is more effective than before. A fuller explanation and vector diagram is provided in Appendix 1.

The instrument can also be used to select an optimum course and sail combination when sailing downwind. This is done by optimising the negative VMG so that the boat is sailing directly downwind at the highest possible speed. For many boats it will be found that the optimum negative VMG does not occur when sailing at 180 degrees to the wind, but when sailing at around 150 degrees. This varies a great deal on the type of boat and type of rig used.

In certain conditions, especially in light weather it may be found that the response of the VMG function is too slow to be of use to the helmsman. This can be overcome by selecting the lightly damped VMG function, (see section 4.3). When this is selected the VMG display updates more rapidly.

True windspeed can be used to good effect when racing, enabling the correct sail combination to be chosen for the next leg of the course. For example when sailing on the downwind leg, when the apparent windspeed is reduced, the true windspeed will give an accurate guide to windspeed that would be experienced on the upwind leg. It is useful to note that a true windspeed of 20 knots will give an apparent windspeed of 24 knots approx, when beating to windward at 5 knots. Observation of true wind-angle can optimise next mark tactics.

Trim is a useful function on all points of sailing as it shows whether boatspeed is increasing or decreasing about a fixed point. The trim function is very lightly damped so will respond to very small increases/decreases in speed. This can be especially useful in light weather, when the boat speed is low and small changes in boatspeed can be very significant.

The wind alarm will sound if the apparent windspeed exceeds the set value. This can be useful to warn when a sail change may be beneficial or when a sail is likely to be blown out or damaged by excessive windspeed.

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SECTION 4 - OPERATION

1) THE INSTRUMENT

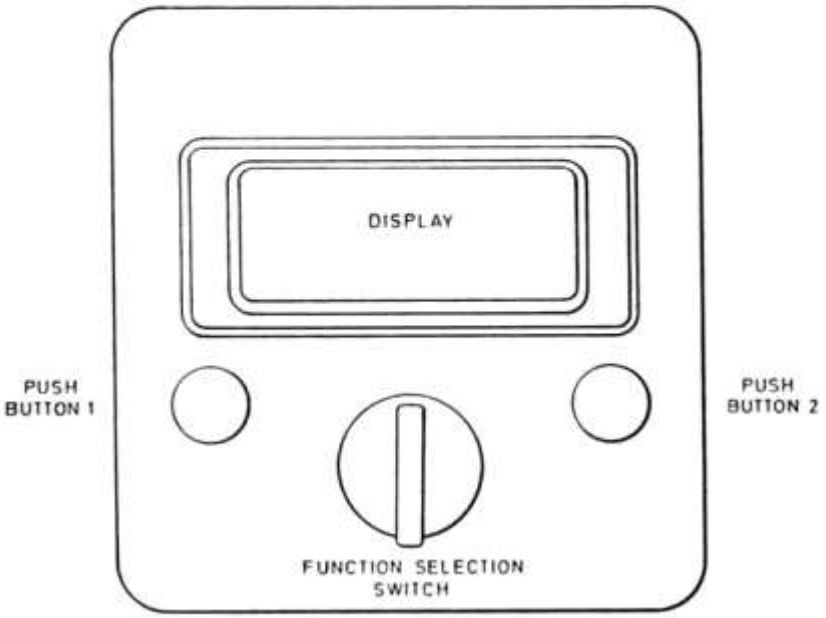

DIAGRAM 1

2) POWER ON

After switching on, the instrument will display the initial value of the selected function. These are as follows:

Boat Speed	0.0 knots
Trim	0.0 knots
Apparent Wind Angle	0 0
Cal Boat Speed	0 8
Unused	blank
Cal Mast Head	0 0
Alarm	0 0.0 knots
True Wind Angle	9 0 =
True Wind Speed	0.0 knots
Velocity Made Good	0.0 knots
True Wind Speed and VMG	0.0:0.0

