

# **B&G**

*EXCELLENCE IN MARINE ELECTRONICS*

## ***HYDRA/HERCULES ACP PILOT INSTALLATION & COMMISSIONING MANUAL***

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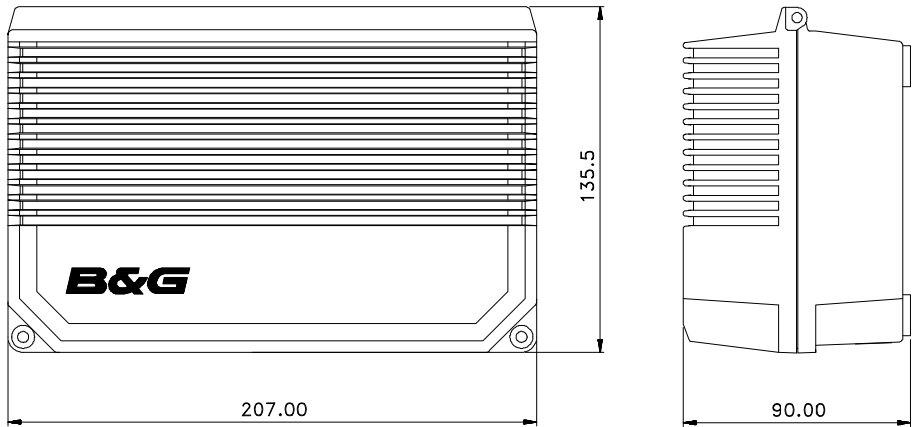
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# 1 : ACP SYSTEM UNITS

**ADVANCED CONTROL PROCESSOR UNIT**



**DESCRIPTION**

The Advanced Control Processor (ACP) Unit contains all the electronics for the autopilot operation and control of the rudder drive options. This computer unit requires the ACP Compass Unit (see next section). The casing is hinged on the long edge, the unit can be opened wide allowing easy access for mounting the unit and making connection to the terminals within. The cables from the other units of the autopilot system enter the computer along the other long edge of the unit.

**The ACP Unit is available in two configurations:**

- |              |                 |                                    |
|--------------|-----------------|------------------------------------|
| <b>ACP 1</b> | <b>12V only</b> | <b>12 amps max. output current</b> |
| <b>ACP 2</b> | <b>12/24V</b>   | <b>25 amps max. output current</b> |

## 1 : ACP SYSTEM UNITS

The 24V ACP 2 unit will control the following rudder drive options:

- Size 1/12V Hydraulic Ram Drive 445-00-061 black
- Size 2/12V Hydraulic Ram Drive 445-00-062 black
- Size 3/24V Hydraulic Ram Drive 445-00-063 black
- Size 1/12V Hydraulic Ram Drive RAM-T1-12V blue
- Size 2/12V Hydraulic Ram Drive RAM-T2-12V blue
- Size 3/24V Hydraulic Ram Drive RAM-T3-24V blue
  
- Size 1/12V Hydraulic Pump 445-00-068 black
- Size 1/24V Hydraulic Pump 445-00-069 black
- Size 2/12V Hydraulic Pump 445-00-033 black
- Size 2/24V Hydraulic Pump 445-00-067 black
- Size 1/12V Hydraulic Pump PMP-T1-12V blue
- Size 2/12V Hydraulic Pump PMP-T2-12V blue
- Size 3/24V Hydraulic Pump PMP-T3-24V blue
  
- 12V Rotary Drive Unit RDU-T1-12V
- 24V Rotary Drive Unit RDU-T3-24V
- Stern Drive Unit SDU-T1-12V

The 12V ACP 1 Unit will control the following rudder drive options:

- Size 1/12V Hydraulic Ram Drive 445-00-061 black
- Size 1/12V Hydraulic Ram Drive RAM-T1-12V blue
  
- Size 1/12V Hydraulic Pump 445-00-068 black
- Size 1/12V Hydraulic Pump PMP-T1-12V blue
  
- 12V Rotary Drive Unit RDU-T1-12V
- Stern Drive Unit SDU-T1-12V


### **SITING THE ACP UNIT**

---

- It is recommended that the ACP unit is mounted with the cable entry points downwards. It must not be mounted with the cable entries uppermost as water may run down the cables and into the unit.
- Ensure that there is sufficient space to allow the unit to be hinged open to make connections to terminals inside, and that the hinges of the two halves of the case may be slid apart.
- Select a position sheltered from the direct effects of the environment and from physical damage.
- Do not mount the unit within 1m/3ft of engines, starter motors and cables, and other cables carrying heavy current, etc., or 3m/10ft of Radar or SSB installation cables.

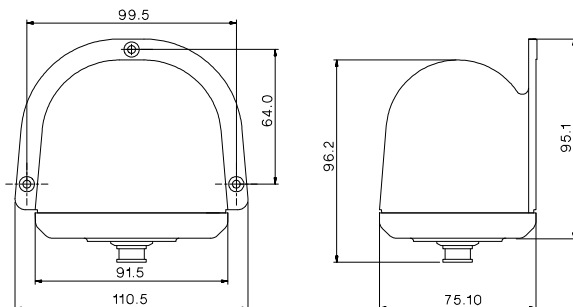
### **MOUNTING PROCEDURE**

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- Undo the two screws at the corner of the unit, and open fully.
  - The hinges are designed to come apart. This enables the electronics to be split from the base of the unit i.e. the connection and terminal blocks.
  - Disconnect the cables between the two halves of the casing.
  - Firmly push the two halves of the computer unit apart.
  - Using the base of the unit as a template, mark the positions of the three mounting screw holes.
  - Using the self-tapping screws provided secure the base of the unit in position.
  - Push the two halves of the unit together again and reconnect the cables.
- 

## 1 : ACP SYSTEM UNITS

### ACP REMOTE COMPASS UNIT



### DESCRIPTION

**IMPORTANT NOTE:** This external fluxgate compass unit can **ONLY** be used with ACP Pilot Systems or Network Compass displays. It **WILL NOT** provide the correct outputs for use with older Type 1 Pilot Systems requiring an external compass unit. In this case a Super Halcyon 3 will be required.

The ACP Remote Compass Unit is a gimbal mounted electronic fluxgate for use with ACP Pilot Systems. The unit is housed in a sealed casing constructed of high impact plastic. It is therefore suitable for on or below deck mounting.

If the installation is in a vessel with a steel or reinforced concrete hull it maybe be necessary to install the external compass unit outside the magnetic screening affect of the hull and super-structure, eg on the mast.

It is supplied with a 12m, 6-core screened cable, one end with a sealed connector for the compass unit and the other connecting directly into the ACP 2 Unit.



### **SITING THE COMPASS UNIT**

---

- Mount the unit upright on a flat, vertical bulkhead.
- A safe distance from external magnetic interference: 1m/3ft from VHF, RDF, loudspeakers, depth sounders, engines, power cables carrying heavy current, etc., 3m/10ft from Radar and SSB Equipment.
- Reasonably well protected from direct physical damage.
- With the connector downwards as shown in the above diagram.

### **MOUNTING PROCEDURE**

---

- Secure the unit in the selected site using the self-tapping screws provided.
- Route the cable to the computer unit avoiding other cables carrying heavy currents, e.g. engine starter, trim tab, etc.
- Secure in place with cable clips or tie-wraps.
- Avoid bending the cable through a tight radius especially near the connector as this may damage the wires inside the cable.

### **SUPER HALCYON 3 EXTERNAL COMPASS (OPTIONAL)**

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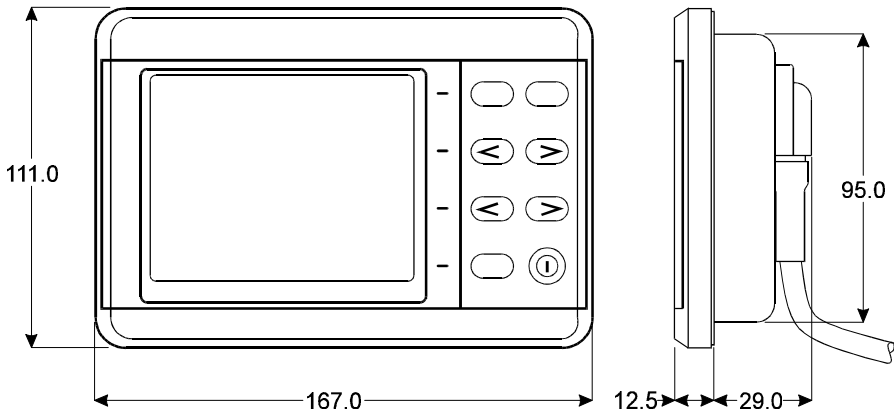
The Super Halcyon 3 compass unit is connected into the Hydra or Hercules system processor, providing heading information to the pilot via the “Fastnet” network. This can be used in lieu of the ACP Compass Unit.

Refer to Super Halcyon and instrument system manuals for details. When the Super Halcyon 3 compass is used it will have to be selected when the ACP Pilot is commissioned.

NOTE: Compass calibration will have to be carried out in accordance with the Super Halcyon 3 Owner's Manual and not as described in the Commissioning Section of this manual.

## 1 : ACP SYSTEM UNITS

### **PILOT DISPLAY**



### **DESCRIPTION**

The Pilot display allows the autopilot to be operated and initialised. It is essential that the autopilot is initialised before operation, details are given in the commissioning section of this manual.

The Pilot display is connected onto the Hydra, HS921 or Hercules instrument "Fastnet" network system. This enables multiple Pilot displays to be used with any combination of FFD's (NMEA or non-NMEA), 20/20CD or Halcyon Compass Displays to form a totally integrated navigation system. Where multiple Pilot displays are installed, the autopilot can be controlled from any Pilot display station.

### SITING THE PILOT DISPLAY

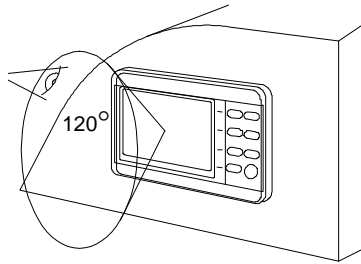
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The display is fully sealed and designed for mounting on or below deck. Select a display site that is:

- At a convenient position within easy reach of the helmsman
- On a smooth and flat surface
- At a Compass safe distance 100mm (4")
- Reasonable well protected from physical damage.

