CONTENTS

1.1 INTRODUCTION

The Harrier 6 combined log and speedometer has been developed by Brookes and Gatehouse for discerning cruising and racing yachtsmen as well as power boat owners. Full use has been made of micro-processor technology to provide valuable extra facilities such as timer, average speed, reset log, accelerometer, calibration setting, variable damping and variable display illumination all controlled at the display unit keyboard. The accumulated log, calibration setting and other values are retained in the computer memory when power is switched off. The traditional B&G standards of accuracy, reliability and sea-going durability have been built into the Harrier 6.

1.2 FACILITIES

The display unit is provided with a large liquid crystal digital display and a keyboard with four clearly marked keys. The input to the display unit is taken from an underwater unit, which is mounted through the hull.

The following facilities are provided:

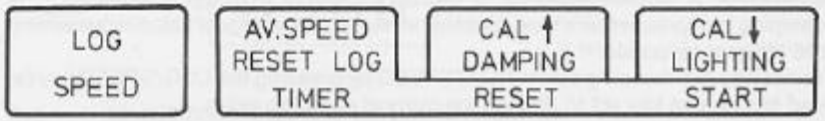
ACCUMULATING LOG	Nautical miles with one decimal place up to 9999 n/miles
RESET LOG	Nautical miles up to 999.9 n/miles
BOAT SPEED	Knots with two decimal places up to 9.99 knots and with one decimal place up 99.9 knots.
ACCELEROMETER	An indication is given on the LCD to show if your speed through the water is increasing, decreasing or constant.
BOAT SPEED DAMPING	Five selectable time constants are available to enable precise steady readings to be obtained in all sea conditions.
AVERAGE SPEED	The average speed is computed from the time at which the system was reset e.g. at the start of a voyage.
TIMER	Harrier 6 has a timer which can count down from 5,10 or 15 minutes. The reading is in minutes and seconds. After reaching zero, the timer continues to indicate elapsed time up to 99 hours 59 minutes and 59 seconds.
CALIBRATION	This is carried out at the keyboard avoiding the need to open the instrument. The calibration setting is retained when the instrument is switched off, by means of an internal battery with a life of several years.
DISPLAY ILLUMINATION	Four levels, adjustable at the keyboard

2.1 SWITCHING ON AND OFF

The Harrier 6 combined speedometer and log is switched on and off at the ship's main switchboard, and no switching is provided at the display unit. Boatspeed is displayed when first switched on as shown below.

The flag to the left of the display, if present, shows that the boat is accelerating or decelerating. The upper position shows acceleration and vice versa. If Boatspeed is not displayed the power-up test sequence has discovered a fault with the wiring or the Display Unit itself. See section 4 of this manual.

2.2 THE KEYBOARD



2.2.1 Log/speed key

By itself key **(a)** brings LOG or BOATSPEED to the display. Successive operations of the key cause the display to change from one to the other.

2.2.2 Av speed/reset log/timer key

Pressing **(b)** causes the display to show AVERAGE SPEED, RESET LOG or TIMER. Successive operations of the key bring up each function in turn.

2.2.3 Cal ↑/damping/reset key

This key **(c)** has three distinct alternative functions which are dependent upon whether the display is showing LOG (key **a**), BOATSPEED (key **a**) or AV SPEED or RESET LOG or TIMER (key **b**).

With BOATSPEED on display, operating key **(c)** brings BOATSPEED DAMPING to the display. Further operation of key **(c)** changes the DAMPING through the available values.

With LOG being shown, operation of **(c)** causes the CALIBRATION value in Hz per knot to be displayed. Further operation of **(c)** together with key **(d)** adjusts the CALIBRATION value (see section 3 of this book).
With AVERAGE SPEED or RESET LOG or TIMER being displayed, key **(c)** is used to reset the function displayed.

2.2.4 Cal ↓/lighting/start key

Key **(d)** has three functions which are dependent on the function being displayed.

If BOATSPEED or LOG is on display then pressing key **(d)** displays the existing lighting level and then changes the display lighting through its four available levels (including OFF).