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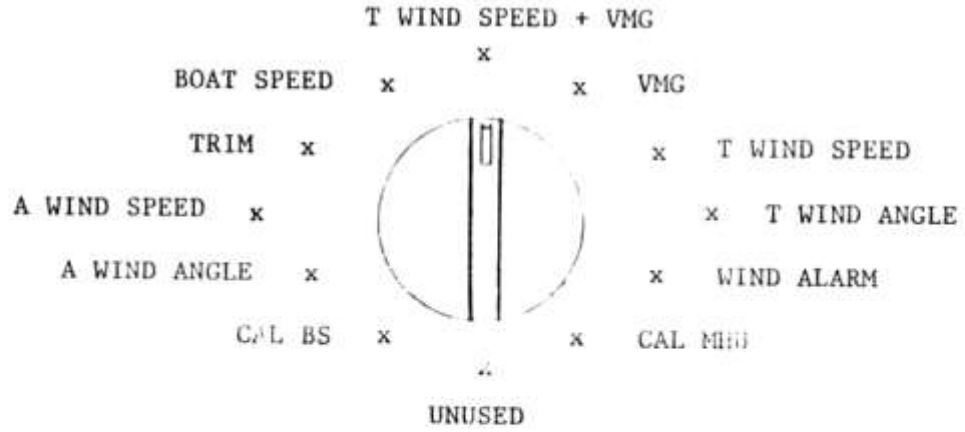
Once underway, within 8 seconds the Navigator VMG will have taken readings from the mast head unit and the paddle wheel transducer, and then displayed the relevant value selected by the function switch.

The four digit display on the Navigator VMG is similar to that of the other instruments in the Navigator range.

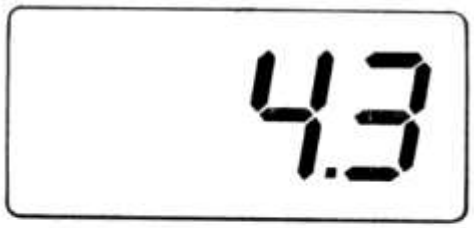
3) DESCRIPTION OF MAIN FUNCTIONS

LAYOUT:



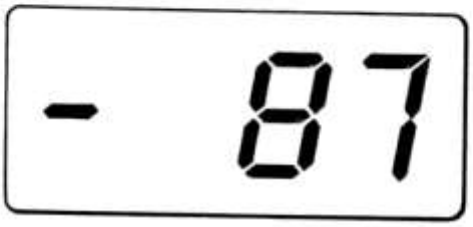
BOAT SPEED - Boat Speed in knots

Boat speed is displayed to the nearest tenth of a knot, and is normally damped over 4 seconds. The display is updated every 4 seconds. This is similar to the speed 1 function on the Navigator 2 log unit.



A WIND ANGLE - Apparent Wind Angle in degrees

This function shows the angle of the boat to the apparent wind direction. The angle is displayed between 0 and 180 degrees, and either Port Apparent or Starboard Apparent is indicated by a single bar on the windward side. The angle is damped over 8 seconds and the display is updated every 2 seconds.



PORT

STARBOARD

A WIND SPEED - Apparent Wind Speed in knots

The apparent wind speed is shown to the nearest tenth knot. The reading is heavily damped over 35 seconds and updated every 8 seconds, giving a running average accurate to a tenth of a knot.

VMG - Velocity Made Good to Windward in knots

Selection of this function will provide VMG to one tenth of a knot and will display a minus sign if it is negative. There are two levels of damping for this function, a light damping and a heavy damping. When the instrument is switched on it is in heavily damped mode, and will update every 2 seconds. To select lightly damped VMG press one of the push buttons until the buzzer sounds. The display is now updated when a new boat speed, or wind speed or angle is calculated. To change the damping again press one of the buttons and wait for the buzzer to sound.

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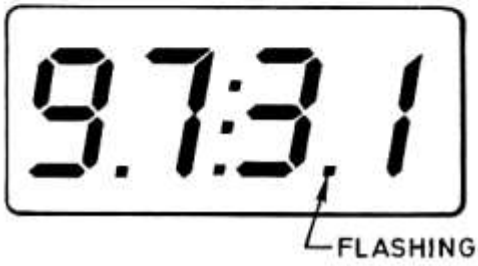
T WIND SPEED + VMG - Dual display, both in knots

This displays true wind speed and VMG together. The two digits on the left hand side show true wind speed to a tenth of a knot (to whole knots if the speed is 10 knots or above.) The righthand two digits show the current VMG, and if the VMG is negative the decimal point will flash.



T WIND ANGLE - True Wind Angle in degrees

This function gives the angle of the boat to the true wind direction. The angle is displayed between 0 and 180 degrees, and either Port True or Starboard True is indicated by two bars on the windward side.

T WIND SPEED - True Wind Speed in knots

The true wind speed is displayed to the nearest tenth of a knot.

TRIM

When selected this function is set to zero and any subsequent variation in boat speed will be displayed. A reduction in boat speed will give negative trim and an increase in boat speed will give positive trim. Trim is calculated to a tenth of a knot, and updated every second.

WIND ALARM - Set Apparent Wind Speed Alarm

Initially the right hand digit (1/10th knot) will display a flashing zero, The value of a digit can be incremented by pressing button 2 (which wraps over from 9 to 0.) When the right value appears for the digit, the next digit to the left is selected by pressing button 1, which 'wraps around' from the 3rd digit to the 1st.