### FLUSH MOUNTING THE PILOT DISPLAY

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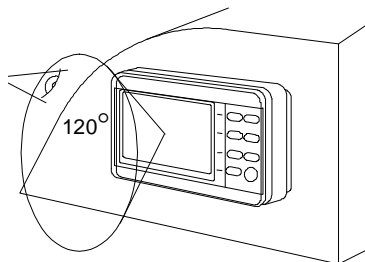


- Select a bulkhead position that approximates the viewing angle shown.
- Cut hole in bulkhead, use the cutting template supplied.
- Seal the cut edge in GRP hulls.
- Ensure gasket (supplied) is fitted to prevent leakage.
- Screw display in place using self tapping screws (supplied).
- Snap bezel on to display unit.
- Route cable to system network, connect in a network junction box as per installation sheet.
- Carbon composite materials should be cut back to give at least a 3mm (1/4") clearance around the metal back of the display.

## 1 : ACP SYSTEM UNITS

### SURFACE MOUNTING THE PILOT DISPLAY

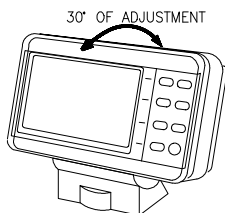
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- Use Surface mount box Part No.239-00-072
- Select a bulkhead position that approximates viewing angle shown.
- Screw the surface mount box on to the bulkhead.
- Cut 10mm hole for cable entry.
- Thread cable carefully through hole.
- Assemble display unit and mounting box, with fixing screws provided.
- Snap bezel on to display unit.
- Route cable to system network, connect in a network junction box as per installation sheet.

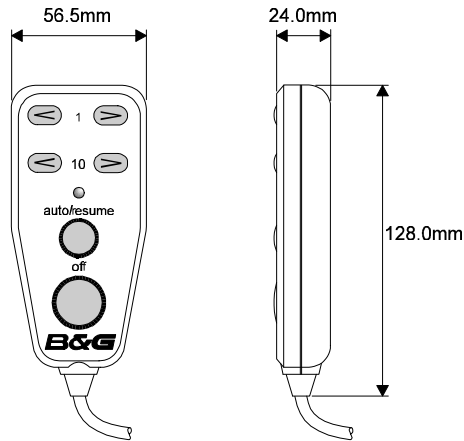
### ADJUSTABLE MOUNT FOR PILOT DISPLAY

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- Use Adjustable Mounting Bracket Part No.239-00-074.
- The bracket allows mounting on a sloping or horizontal surface, e.g power boats consoles, chart table etc.
- Refer to installation sheet supplied for assembly instructions.

## HAND-HELD CONTROLLER



### DESCRIPTION

---

The hand-held remote controller is a waterproof unit that has six function buttons and a status LED to indicate the operating mode of the autopilot. The unit provides palm-of-the-hand control of the PILOT. The cable has a 10 metres straight section, plus a coiled length that extends from 1 to 3 metres.

### SITING THE HAND-HELD UNIT

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- At a convenient position within easy reach of the helmsman
- Ensure at all times the hand-held remote controller's cable does not become snagged on any moving parts e.g. throttle controls.

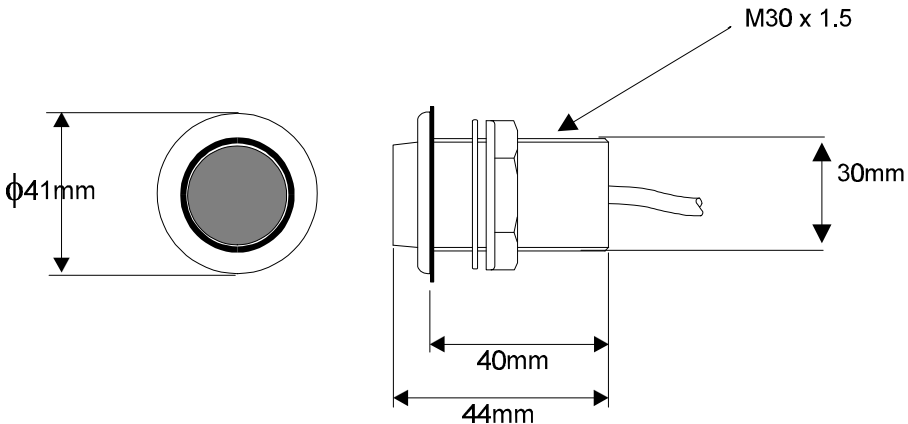
### MOUNTING PROCEDURE

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- Heavy duty self-adhesive Velcro strip is supplied with the unit
- Clean and de-grease the site, stick the Velcro in firmly place.

## 1 : ACP SYSTEM UNITS

### **MAN OVERBOARD BUTTON (MOB)**



### **DESCRIPTION**

The man overboard alarm button (MOB) is a large red waterproof switch with 15 metres of two-core screened cable. This button starts the MOB sequence of operations when pressed and the audible alarm sounds (if fitted).

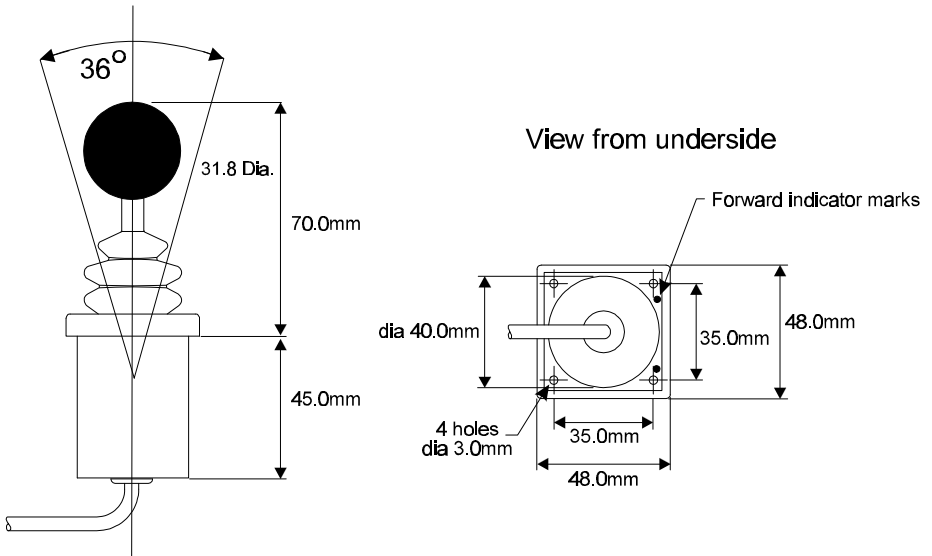
### **SITING THE MAN OVERBOARD ALARM BUTTON**

- Select a suitable bulkhead, easily accessible in an emergency.

### **MOUNTING PROCEDURE**

- With a 32mm (1 1/4") hole-cutter cut a clearance hole for the button body.
- Remove the nut and washer then, ensuring the sealing gasket is in place to prevent leakage, carefully feed the cable through the hole.
- From behind the bulkhead, fit the washer and nut and tighten.

## ACP JOYSTICK



## DESCRIPTION

The joystick allows direct control of the vessel's rudder via the autopilot control electronics. The unit is deck-mountable, allowing it to be used at inside or outside steering positions. A 10m/30ft 6-core screened cable connects the unit directly into the ACP Units terminals.

Joystick steering is engaged and disengaged with the separate red button. The lever can only be moved to port or to starboard.

## SITING THE JOYSTICK UNIT

- At a convenient position within easy reach of the helmsman.


# 1 : ACP SYSTEM UNITS

## MOUNTING PROCEDURE

---

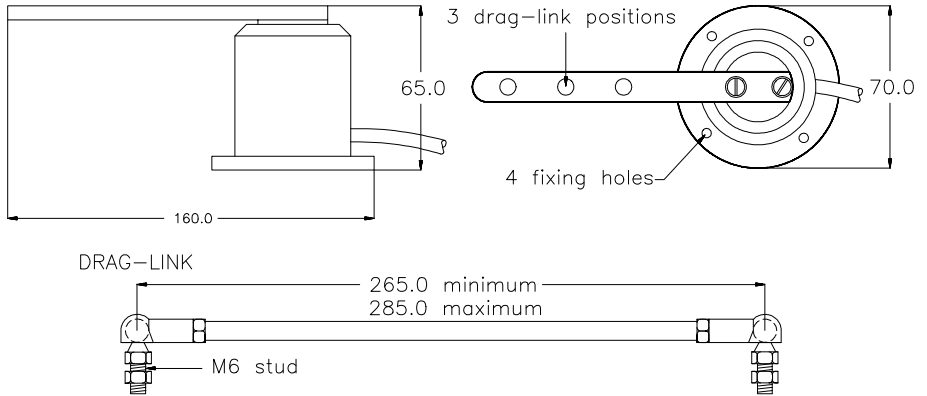
- To ensure correct steering sense the unit is marked with two indents, the unit must be installed with these forward.
- The unit requires at least 65mm/2.5" clearance behind the selected mounting position.
- Use a 40mm (1 9/16th") hole cutter for the joystick body.
- Ensure the gasket is fitted under the joystick body flange.
- Secure in place with self-tapping screws.
- Route the cable to ACP unit. Connect as per instruction in Section 4 of this handbook.

For details on how to install the controller button refer to the MOB section.





## RUDDER REFERENCE UNIT (RRU)



### DESCRIPTION

The Rudder Reference Unit (RRU) is a sealed high specification potentiometer, in a robust casing providing rudder position information to the Computer Unit. The operating arm is constructed in aluminium with three positions ready drilled for the adjustable drag-link. The drag-link, has ball-joints at each end that connect the unit operating arm to the tiller arm or steering quadrant. The unit base has four holes to allow for mounting. The unit is supplied with 10 metres of 3-core screened cable.