If any of the functions selected by key **(b)** (AVERAGE SPEED, RESET LOG or TIMER) is on display then key **(d)** is the start control.

With CALIBRATION on display, key **(d)** is used in conjuction with key **(c)** to adjust the calibration. (See section 3 of this book).

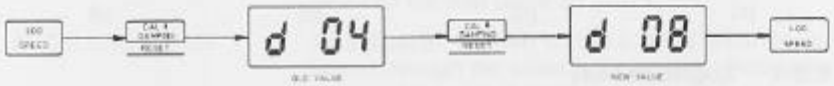
2.3 READING BOAT SPEED

To read boat speed press the LOG/SPEED key. (Successive operations of this key cause the display to alternate between LOG and BOATSPEED). The reading is given in knots with two decimal places up to 9.99 and to one decimal place up to 99.9. An acceleration/deceleration flag appears to the left of the display for speed changes greater than 0.01 knots in one second.

2.3.1 Damping

The damping (speed of response) of this reading is adjustable to suit differing sea conditions. A slower response is usually desirable in rough conditions. The damping is expressed as a time constant in seconds, the largest value representing the slowest response.

To change the damping select BOATSPEED by pressing the LOG/SPEED key **(a)** and then press key **(c)** to display the current damping value.



Press key **(c)** as necessary to obtain the required damping level. Then re-select SPEED. The new damping value is immediately in use.

2.3.2 Average Speed

To display AVERAGE SPEED operate key **(b)**. The display has the letter A to the left.

Only the left hand A is shown when the function is reset. With AVERAGE SPEED on display operate key **(c)** to reset the function (e.g. at the start of a voyage) and use key **(d)** to start.

Warning: Do not rely on the boat speed or log readings until calibration has been correctly performed. See section 3.

2.4 READING LOG

2.4.1 Accumulating log

Press the LOG/SPEED key to display the log reading, which is given in nautical miles. If the key is held down the reading is in thousands of miles, but when released the display shifts after two seconds to reveal tenths of a mile. (Successive operations of this key cause the display to alternate between LOG and BOATSPEED).

2.4.2 Reset log

Press key **(b)** to display RESET LOG. Only at 0 at the left of the display is shown when the function is reset. With RESET LOG on display operate key **(c)** to reset the function (e.g. at the start of a voyage) and use key **(d)** to start.

Note: The log is dependent on correct calibration. Refer to section 3 for details.

2.5 TIMER

Press key **(b)** to display TIMER. The display shows zero or the preset time when reset. With TIMER on display operate key **(c)** to reset the TIMER (e.g. at the start of a voyage). Further presses of key **(c)** can be used to preset the timer to −5, −10 or −15 minutes for count-down. Use key **(d)** to start the timer.

2.6 ADJUSTING DISPLAY ILLUMINATION

With LOG or BOATSPEED on display operate key **(d)** to show the current lighting level. Pressing **(d)** again steps the display through the four lighting levels (including OFF). Re-select LOG or BOATSPEED and the selected lighting level will be operating.

3 CALIBRATION

3.1 SPEED/LOG CALIBRATION

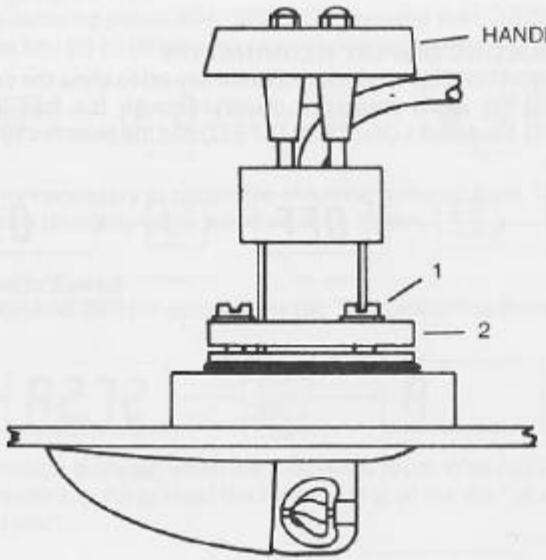
One calibration adjustment is needed for these two functions.