The maximum value that can be set is 99.9. The buzzer sounds each time a button is pressed.

When the correct value has been obtained, this is stored by just selecting any other function. The Navigator VMG will then operate as normal, but will sound the alarm buzzer if the Apparent wind speed becomes greater than the alarm setting, the alarm will automatically stop if the wind speed goes below the alarm setting. Sudden gusts will not trigger the alarm, because the wind speed is damped to give an average.

The alarm can be silenced by depressing one of the buttons, or by setting the alarm value to zero. To reinstate the alarm function after one of the buttons has been pushed, just turn the function switch to the Alarm setting, and then turn back to any function.

CAL BS - Calibration for boat speed

This displays the position of the boatspeed calibration switch, 0 to 15. The nominal position is 8, and decreasing positions will increase the boat speed reading in 3.3% steps, and increasing positions will reduce boat speed readings in 3.3% steps.

Calibration of the Navigator VMG should be straightforward, as the existing instruments - Nav 1 or Nav 2 - should already be calibrated correctly for the yacht. Adjust the calibration switch at the rear of the instrument head using a 5mm wide screwdriver until the Boat Speed readings on the Nav VMG and existing instruments coincide. (Note: turn Navigator 1 or 2 function switch to lower position to read the calibration switch position.)

Calibration Table

Switch Position		Calibration Shift
0		+26.66%
1		+23.33%
2		+20.00%
3		+16.66%
4		+13.33%
5		+10.00%
6		+ 6.66%
7		+ 3.33%
8	Nominal Value	+ 0.00%
9		- 3.33%
10		- 6.66%
11		-10.00%
12		-13.33%
13		-16.66%
14		-20.00%
15		-23.33%

CAL MHU - Calibration of mast head unit

This displays the offset in degrees, from -14 to 16, in two degree steps. Switch position 8 shows '00', and this is the factory setting.

If the Mast Head Unit is offset to Port, the displayed wind angle will be over-reading, and so a negative calibration needs to be selected, and conversely if the Mast Head Unit is offset to Starboard then the displayed wind angle will be under-reading, and thus a positive calibration should be selected.

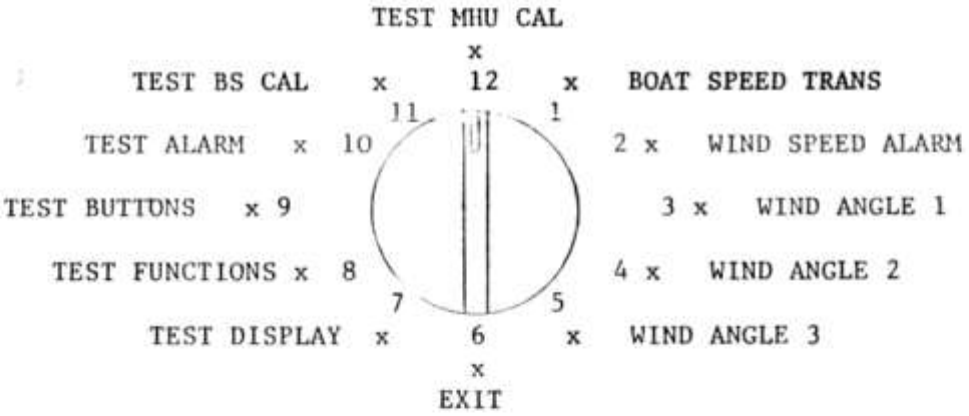
The unit can be calibrated by observing the analogue display on the Wind Monitor, or Wind Angle, and then matching the digital angle on the Navigator VMG by operation of the calibration switch.

Please note that the Navigator VMG is more heavily damped than the analogue displays, and therefore will average out the slight fluctuations shown on the Analogue Display.

UNUSED - This position is unused in normal operation

In normal operation this position will give a blank display, however if both the push buttons are pressed at the same time the display will show 'tESt', meaning that test mode has been entered. In test mode the function switch has the following features.

4) DESCRIPTION OF TEST FUNCTIONS



To exit from the test mode, press both push buttons after at least one test has been selected, eg Test Display. When normal mode has been selected again the display in this position (Position 6) will be blank and the main functions can be selected as normal.

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A) TEST POSITION 7

TEST DISPLAY - To test the operation of the Liquid Crystal Display.

This position will flash the following:

B) TEST POSITION 8

TEST FUNCTIONS - To test correct operation of the function switch.