## 1 : ACP SYSTEM UNITS

### KEY POINTS WHEN INSTALLING THE RRU

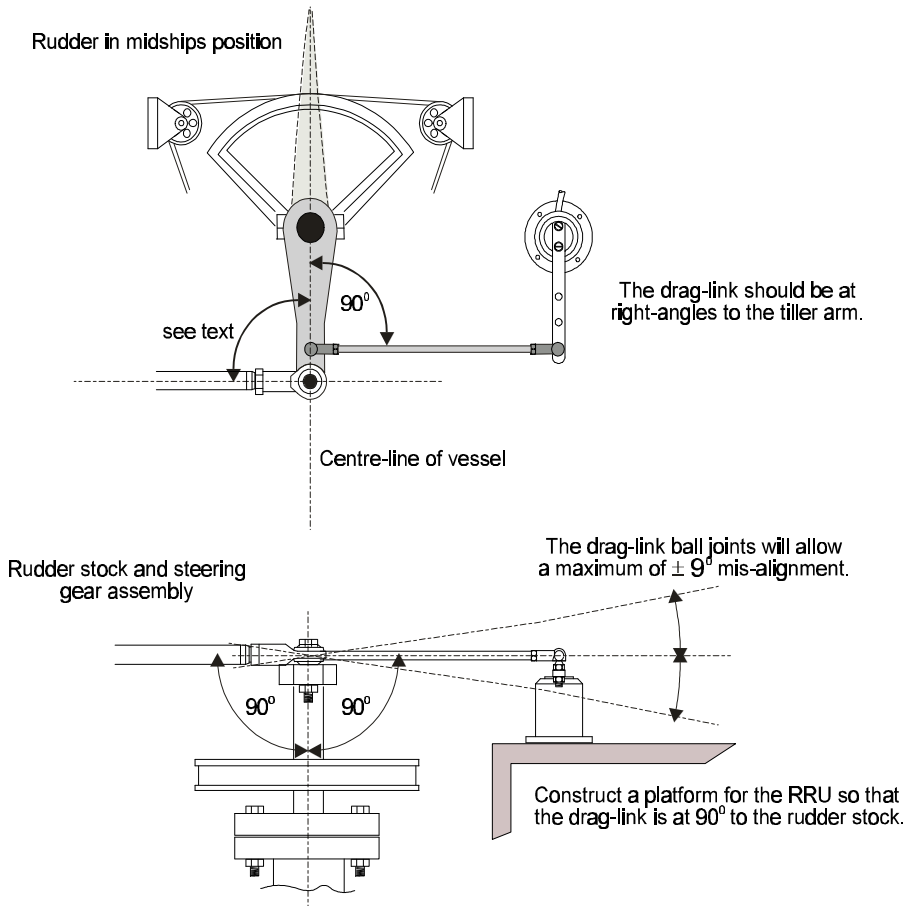
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- General consideration must be given to the steering system and its geometry before commencement of the RRU installation. Many factors must be contemplated for a practical solution, the information given here is for guidance only, although where a maximum or a minimum value is given these must be adhered to.
- Mount the RRU on a flat surface next to the tiller arm or steering quadrant, construct a small platform if necessary.
- Do not lengthen the drag-link arm as this can transmit excessive vibration loads to RRU and will invalidate the warranty.
- The unit operating arm can be rotated through  $360^{\circ}$ , the mid-point of the RRU travel is when the operating arm is opposite the cable entry point.
- When the rudder is moved from hard-over port to hard-over starboard the RRU arm should swing through a minimum of  $90^{\circ}$ , this will ensure that there is sufficient voltage output to the autopilot. Measure the voltage difference between the green and blue wires of the RRU, there should be a minimum of 1 volt from hard over to hard over. N.B. If there is less than 1 Volt variation the Pilot will not commission.
- After installation check full movement of the steering system ensuring that there is no fouling between the steering gear, RRU parts and ram drive unit if fitted.

## 1: ACP SYSTEM UNITS

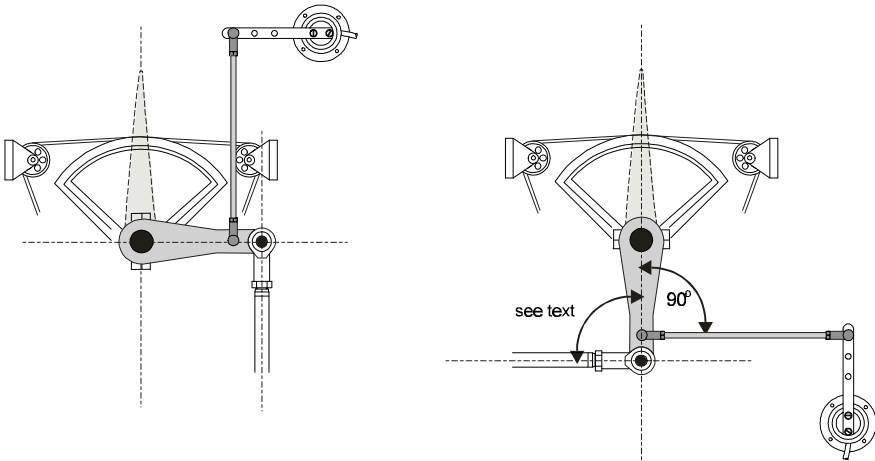
- Ensure that there is no backlash in the linkage between the RRU and the steering gear, else incorrect operation of the autopilot will occur.

The example below shows a plan view of a typical system with a tiller arm and quadrant. When viewed in elevation, the ram drive arm and rudder reference unit drag-link must not be more than  $\pm 9^\circ$  from horizontal. Ideally everything should be horizontally aligned, this prevents excessive stress during operation.

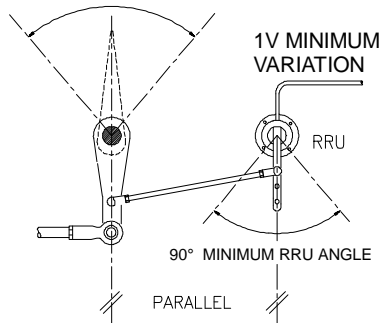


# 1 : ACP SYSTEM UNITS

The RRU can be mounted in many different positions and orientations depending on the layout of the steering system.

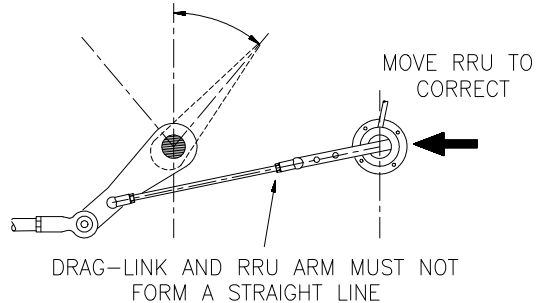


If the maximum rudder angle is less than  $90^{\circ}$  then the position of the RRU or the drag-link must be adjusted so that the operating arm of the RRU swings through a minimum of  $90^{\circ}$  and the output voltage difference is greater than 1 volt from port to starboard lock. Measure the output of the RRU between the green and blue wires. N.B. If there is less than 1 Volt difference the Pilot will not commission.



## 1: ACP SYSTEM UNITS

The rudder hard over angle should only be limited by the rudder stops and not the RRU linkage. Check that when hard over the RRU arm and drag-link, do not form a straight line. If this occurs the steering system could become damaged or jammed endangering the boat and crew. Rectify this immediately by adjusting the position of the RRU.



**SECTION 2 CONTENTS**

**SECTION 2 CONTENTS** \_\_\_\_\_ **1**

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## 2 : RUDDER DRIVE OPTIONS


### ***RAM DRIVE UNIT***

#### **DESCRIPTION**

---

---

A compact DC driven reversible hydraulic pump and hydraulic cylinder assembly for boats without hydraulic steering systems. Three sizes of ram drive are available giving a wide thrust range to suit all sizes and types of vessel. Two varieties of ram are supplied which are colour coded as blue or black. The principal of operation is similar for these two, however the installation details vary. Hence first determine the colour code of the ram and refer to the appropriate section below.



### ***BLUE RAMS***

Type 1 and type 2 rams combine motor, pump and hydraulic cylinder as one unit referred to as an actuator. Type 3 rams are supplied split into a separate motor/pump unit, reservoir and hydraulic cylinder, connected by 1 metre hoses. Longer hoses are available, please contact your dealer. The units can also be mounted on a vertical bulkhead provided care is taken not to exceed the maximum angles between the foot and the cylinders or actuators shown in the diagrams below.



## 2 : RUDDER DRIVE OPTIONS

### RAM DRIVE DATA (BLUE TYPES)

RAM DRIVE TYPE	RAM SIZE1 BLUE	RAM SIZE 1 BLUE	RAM SIZE 2 BLUE	RAM SIZE 3 BLUE
ACP UNIT	ACP1	ACP2	ACP2 only	ACP2 only
MOTOR SUPPLY	12V DC	12V DC	12V DC	24V DC
SOLENOID VALVE SUPPLY	12V DC 1.25A (max)	12V DC 1.25A (max)	12V DC 1.25A (max)	24V DC 0.8A (max)
PEAK THRUST	425 kg force 935 lbs-force	680 kg force 1496 lbs-force	680 kg force 1496 lbs-force	1062 kg force 2342 lbs-force
PEAK CURRENT	14A @ 12V	20A @ 12V	25A @ 12V	17A @ 24V
MAXIMUM STROKE	254mm 10"	254mm 10"	254mm 10"	305mm 12 "
FULL BORE AREA	1208 mmsq, 1.872 "sq	1208 mmsq, 1.872 "sq	1208 mmsq, 1.872 "sq	1885 mmsq, 2.921 "sq
ANNULUS AREA	1005 mmsq, 1.558 "sq	1005 mmsq, 1.558 "sq	1005 mmsq, 1.558 "sq	1570 mmsq, 2.434 "sq
ROD DIAMETER	16 mm, 0.623 "	16 mm, 0.623 "	16 mm, 0.623 "	20 mm, 0.623 "
TILLER ARM for 70 <sup>0</sup> rudder	214 mm 8.4 "	214 mm 8.4 "	214 mm 8.4 "	257 mm 10.16 "
MAXIMUM TORQUE	891 Nm 7854 lb.ins	1427 Nm 12566 lb.ins	1427 Nm 12566 lb.ins	2688 Nm 23780 lb.ins
WEIGHT	7 kg, 15 lbs 6oz	7 kg, 15 lbs 6oz	7 kg, 15 lbs 6oz	10.3 kg, 22lbs 11oz
HELM TO HELM TIME extend retract (200Kg force)	18.5 sec 15.9 sec	18.5 sec 15.9 sec	11.9 sec 10.2 sec	14.6 sec 12.6 sec

The following table may be used to determine the steering system geometry for different maximum rudder angles and ram type. The last three columns show the peak torque available (in Kgm), at midships position and at the maximum rudder angle, with the latter two with the motor running at 50% duty cycle.