3.1.1 Underwater unit alignment (paddlewheel type)

Ensure that the underwater unit handle is pointing forward.

3.1.2 Underwater unit alignment (impeller type)

With the valveless housing slacken off the three locking screws (1) fully by means of a screwdriver and then slacken the ring-nut (2) if necesary so that the housing is free to rotate. With the boat making constant speed under power with the impeller unit down, turn the handle slowly through a small angle on either side of the fore-and-aft line until a maximum reading of speed is obtained. (the flow lines beneath the hull are not necessarily parallel with the boat's fore-and-aft line). Then re-tighten the ring-nut by hand and screw down screws (1) fully, ensuring that their heads 'bottom' onto the shakeproof washers on the ring-nut (2). Subsequent re-alignment after removing the underwater unit for cleaning or maintenance is obtained automatically when the unit is lowered fully into its operating position.



IMPELLER-TYPE UNDERWATER UNIT & HOUSING

3.1.3 Calculating the correction factor

A series of runs over a measured distance is required. Three methods are described and a choice can be made depending on the prevailing conditions and the accuracy required. In each case a correction factor k is calculated. The new calibration value is the old value divided by k. For example if the present calibration figure is 6.20 and the correction factor $k = 1.03$ divide 6.20 by 1.03 to give a new calibration value of 6.02 to correct the existing under-reading.

Method A is the simplest as no timing is involved, but the vessel must maintain a constant speed for both runs, and it is assumed that the current is constant. Carry out a run in both directions and note the distance for each run using the RESET LOG to give the indicated distance run in each case: D_1 and D_2.

$$\text{If the measured distance} = M \text{ (nautical miles)}$$

$$\text{correction factor } k = \frac{M}{\frac{2}{\left(\frac{1}{D_1} + \frac{1}{D_2}\right)}}$$

Example A

Method B is carried out as above but in addition the time taken for each run t_1 and t_2 is recorded. In this case the speed need not remain constant and calibration can be carried out under conditions when the speed could vary, e.g. whilst under sail or when engine r.p.m. are maintained but the boat is affected by windage.

$$\text{In this case correction factor } k = \frac{M\left(\frac{1}{t_1} + \frac{1}{t_2}\right)}{\frac{D_1}{t_1} + \frac{D_2}{t_2}}$$

Example B

Method C is the most accurate method requiring three runs over the measured distance. Again there is no necessity to maintain constant speed and the calibration can be carried out, if required, under sail. Current is assumed to be increasing or decreasing at a steady rate. Record times and indicated distances as before.

$$\text{correction factor } k = \frac{M\left(\frac{1}{t_1} + \frac{2}{t_2} + \frac{1}{t_3}\right)}{\frac{D_1}{t_1} + \frac{2D_2}{t_2} + \frac{D_3}{t_3}}$$

Example C

Note: for the above calculations M is is measured in nautical miles and t is in decimal hours. (See following table for converting minutes and seconds into decimal hours).