This will display the relevant position number for each of the function switch positions, from 1 to 12, like a clock face. (See test function switch layout above.) Once the function switch has been rotated fully and all the numbers checked, press either button.

Note that if the function switch is still in this position (position 8) then the display will show 08, so select a different position, eg position 9, and press either button.

Please also note that if the function switch is turned through this position again during the test procedure, then the display will again show the relevant switch position number. Select a position other than Position 8 and press either button.

C) TEST POSITION 9

TEST BUTTONS - To test both of the push buttons.

When the leftmost button is pressed, 80 will be displayed in the left two digits, likewise the right button will display 08 in the right two digits.

D) TEST POSITION 10

TEST ALARM - To check that the buzzer is working.

The buzzer will sound at one second intervals.

E) TEST POSITION 11

TEST BS CAL - To check the boat speed calibration switch.

This will display the current setting, and if the cal switch is rotated will display all the different settings, from 0 to 15.

F) TEST POSITION 12

TEST MHU CAL - To check mast head calibration switch.

This will display the current setting, and if the cal switch is rotated will display all the different settings, from 0 to 15.

G) TEST POSITION 1

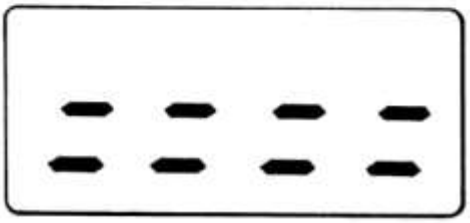
BOAT SPEED TRANS - Tests the operation of the boat speed transducer.

Four single bars across the display will flash each time the paddle wheel rotates. If the display is blank either there is no input from the paddle wheel, or there is an instrument head fault.

H) TEST POSITION 2

WIND SPEED TRANS - Tests the operation of the anemometer.

Four double bars across the display will flash each time the anemometer rotates. If the display is blank either there is no input from the anemometer, or there is an instrument head fault.



I) TEST POSITIONS 3,4,5

WIND ANGLE TEST - Tests action at wind vane.

When the Mast Head Unit is attached, the wind angle is given by the voltages on the three input lines (the green, white and yellow wires going into the back of the VMG.) The number displayed will be between 0 and 255, and is directly related to the input voltage, thus the number will alter as the wind vane moves.

Test 3 is for the green wire

Test 4 is for the white wire

Test 5 is for the yellow wire

A check may be performed by adding the three numbers, as the sum should be between 340 and 425 at any wind angle.

Please note this function will only give meaningful results if the Mast Head Unit is attached.

J) TEST POSITION 6

EXIT

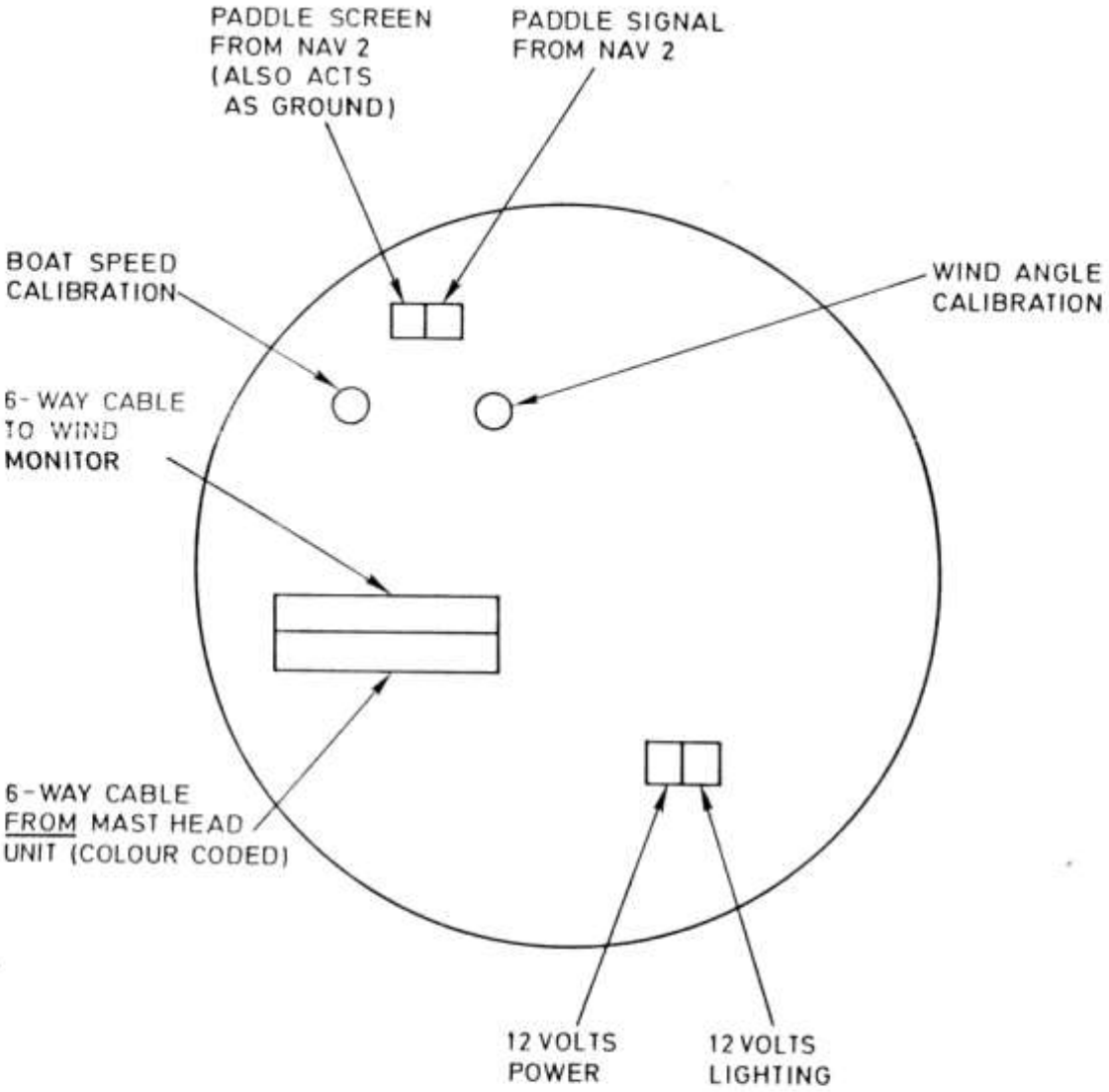
To leave the test mode turn the function switch to this position and press both buttons, the display will be blank and the normal operating mode has been re-entered.