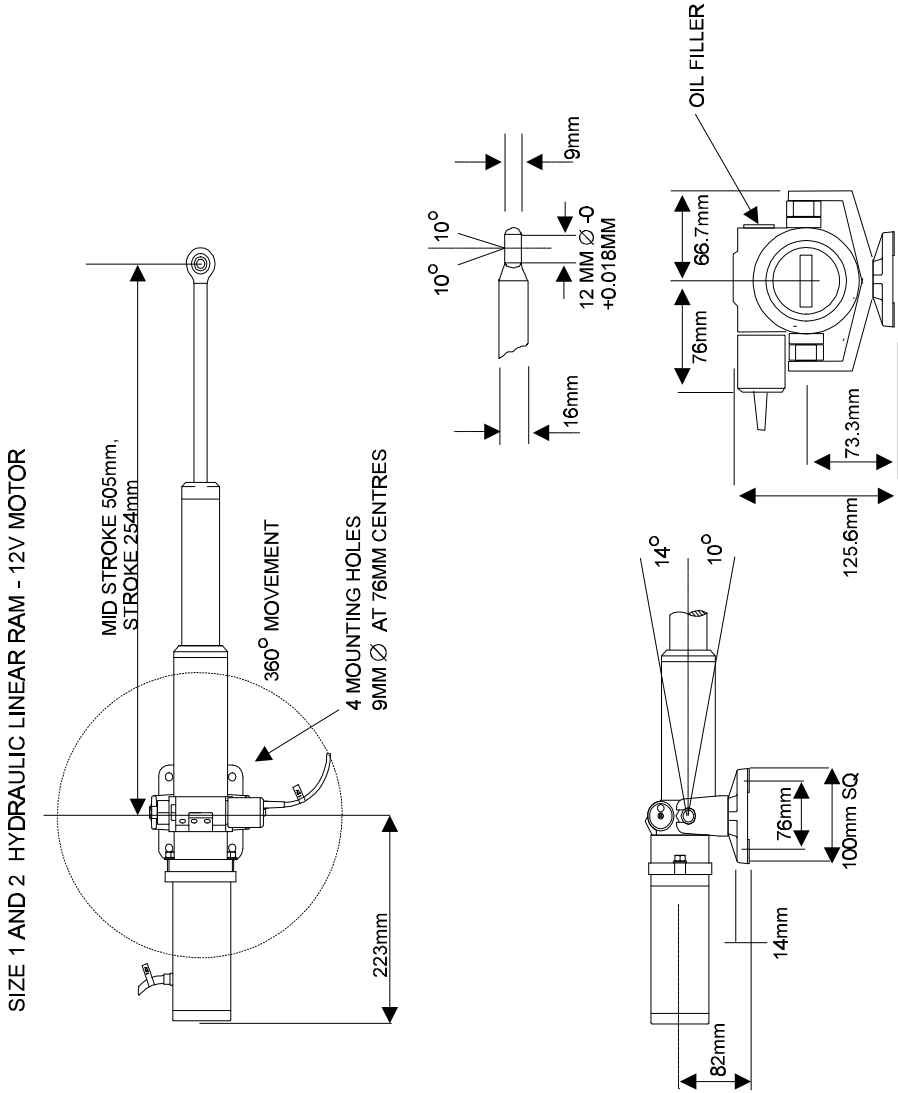
## 2 : RUDDER DRIVE OPTIONS

<b>RAM-T1-12V</b>		midstroke =	505mm	ACP1 only	d=	73.3
<b>1/2 max</b>	<b>Tiller arm</b>	<b>Offset</b>	<b>Thrust</b>	<b>Torque at</b>	<b>Torque at</b>	<b>Torque</b>
<b>rudder angle</b>	<b>mm</b>	<b>mm</b>	<b>(peak</b>	<b>midships</b>	<b>midships</b>	<b>(at max °</b>
<b>a</b>	<b>b</b>	<b>c</b>	<b>Kgf)</b>	<b>(peak Kgm)</b>	<b>(50% Kgm)</b>	<b>50% Kgm)</b>
25	290	272	425	123	123	118
30	245	227	425	104	104	90
35	214	196	425	91	91	74
40	190	172	425	81	81	62
45	173	155	425	74	74	52
50	160	142	425	68	68	44
<b>RAM-T1-12V</b>		midstroke =	505mm	ACP2 only	d=	73.3mm
<b>1/2 max</b>	<b>Tiller arm</b>	<b>Offset</b>	<b>Thrust</b>	<b>Torque at</b>	<b>Torque at</b>	<b>Torque</b>
<b>rudder angle</b>	<b>mm</b>	<b>mm</b>	<b>(peak</b>	<b>midships</b>	<b>midships</b>	<b>(at max °</b>
<b>a</b>	<b>b</b>	<b>c</b>	<b>Kgf)</b>	<b>(peak Kgm)</b>	<b>(50% Kgm)</b>	<b>50% Kgm)</b>
25	290	272	680	197	197	179
30	245	227	680	167	167	144
35	214	196	680	145	145	119
40	190	172	680	129	129	99
45	173	155	680	118	118	83
50	160	142	680	109	109	70
<b>RAM-T2-12V</b>		midstroke =	505mm	ACP2 only	d=	73.3mm
<b>1/2 max</b>	<b>Tiller arm</b>	<b>Offset</b>	<b>Thrust</b>	<b>Torque at</b>	<b>Torque at</b>	<b>Torque</b>
<b>rudder angle</b>	<b>mm</b>	<b>mm</b>	<b>(peak</b>	<b>midships</b>	<b>midships</b>	<b>(at max °</b>
<b>a</b>	<b>b</b>	<b>c</b>	<b>Kgf)</b>	<b>(peak Kgm)</b>	<b>(50% Kgm)</b>	<b>50% Kgm)</b>
25	290	272	680	197	128	116
30	245	227	680	167	108	94
35	214	196	680	145	95	77
40	190	172	680	129	84	64
45	173	155	680	118	77	53
50	160	142	680	109	71	45
<b>RAM-T3-24V</b>		midstroke =	690mm	ACP2 only	d=	51mm
<b>1/2 max</b>	<b>Tiller arm</b>	<b>Offset</b>	<b>Thrust</b>	<b>Torque at</b>	<b>Torque at</b>	<b>Torque</b>
<b>rudder angle</b>	<b>mm</b>	<b>mm</b>	<b>(peak</b>	<b>midships</b>	<b>midships</b>	<b>(at max °</b>
<b>a</b>	<b>b</b>	<b>c</b>	<b>Kgf)</b>	<b>(peak Kgm)</b>	<b>(50% Kgm)</b>	<b>50% Kgm)</b>
25	350	326	1062	372	372	337
30	295	271	1062	313	313	271
35	257	233	1062	273	273	223
40	230	206	1062	244	244	187
45	210	186	1062	223	223	157
50	193	169	1062	205	205	131