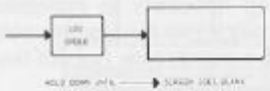
TABLE OF DECIMAL HOURS

MINUTES	SECONDS											
	0	5	10	15	20	25	30	35	40	45	50	55
0		.001	.003	.004	.005	.007	.008	.010	.011	.012	.014	.015
1	.017	.018	.019	.020	.022	.024	.025	.026	.028	.029	.030	.032
2	.033	.034	.036	.037	.038	.040	.041	.043	.044	.046	.047	.049
3	.050	.051	.053	.054	.055	.057	.058	.060	.061	.062	.064	.065
4	.067	.068	.070	.071	.072	.074	.075	.076	.077	.079	.080	.082
5	.083	.085	.086	.087	.089	.090	.092	.093	.094	.096	.097	.098
6	.100	.101	.103	.104	.105	.107	.108	.110	.111	.112	.114	.115
7	.117	.118	.119	.121	.122	.124	.125	.126	.128	.129	.130	.132
8	.133	.135	.136	.137	.139	.140	.142	.143	.144	.146	.147	.149
9	.150	.151	.153	.154	.155	.157	.158	.160	.161	.162	.164	.165
10	.167	.168	.169	.171	.172	.174	.175	.176	.178	.180	.181	.182
11	.183	.185	.186	.187	.189	.190	.192	.193	.194	.196	.197	.199
12	.200	.201	.203	.204	.205	.207	.208	.210	.211	.212	.214	.215
13	.217	.218	.219	.221	.222	.224	.225	.226	.228	.229	.230	.232
14	.233	.235	.236	.237	.239	.240	.242	.243	.244	.246	.248	.249
15	.250	.251	.253	.254	.255	.257	.258	.260	.261	.262	.264	.265
16	.267	.268	.269	.271	.272	.274	.275	.276	.278	.279	.280	.282
17	.283	.285	.286	.288	.289	.290	.292	.293	.294	.296	.297	.299
18	.300	.301	.303	.304	.305	.307	.308	.310	.311	.312	.314	.315
19	.317	.318	.319	.321	.322	.324	.325	.326	.328	.329	.330	.332
20	.333	.335	.336	.337	.339	.340	.342	.343	.344	.346	.347	.349

3.1.4 Adjusting the log/speed calibration

Operate key **(a)** to display LOG and then press key **(d)** to display the existing calibration value in Hz/knot. (The initial factory value is 6.25). Use keys **(c)** or **(d)** as required to change the display to the new value.

Then hold down key **(a)** until the display goes blank (approximately five seconds). This fixes the new value into the instrument memory.



3.2 UNITS OF MEASUREMENT

The Harrier 6 can be set to measure speed in metres/second and distance in kilometres instead of the standard factory setting of knots and nautical miles. **Warning:** the accumulated log value is **not** recalculated when this happens and the change should only be made when the instrument is first installed. After the change the log continues to count in the new units.

First display the unit selection by pressing LOG/SPEED to display BOATSPEED and then hold down CAL ☼/LIGHTING/START for five seconds. Observe the display.

u1 is the standard factory setting which indicates speed measurement in knots and distance in nautical miles.

u2 indicates speed measurement in metres/second and distance in kilometres.

To change units press CAL ☼/LIGHTING/START key again. Then hold down LOG/SPEED until the display goes blank (approx. five seconds). The new selection is now fixed in the computer memory and will be retained when the power is switched off.

3.3 OUTPUT PULSES

The Harrier 6 can be set to provide an output of 200 pulses/nautical mile (200 pulses/kilometre if operating in metric units as described in section 3.2) for connection to a satellite navigator, or to provide an output at the same frequency as the underwater unit for connection to further B&G instruments.

First display the output mode by pressing LOG/SPEED to display LOG. Then hold down the CAL ☼/LIGHTING START key for five seconds. Observe the display.

out 1	indicates 200 pulses per unit of distance (n/miles or kilometres as selected)
out 2	indicates an output of the same frequency as the Paddlewheel unit for use with further B&G instruments.

To change the output mode press CAL ☼/LIGHTING START key again and hold down the LOG/SPEED key until the display goes blank (approx. five seconds). The selection is now fixed in the computer memory and will be retained when the power is switched off.

4 MAINTENANCE

4.1 ROUTINE MAINTENANCE

4.1.1 Underwater unit housing

Keep the screw thread of the housing well greased with silicone or water pump grease. Ensure that the outer surfaces of the housing are properly coated with anti-fouling paint.

4.1.2 Underwater unit

The underwater unit must be kept free from marine growth using a stiff brush. The sealing ring must be kept liberally greased (water-pump or silicone type).

4.1.3 Desiccator

Should the display window show signs of moisture having penetrated the seals, e.g. misting of the glass or condensation, the desiccator should be removed from the rear of the instrument and reactivated by placing in an oven or drying cupboard for approximately two hours at a temperature of 270°F (130°C). Plug the desiccator hole and keep the instrument dry during reactivation.