Please note that at least one other function must be selected before leaving the test mode.

SECTION 5 - INSTALLATION

1) THE INSTRUMENT HEAD

A 4 inch (102 mm) diameter hole is required for the instrument head, which should be installed with silicon rubber caulk around the outer flange. The flange edges should be masked with tape, to prevent unsightly smears of sealing caulk. The instrument is held in place by the clamping stirrup. Do not over tighten the securing nuts as this will place undue stress on the instrument head seals and may break the glass window.



PLEASE NOTE:

1) Nav VMG has no direct ground connection.

2) The mast head unit is connected directly to the Nav VMG.

3) Wind Speed Repeaters should be connected to the Mast Head Input.

4) Wind Angle Units should be connected to the Wind Monitor Output.

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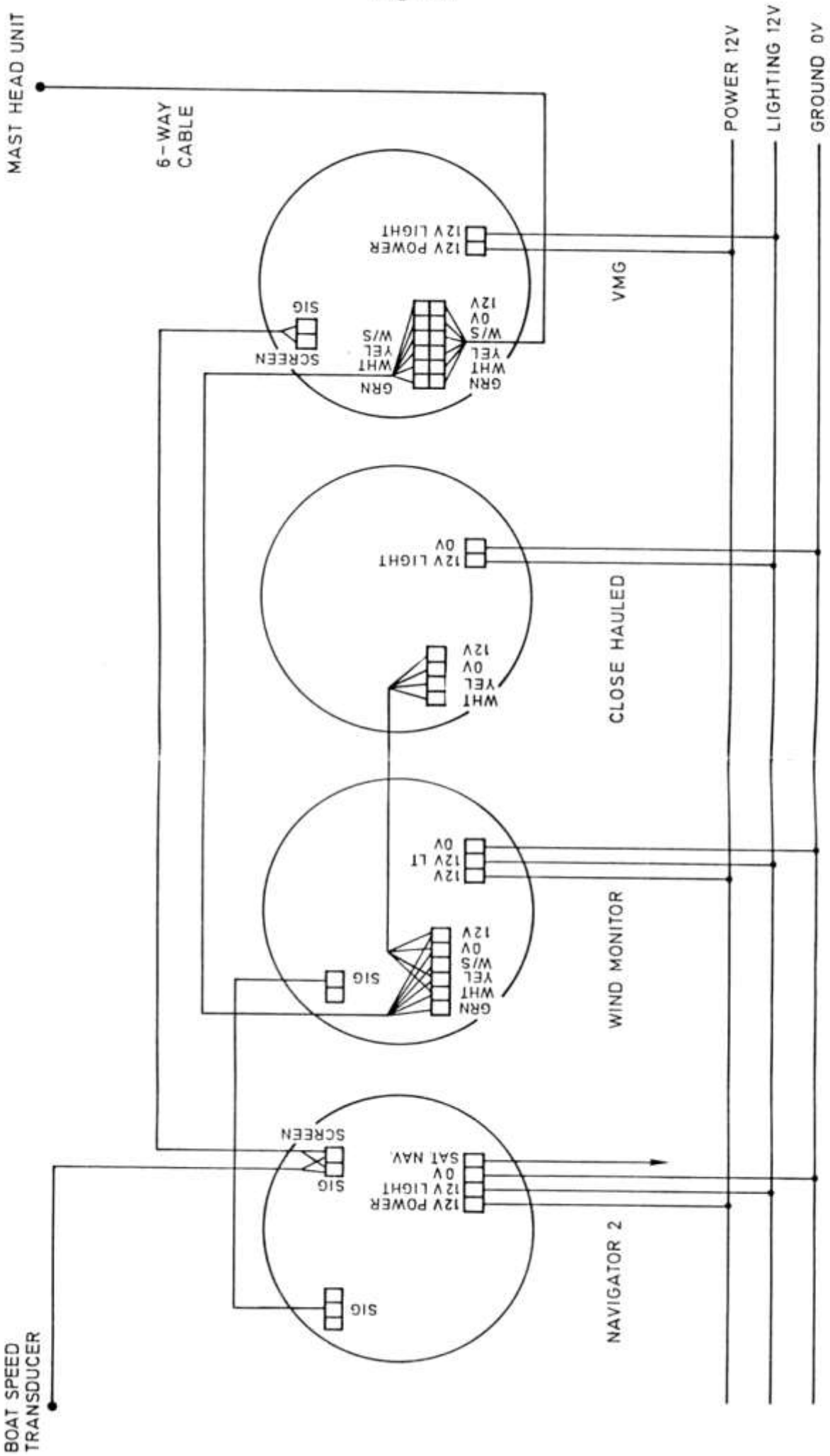
MAST HEAD UNIT
6-WAY CABLE
POWER 12V
LIGHTING 12V
GROUND 0V
VMG
12V POWER
12V LIGHT
SIG
SCREEN
GRN
WHT
YEL
W/S
0V
12V
CLOSE HAULED
12V LIGHT
0V
WHT
YEL
0V
12V
WIND MONITOR
12V
12V LT
0V
GRN
WHT
YEL
W/S
0V
12V
SIG
NAVIGATOR 2
SCREEN
SIG
SAT NAV
0V
12V LIGHT
12V POWER
SIG
BOAT SPEED TRANSDUCER

2) POWER SUPPLY