## 2 : RUDDER DRIVE OPTIONS

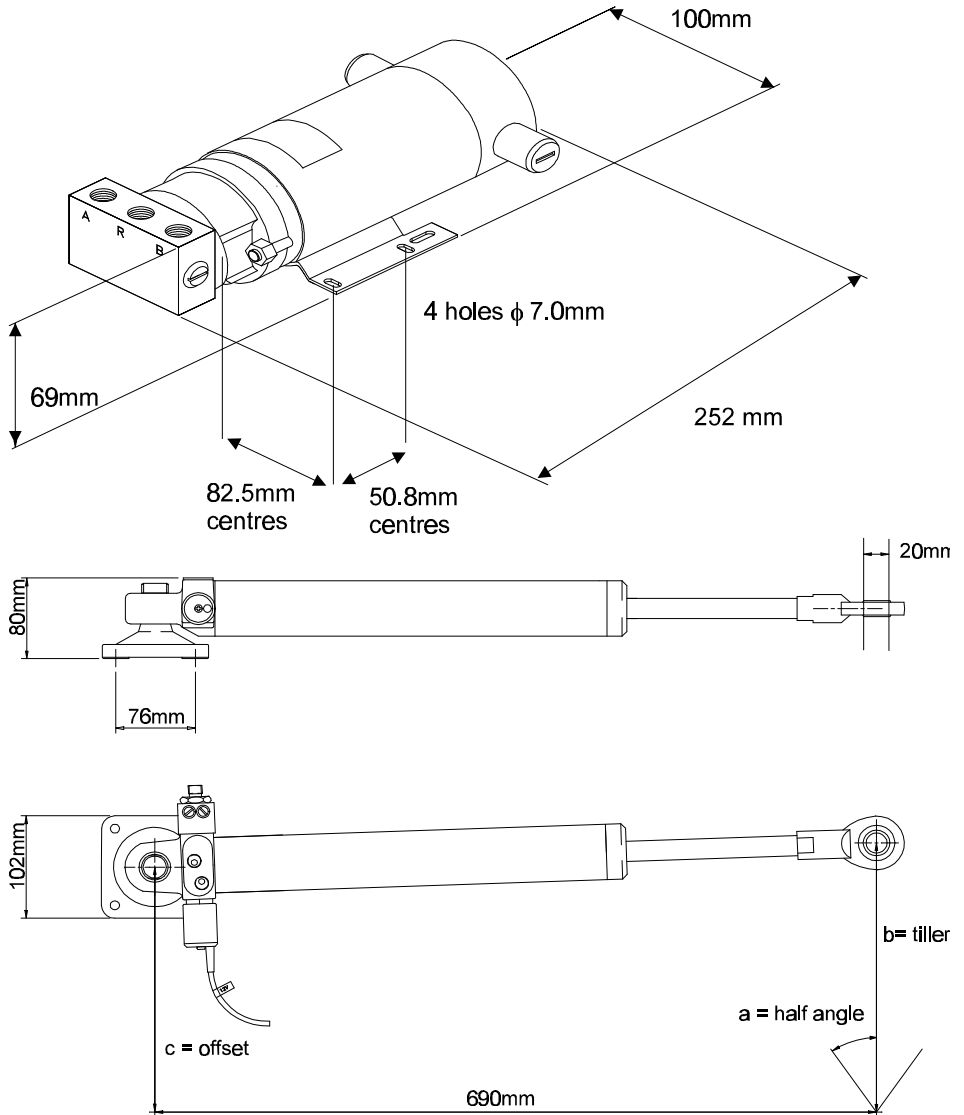
### RAM DRIVE UNIT DIMENSIONS - BLUE SIZE 1 AND 2 ACTUATORS AND BLUE RAMS

#### ACTUATOR UNIT DIMENSIONS - BLUE SIZES 1 AND 2



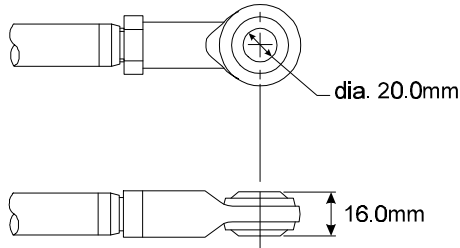
## 2 : RUDDER DRIVE OPTIONS

### PUMP AND RAM DRIVE UNIT DIMENSIONS - BLUE SIZE 3

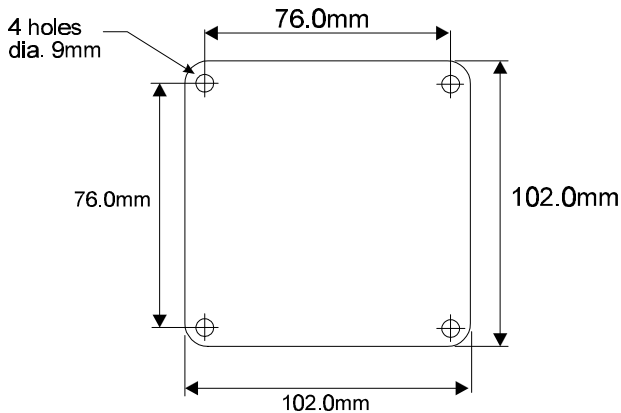


## 2 : RUDDER DRIVE OPTIONS

### ROSE JOINT DETAIL



### MOUNTING PLATE DETAIL



## RAM DRIVE UNIT INSTALLATION

General consideration must be given to the steering system and its geometry before commencement of the installation. Many factors must be contemplated for a practical solution, the information given here is for guidance only, although where a maximum or minimum value is given this must be adhered to. It is essential that the unit is only installed in a fully functional

## 2 : RUDDER DRIVE OPTIONS

steering system, with no backlash or stiffness when operating. Rectify any steering problems before installation of the ram drive unit or the autopilot will not function correctly.

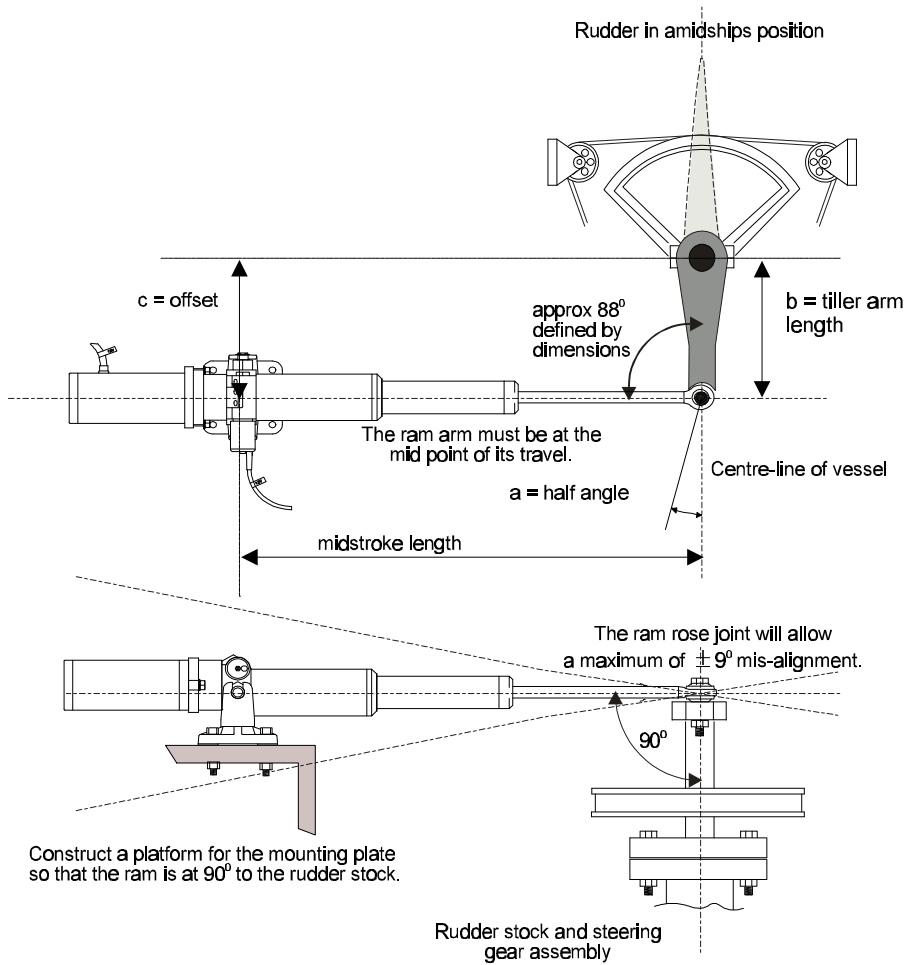
### **KEY POINTS ON INSTALLATION**

---

- Check that the steering gear is in good condition. Rectify any steering defects prior to installation of the ram.
- The ram drive unit must be secured onto a flat, rigid base, it maybe necessary to construct a platform section for the mounting plate. For angled rudder stocks an angled platform section will have to be constructed.
- All setting up and aligning of the ram drive unit with the steering system should be carried out with the rudder in the amidships position and the ram arm at the centre point of its travel.
- The angle between the ram arm and the tiller arm should be as shown in the next two diagrams.
- The ram arm should ideally be at right-angles to the rudder stock. The ball-joint on the end of the ram arm will allow a **MAXIMUM** of  $\pm 9^{\circ}$  of misalignment.

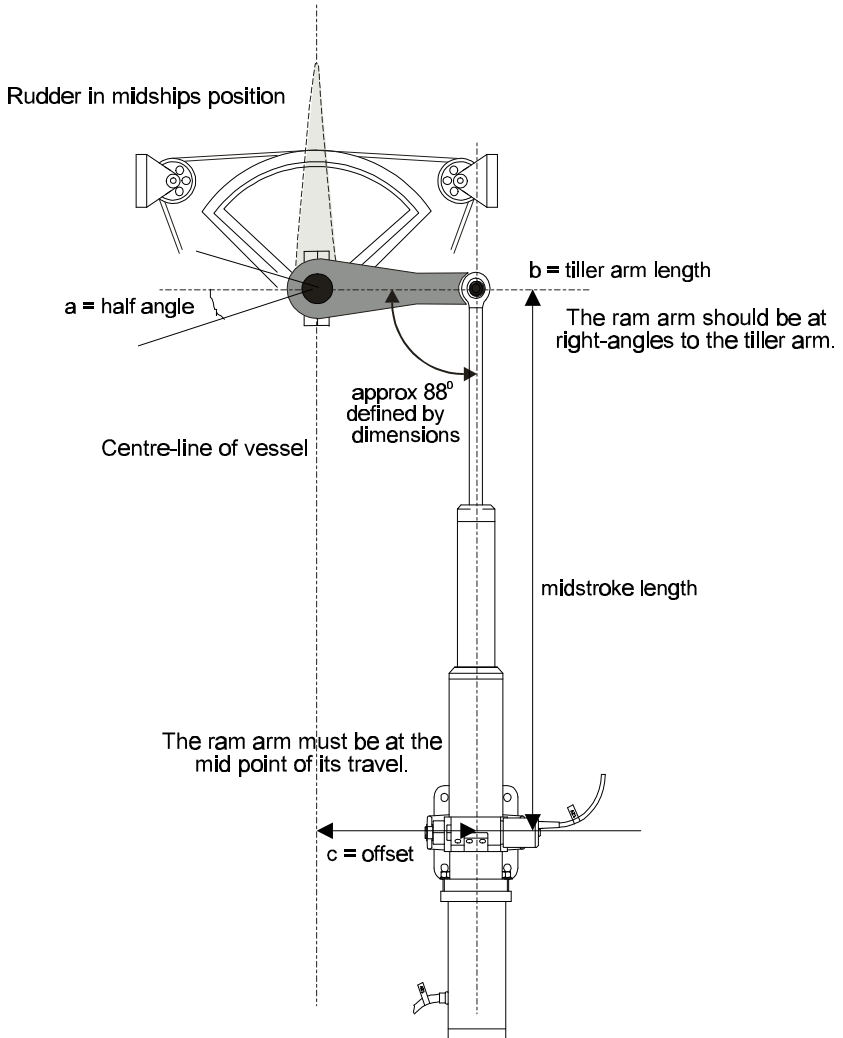
## 2 : RUDDER DRIVE OPTIONS

### A TYPICAL RAM DRIVE UNIT LAYOUT



## 2 : RUDDER DRIVE OPTIONS

### RAM MOUNTED PARALLEL TO VESSELS CENTRE-LINE





## 2 : RUDDER DRIVE OPTIONS

- **Make sure that the rudder angle is limited by the rudder stops and not the limit of travel of the ram arm. Failure to do this will damage the unit and invalidate the warranty.**
- Make sure that there is sufficient space at each end for the ram arm to extend fully, the ram stroke length is shown in the table below.
- Check for full movement and security of the steering gear before applying any power to the autopilot system, refer to the installation check list in the commissioning section of this handbook.