4.2 FAULT FINDING

DISPLAY BLANK	Check the main switchboard, batteries, & wire connections at back of the instrument. If O.K. return the instrument to an agent for repair.
INTERMITTENT DISPLAY	Check for intermittent fault in power supply.
INCORRECT SPEED/ LOG READING	Check underwater unit connections. Withdraw the underwater unit, fitting the sealing cap in its place, spin the paddle wheel or impeller by blowing on it, and check for a speed reading. Has the calibration been carried out? If no fault is identified return the instrument to a B&G agent for repair.
CONDENSATION	Remove desiccator and heat in an oven at 130°C. Keep the instrument warm and dry, fit the desiccator while still hot.
DISPLAY OF 'C 6.20' WHEN POWER IS FIRST APPLIED (NO KEY PRESSED)	Internal battery not working. Instrument will still operate but LOG and CALIBRATION values may not be preserved when external power is removed. Return the instrument to a B&G service agent for a replacement battery.
DISPLAY OF 'out 1' OR 'out 2' WHEN POWER IS FIRST APPLIED (NO KEY PRESSED)	Output terminal short-circuit. Instrument will still operate. Check wiring to output terminal.

5 PARTS LIST

Harrier 6 Display Unit	222-00-006
Changeover switch	190-00-146
Hull housing with integral weed deflector, standard, with sealing cap, ring nut and washers*	117-00-046
Replacement hull housing with integral weed deflector*	117-30-032
Underwater unit, standard with 12m cable*	117-00-120
Impeller fin unit with impeller*	110-10-B21
Paddle wheel hull housing with nut, plug and cap	202-00-010
Paddle wheel unit with cable (12m)	202-00-011
Cable, power (9m)	135-0A-096
Cable, display unit to changeover switch (3m)	135-0A-098

*impeller type only

6 SPECIFICATION

General

Display:
liquid crystal display with four large 17.8 mm digits.

Construction:
glass-filled thermoplastic case. Fully sealed and fitted with a desiccator which can be removed and re-activated.

Size and weight:
110 mm (4.375 in) x 110 mm x 42 mm (1.7 in)
500 g (1 lb)

Paddlewheel unit:
Height from outer surface of hull: 115 mm (4.5 in)
Withdrawal height: 305 mm (12 in)

Underwater unit (impeller type):
Height from outer surface of hull:
Operating: 160 mm (6.25 in)
Retracting: 200 mm (7.75 in)
Withdrawal: 290 mm (11.375 in)

Standard cable lengths:
Paddlewheel unit cable 12m
Power cable 3m

Performance

Temperature: operating range –10°C to +60°C
storage range –25°C to +80°C

Humidity range: 0 to 100%

Speed resolution: 0.01 knot

Reset log resolution: 0.01 nautical mile

Data retention: all settings are retained while power is off for more than three years using a standard 3V lithium battery (BR1225).

Calibration range: 0.50Hz/knot to 9.99Hz/knot, which gives a percentage change in displayed speed of –35.5% to +1150% compared with the factory setting of 6.20Hz/knot.

Boat speed damping: 2, 4, 8, 16 or 32 seconds (selectable at keyboard)

Satnav interface: 200 pulses/nautical mile (or 200 pulses/km if metric units have been selected, see 3.2)