It is advisable to tin, with solder, the ends of the wire before inserting into terminal blocks. This prevents the ends from fraying and ensures good electrical contact. 12 volts is fed into the terminal block marked 12V, taken from the existing installation. Ground (0 volts) is provided via the paddlewheel screen from the Navigator 1/2 to avoid earthing problems. (It is very important that this is the only ground connection to the instrument.) Lights are switched on by applying 12 volts to the terminal marked 12V LIGHTS, this can be taken from the existing installation.

NOTE: Positive (+) = 12 volts Negative (-) = 0 volts.

3) PADDLEWHEEL/TRAIL INPUT

Connection of the waterspeed transducer can be made by taking the signal and screen output directly from the Navigator 1/2 to the boatspeed input, screened cable must be used for this purpose.

4) MASTHEAD UNIT CONNECTION

The masthead unit cable is fed directly into the terminal block marked 'MAST INPUT'.

5) CONNECTION OF OTHER WIND INSTRUMENTS

Other wind instruments are connected into the terminal block marked 'output to other wind instruments'. The close hauled meter should be connected to the terminal block on the wind monitor/wind angle instrument.

SECTION 6 - TROUBLE SHOOTING GUIDE

CONDITION	PROBABLE CAUSE	ACTION
Digital display completely blank	* No power to system.	Check fuse, battery switch, battery state.
	* Battery cable/ connections reversed.	Check wiring polarity and connections to display head.
Digital display only partly operative	* Failed micro-processor or display.	Use test function 1.
	* Poor connections to transducers.	Check connections.