### **MOUNTING A BLUE UNIT ON A VERTICAL BULKHEAD**

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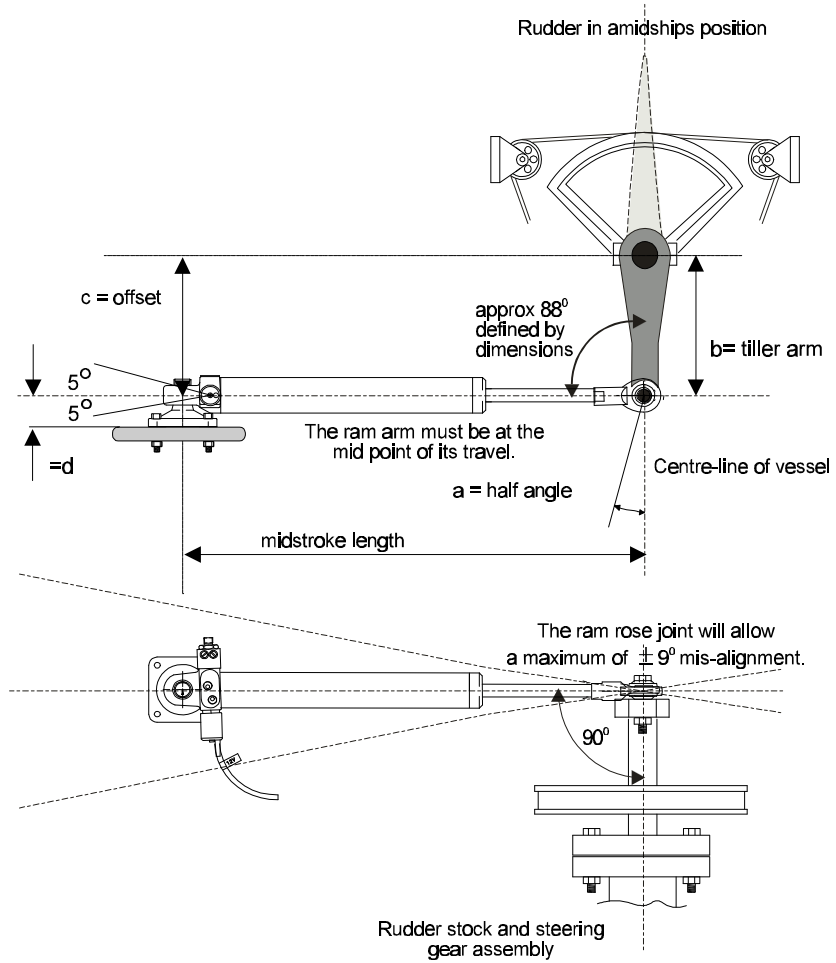
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Due to the restricted movement of the ram of  $+14^{\circ}$ ,  $-10^{\circ}$  for the size 1 and 2 and  $\pm 5^{\circ}$  for the size 3, it is important that the maximum rudder angle is carefully measured and the positioning of the RAM, tiller arm length and offset are carefully followed from the diagrams below. **FAILURE TO COMPLY WITH THESE DIMENSIONS MAY CAUSE PREMATURE FAILURE OF THE RAM, AND PLACE GREAT STRESS ON THE STRUCTURE OF THE VESSEL.**

The blue Ram or actuator unit may be mounted in any orientation, however if an external reservoir is fitted then it must be mounted above the unit.

## 2 : RUDDER DRIVE OPTIONS

### TYPICAL VERTICAL BULKHEAD MOUNTING



## 2 : RUDDER DRIVE OPTIONS

### SPLITTING THE RAM DRIVE UNIT

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---

**IMPORTANT NOTE:** When dealing with any hydraulic system great care must be taken to ensure that a high degree of cleanliness is observed and no dirt, moisture or foreign objects are allowed to enter the system. Only the recommended fluids must be used:

Use only Q8 DYNObEAR 10 or equivalent (10cSt at 40°C)

It is not possible to split linear actuators.

**Type 1 and type 2** units comprising separate ram/pumps, reservoirs and hydraulic cylinders connected by hoses, are available from your dealer. These are supplied with 1 metre hoses. Units with longer hoses are available from your dealer. These can be supplied with quick connect couplings and pre-filled hoses. Such units do not need to be bled.

**Type 3** units are supplied as split units, connected by 1 metre hoses. Units with longer hoses are available from your dealer. These can be supplied with quick connect couplings and pre-filled hoses. Such units do not need to be bled.

## **BLUE HYDRAULIC DRIVE PUMPS**

### **DESCRIPTION**

The Reversible Hydraulic Drive Pump has a small high speed pump driven by a 12 or 24V DC permanent magnet motor. The pump has pilot check valves to prevent back driving and a pilot operated reservoir valve to enable the unit to drive balanced or unbalanced cylinders. The unit has Port and Starboard 1/4" BSP service ports and a 1/4" BSP reservoir port. Adapters for 1/4" BSP to NTP are available.

### **PUMP DATA**

HYDRAULIC PUMP TYPE	PMP-T1-12V	PMP-T2-12V	PMP-T3-24V
PUMP TYPE	Reversible DC motor	Reversible DC motor	Reversible DC motor
SUPPLY VOLTAGE	12V DC	12V DC	24V DC
TYPICAL OPERATING CURRENT RANGE	5 to 17.5 Amps	5 to 22.5 Amps	6 to 17.5 Amps
MAXIMUM PRESSURE	1000 psi	1000 psi	1000 psi
MAXIMUM FLOW RATE at continuous duty motor loading	750 cc/min, 46 ins <sup>3</sup> /min	1420 cc/min, 87in <sup>3</sup> /min	1980 cc/min, 121 in <sup>3</sup> /min
CYLINDER CAPACITY	100-300cc, 6.1 to 18.3 in <sup>3</sup>	275 to 550cc, 16.8 to 33.6in <sup>3</sup>	525 to 750cc, 32 to 46in <sup>3</sup>
WEIGHT	3 kg 6.6 lbs	3 kg 6.6 lbs	4 kg 8.8 lbs

## **2 : RUDDER DRIVE OPTIONS**

### **KEY POINTS ON INSTALLATION**

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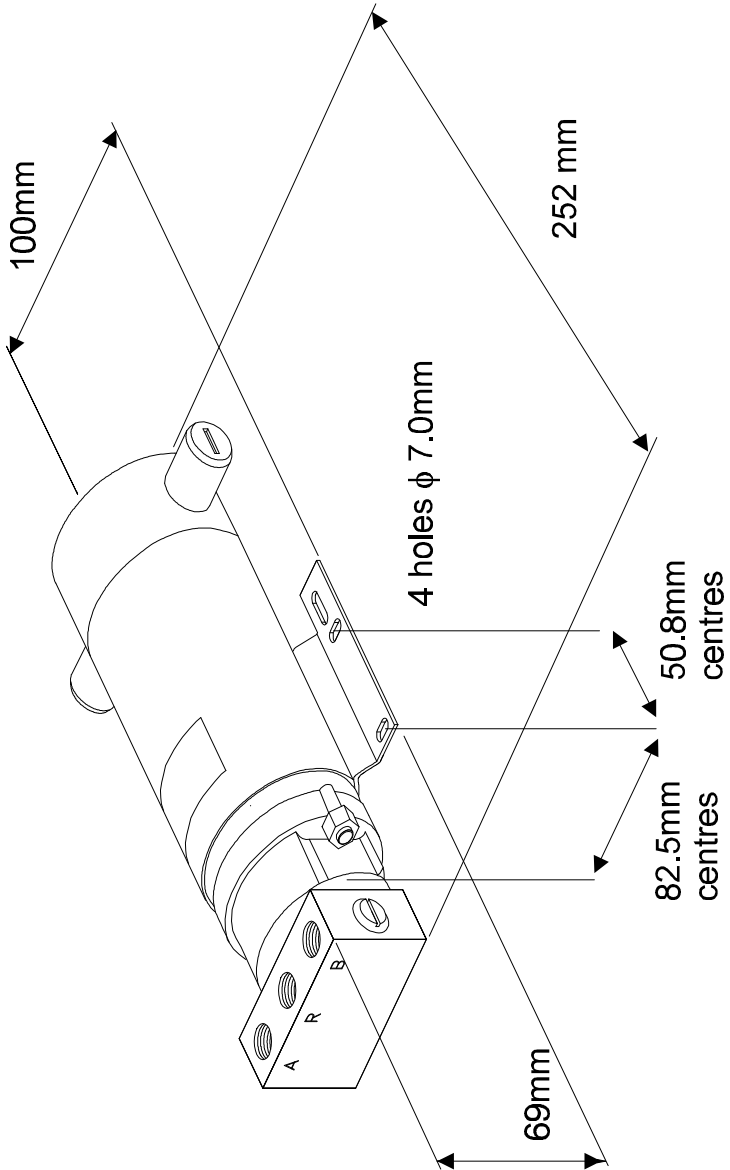
- A position should be chosen convenient for the steering system hydraulic delivery lines.
- The site should be rigid and flat to prevent excess vibration.
- Shielded from the direct effects of the elements.
- Minimise the lengths of the hydraulic lines from the pump to the cylinder and where possible the pump motor supply cables.

## 2 : RUDDER DRIVE OPTIONS

### HYDRAULIC DRIVE PUMPS DIMENSIONS

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ALL SIZES OF PUMP



## 2 : RUDDER DRIVE OPTIONS

### HYDRAULIC DRIVE PUMP INSTALLATION

---

**IMPORTANT NOTE:** When dealing with any hydraulic system great care must be taken to ensure that a high degree of cleanliness is observed and no dirt, moisture or foreign objects are allowed to enter the system. Only the recommended fluids must be used. Use Q8 DYNOBEAR or equivalent (10cSt at 40° C).

1. Drain the steering system from the lowest point, usually at a cylinder coupling.
2. Fit T-pieces into the port and starboard delivery lines, couple the lines to the appropriate service ports of the pump using flexible hydraulic hose.
3. Couple the reservoir port to the reservoir/balance line from the helm units. A low pressure, transparent plastic tube can be used. Ensure that this line rises gradually with no down turns.
4. Refill the steering system as recommended by the manufacturer, using clean hydraulic fluid.
5. Fill the cylinder by temporally removing the cylinder couplings and hoses at each end, refit the hoses securely.
6. Starting at the highest helm unit, fill the helm reservoir.
7. Slowly turn the steering wheel two turns to port and then to starboard, checking the level of fluid in the helm unit reservoir at all times.
8. Next turn the wheel fully in one direction until a slight pressure is felt, continuously monitor the reservoir level.