Display time: 1 second

Accuracy after calibration: ±1%

Timer accuracy: ±1 second/day

Boatspeed display range: 0.01 knot to 99.9 knot

Average speed display range: 0.01 knot to 99.9 knot

Log range: 0.1 n/mile to 9999.9 n/mile

Reset log range: 0.01 n/mile to 99.99 n/mile

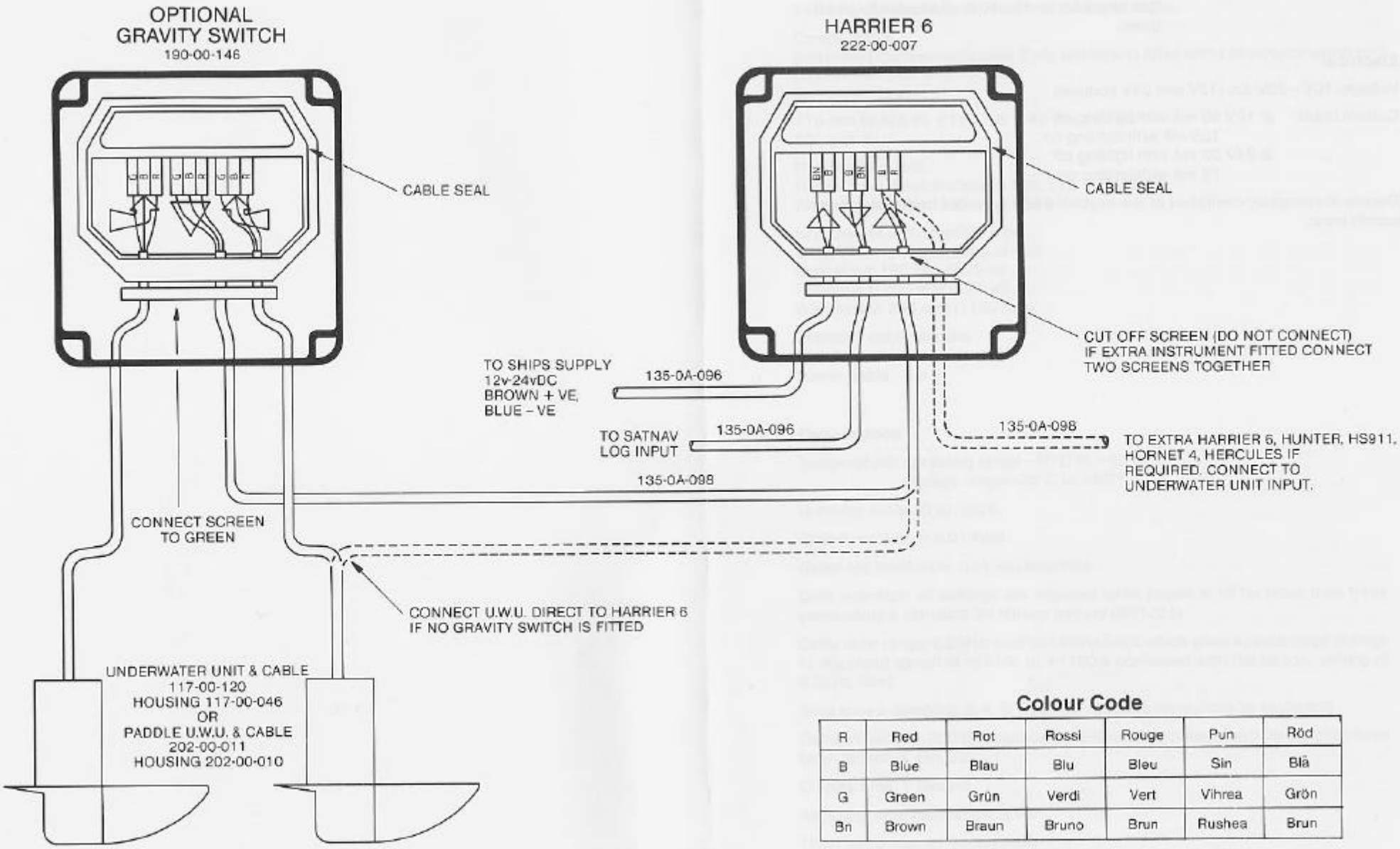
Timer range: 1 second to 99 hours 59 minutes & 59 seconds
Can be preset to –15, –10 or –5 minutes for count-down.

Electrical

Voltage: 10V – 30V d.c. (12V and 24V nominal)

Current drain: @ 12V 50 mA with lighting off
125 mA with lighting on
@ 24V 30 mA with lighting off
75 mA withlighting on

Display illumination: controlled at the keyboard and powered from main power supply input.



Colour Code

R	Red	Rot	Rossi	Rouge	Pun	Röd
B	Blue	Blau	Blu	Bleu	Sin	Blå
G	Green	Grün	Verdi	Vert	Vihrea	Grön
Bn	Brown	Braun	Bruno	Brun	Rushea	Brun

7 CONNECTIONS DIAGRAM