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CONDITION	PROBABLE CAUSE	ACTION
Display shows all 8's	* Failed micro-processor due to lightening strike or 12v applied to transducer input.	Return instrument head to factory or service centre.
No lighting in display.	* Faulty wiring/ switches.	Check 12v supply and connections.
	* Failed bulbs.	Return to service centre.
Display data jumbled after switched on.	* Low battery voltage or poor connection.	Check battery voltage at instrument head.
No boat speed or low boat speed.	* Transducer not connected.	Check connection to Nav 1/2.
	* Paddle wheel fouled.	Clean paddle wheel. Use test function 7, if the display is blank then there is no input to the processor.
	* Transducer not aligned.	Ensure cross pin aligned fore and aft.
Erratic or very high boat speed.	* Electrical interference eg from engine.	Isolate problem source and re-route or screen the paddle cable or fit supressors to source.
No wind speed.	* Faulty connection.	Check wiring to Mast Head Unit.
	* Failed components.	Use test function 8. Disconnect the blue and black wires from Mast Head cable. Short out the blue and black terminals once per second. If the display is blank the instrument is faulty and should be returned to the factory.

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CONDITION	PROBABLE CAUSE	ACTION
No wind speed	* Anemometer rotor Seized.	Return to factory or service centre for bearing replacement.
Erratic or very high wind speed.	* Poor power supply to instrument causing voltage fluctuation along mast cable.	Connect equipment direct to battery to avoid voltage drops.
Erratic or incorrect wind angle.	* Loose connection.	Check connections at back of instrument and base of mast.
	* Defective mast head potentiometer.	Use test functions 9-11. For each function, sail the yacht in a circle and check the number displayed goes from 0 up to 255 and back to 0.

For additional assistance call the Service Centre Hotline as follows:

AUSTRALIA		02 560 8644
EUROPE	UK	0705 412044
USA		617 667 6318

SECTION 7 - APPENDIX 1

A brief description of VMG (Velocity Made Good), True Windspeed and True Windangle.

The True Windspeed is the true speed of the wind, whereas Apparent Windspeed is the speed of the wind over the boat, as this is a combination of the True Windspeed and the Boatspeed.

Normally a Wind Monitor will display the Apparent Windspeed and Apparent Windangle, ie readings that are a combination of the True Wind and Boatspeed. The Navigator VMG uses the Apparent Wind and the Boatspeed inputs, and then from these calculates the True Windpseed and Windangle, the True Windangle being the angle of the boat to the true wind.

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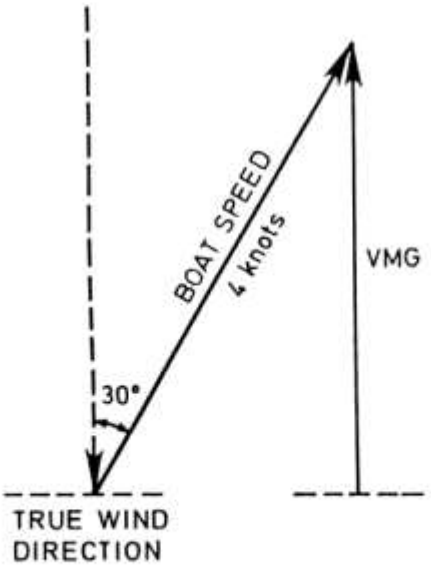
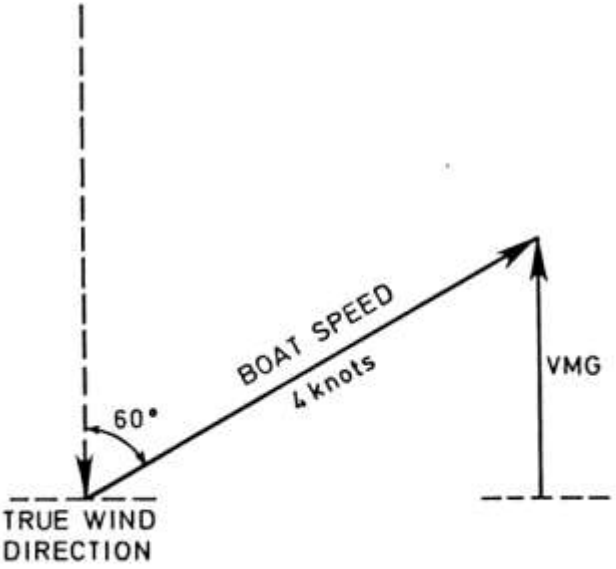
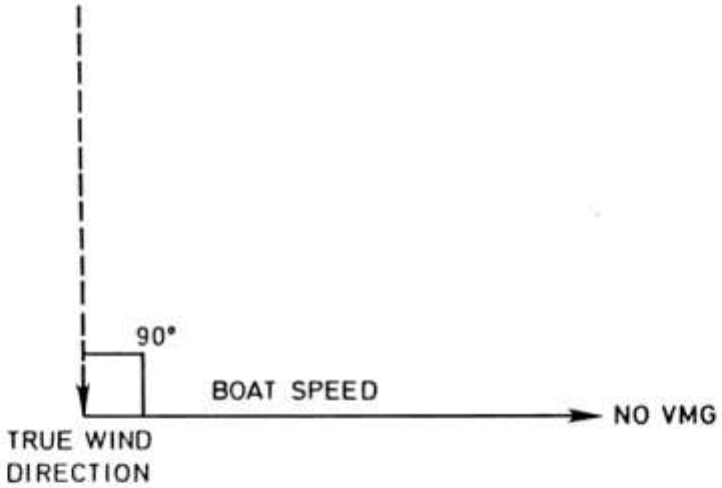
The Velocity Made Good is how fast the boat is travelling directly into the wind. So a boat sailing at 4 kts and at 30 degrees to the wind will have a greater VMG than a boat sailing at the same speed, but at 60 degrees to the wind.