## **2 : RUDDER DRIVE OPTIONS**

- 9.** Repeat in the opposite direction and continue in this manner until topping up is no longer necessary.
- 10.** When satisfied that the steering is fully bled manually, apply power to the pump unit.
- 11.** Turning the wheel fully from lock to lock will cause the pump to self purge.
- 12.** Check the fluid level in the helm unit reservoir.
- 13.** When the system appears to be fully functional, with the pump running and the helm hard over check for leaks.
- 14.** Secure all hoses and cables to prevent damage.

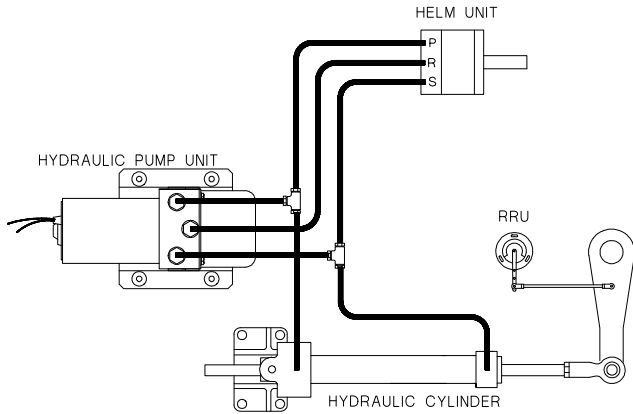


## 2 : RUDDER DRIVE OPTIONS

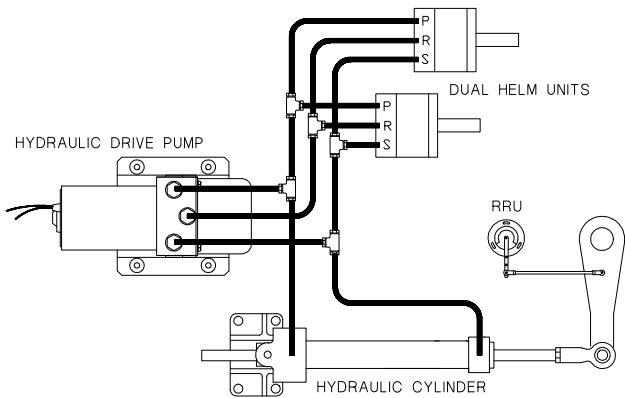
### HYDRAULIC DRIVE PUMP INSTALLATION EXAMPLES

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#### Single Station System Example

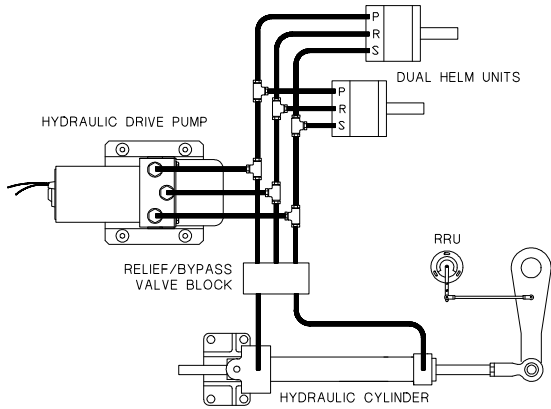


#### Dual Station System Example

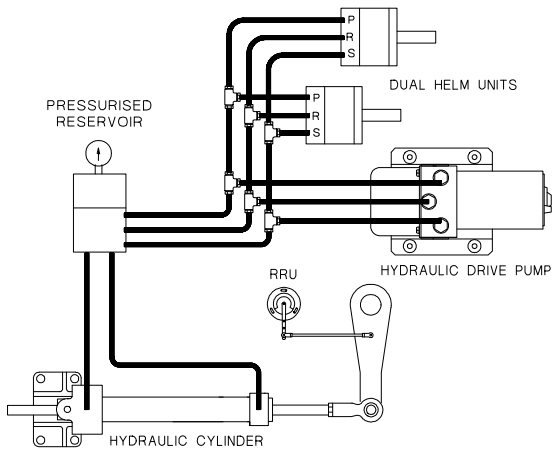


## 2 : RUDDER DRIVE OPTIONS

### Dual Station System With Bypass Example



### Dual Station Pressurised System Example



**SECTION 3 CONTENTS**

**SECTION 3 CONTENTS** \_\_\_\_\_ **1**

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### ***RAM DRIVE UNIT***

#### **DESCRIPTION**

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A compact DC driven reversible hydraulic pump and hydraulic cylinder assembly for boats without hydraulic steering systems. Three sizes of ram drive are available giving a wide thrust range to suit all sizes and types of vessel. Two varieties of ram are supplied which are colour coded as blue or black. The principal of operation is similar for these two, however the installation details vary. Hence first determine the colour code of the ram and refer to the appropriate chapter.

### 3 : RUDDER DRIVE OPTIONS

## **BLACK RAMS**

The units feature a removable mounting foot to ease installation and servicing.

The unit can be connected directly to the tiller arm or steering quadrant, or where space is limited the pump and cylinder can be split and mounted separately with the Ram Drive Splitter Kit, available from your dealer. The unit can also be mounted on a vertical bulkhead with the Vertical Bulkhead Mounting Kit.

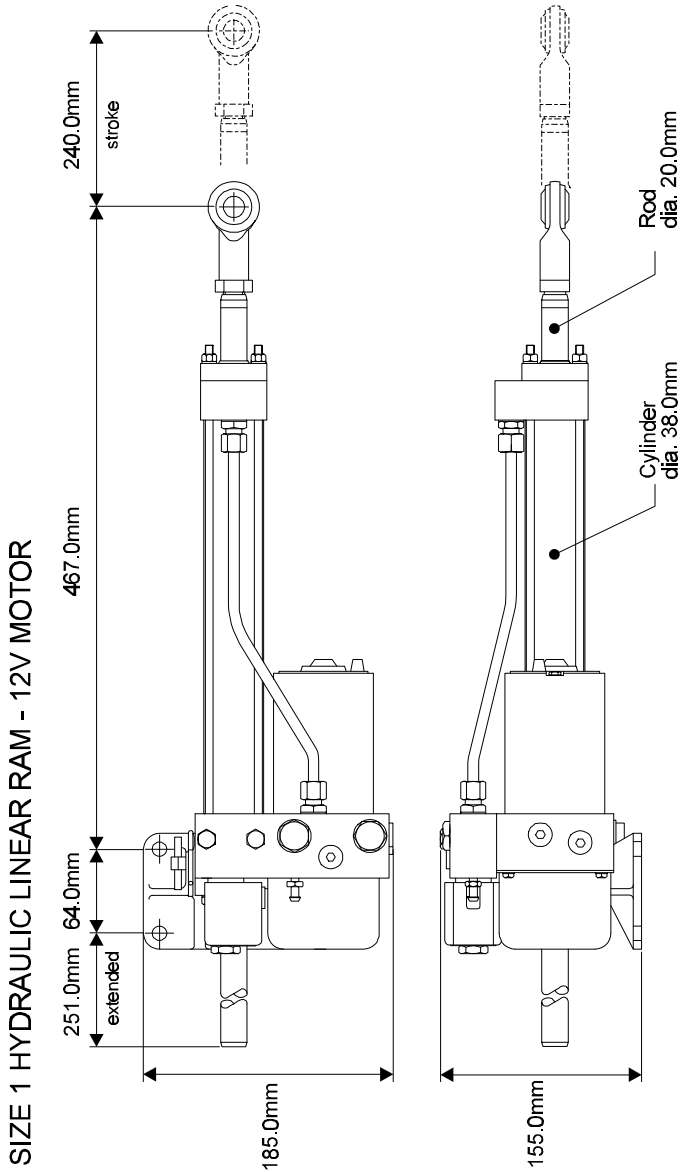
### **RAM DRIVE DATA (BLACK TYPES)**

RAM DRIVE TYPE	RAM SIZE 1 Black	RAM SIZE 1 Black	RAM SIZE 2 Black	RAM SIZE 3 Black
ACP UNIT	ACP1	ACP2	ACP2 only	ACP2 only
MOTOR SUPPLY	12V DC	12V DC	12V DC	24V DC
SOLENOID VALVE SUPPLY	12V DC 1A (max)	9V DC 1A (max)	9V DC 1A (max)	18V DC 1A (max)
PEAK THRUST	350 kg-force 772 lbs-force	350 kg-force 772 lbs-force	700 kg-force 1544 lbs-force	1200 kg-force 2650 lbs-force
PEAK CURRENT	12 A @ 12V	12 A @ 12V	25 A @ 12V	25 A @ 24V
MAXIMUM STROKE	240mm 9.45"	240mm 9.45"	240mm 9.45"	240mm 9.45"
BORE DIAMETER ROD DIAMETER	38mm, 1.5" 20mm, 0.79"	38mm, 1.5" 20mm, 0.79"	50mm, 2.0" 20mm, 0.79"	50mm, 2.0" 20mm, 0.79"
TILLER ARM for 70° of rudder	204mm 8"	204mm 8"	204mm 8"	204mm 8"
MAXIMUM TORQUE	698 Nm 6175 lb.ins	698 Nm 6175 lb.ins	1396 Nm 12350 lb.ins	2392 Nm 21168lb.ins
WEIGHT	9.6 kg, 21 lbs	9.6 kg, 21 lbs	10.4 kg, 23 lbs	11.5 kg, 25 lbs