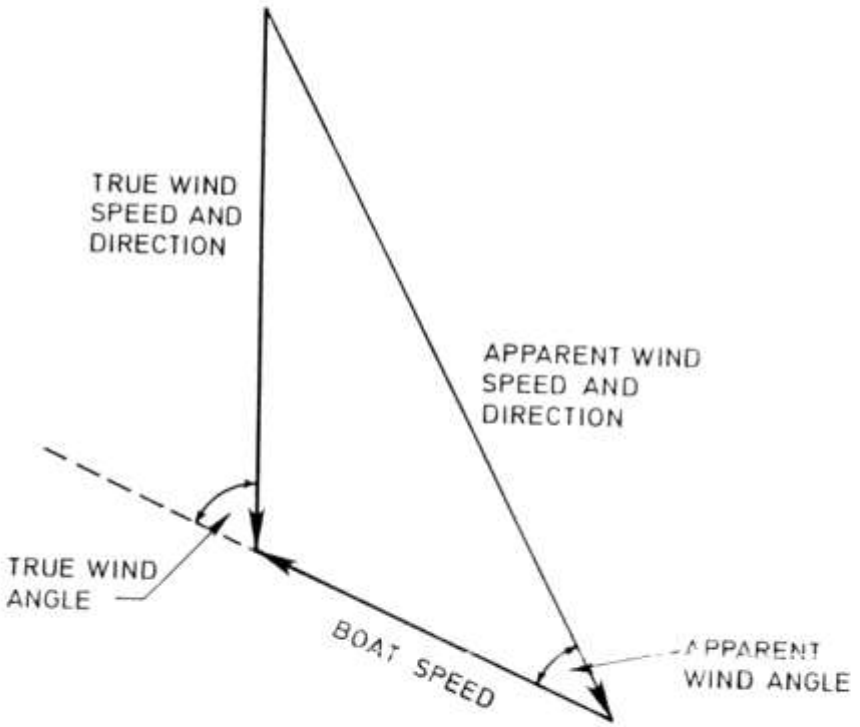




And when the boat is at 90 degrees to the true wind, the VMG is zero, as the boat is neither moving into nor away from the wind.



The relationship between True wind angle and Apparent wind angle is shown by the following vector diagram:



SECTION 8 APPENDIX 11

SPECIFICATION

ELECTRONICS

8 bit microcomputer with 4K ROM and A/D converter.

RANGE

VMG	0-30 knots positive and negative.
True Windspeed	0-90 knots.
True Wind Angle	0-180 degrees port and starboard.
Apparent Windspeed	0-90 knots.
Apparent Wind Angle	0-180 degrees port and starboard.
High Windspeed Alarm	Selectable 0.00 - 99.9 knots.
Boat Speed	0-50 knots.
Trim	0-50 knots.
Calibration Boat Speed	16 position switch, 3.33% shift per position.
Calibration MHU	16 position switch, 2 degree shift per position.

DIGITAL DISPLAY

18mm 4 digit LCD with high daylight contrast.

ILLUMINATION

0.5w backlight to LCD. Beta light positioned on switch knob.

ALARM

Audible. Mounted on rear of housing.

WATERPROOF HOUSING

Noryl glass filled thermoplastic with bonded-in glass window and 'O' ring switch seals.

Bezel	110mm x 110mm
Barrel	102mm diameter
Barrel Length	90mm including terminals

POWER REQUIREMENTS

11-16 volts. 100mA + 90mA lighting (when required.)

COMPASS SAFE DISTANCE

300mm (1ft.)

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