### 3 : BLACK RUDDER DRIVE OPTIONS

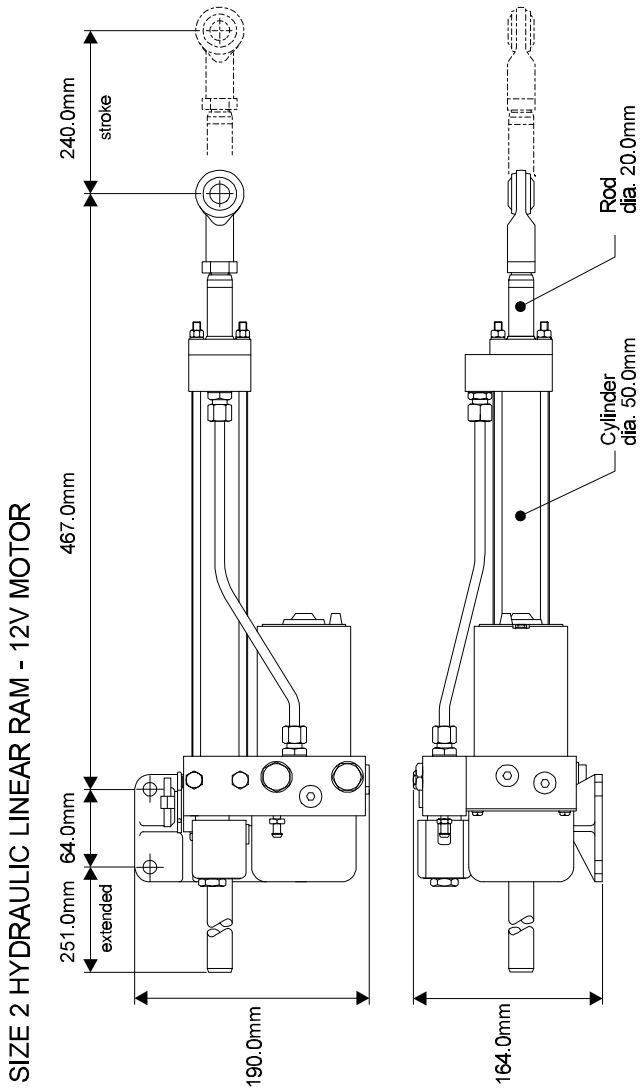
#### BLACK RAM DIMENSIONS

#### RAM DRIVE UNIT DIMENSIONS - BLACK SIZE 1



### 3 : RUDDER DRIVE OPTIONS

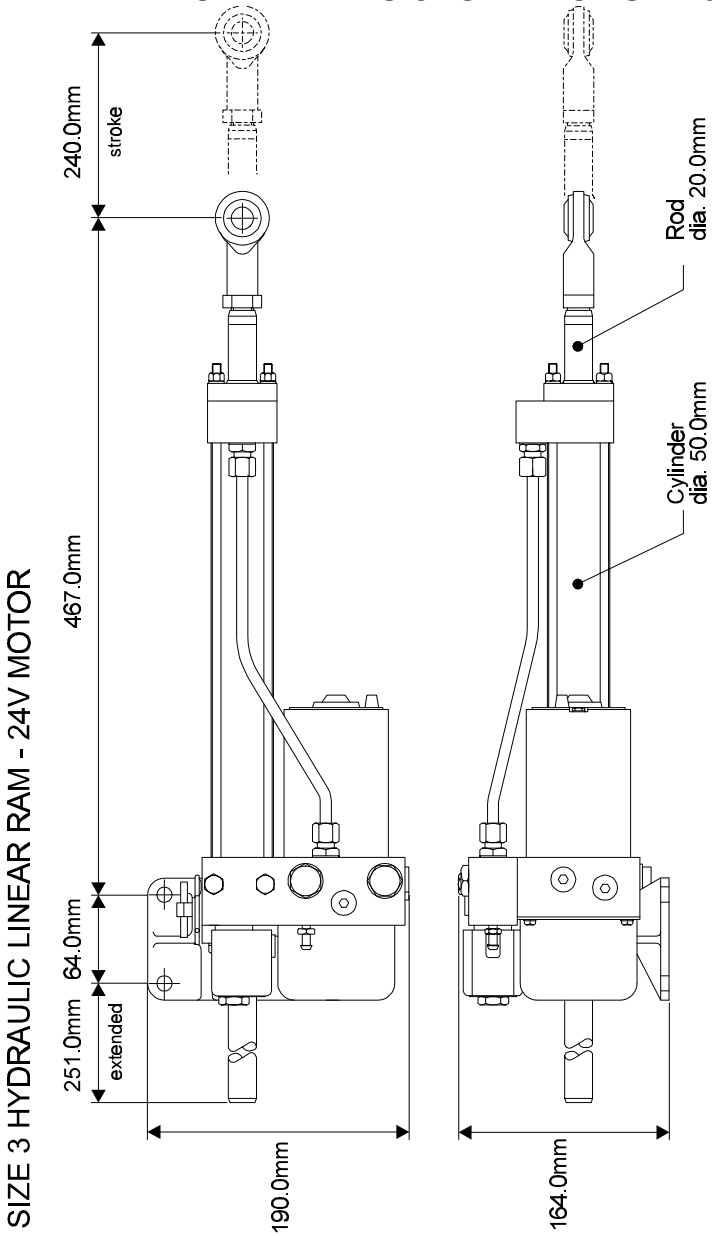
#### RAM DRIVE UNIT DIMENSIONS - BLACK SIZE 2





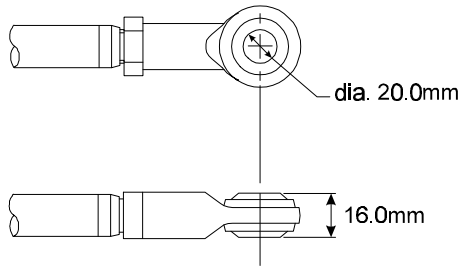
### 3 : BLACK RUDDER DRIVE OPTIONS

#### RAM DRIVE UNIT DIMENSIONS - BLACK SIZE 3

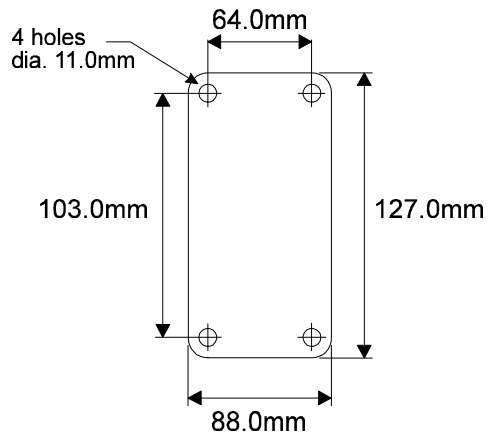


### 3 : RUDDER DRIVE OPTIONS

#### ROSE JOINT DETAIL



#### MOUNTING PLATE DETAIL



### **RAM DRIVE UNIT INSTALLATION**

---

General consideration must be given to the steering system and its geometry before commencement of the installation. Many factors must be contemplated for a practical solution, the information given here is for guidance only, although where a maximum or minimum value is given this must be adhered to. It is essential that the unit is only installed in a fully functional steering system, with no backlash or stiffness when operating. Rectify any steering problems before installation of the ram drive unit or the autopilot will not function correctly.

### **KEY POINTS ON INSTALLATION**

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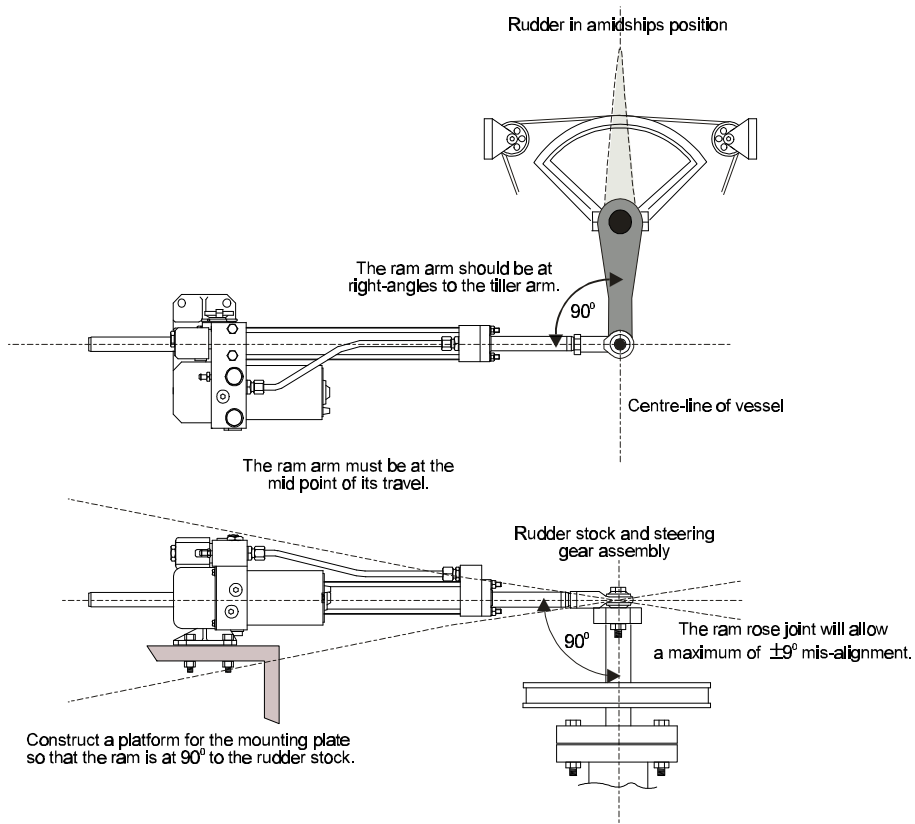
- Check that the steering gear is in good condition. Rectify any steering defects prior to installation of the ram.
- The ram drive unit must be secured onto a flat, rigid base, it maybe necessary to construct a platform section for the mounting plate. For angled rudder stocks an angled platform section will have to be constructed. The ram drive unit should be mounted upright, i.e. with the mounting plate on the platform, it must never be mounted upside-down.
- If required a Vertical Bulkhead Mounting Kit is available so the unit can be mounted on its side. If the available space for fitting the ram drive unit is limited then it is possible to split the ram cylinder and pump motor with the Ram Drive Splitter Kit.
- All setting up and aligning of the ram drive unit with the steering system should be carried out with the rudder in the amidships position and the ram arm at the centre point of its travel.

### 3 : RUDDER DRIVE OPTIONS

- The angle between the ram arm and the tiller arm should be  $90^\circ$  as shown in the next two diagrams.
- The ram arm should ideally be at right-angles to the rudder stock. The ball-joint on the end of the ram arm will allow a **MAXIMUM** of  $\pm 9^\circ$  of misalignment.

#### A TYPICAL RAM DRIVE UNIT LAYOUT

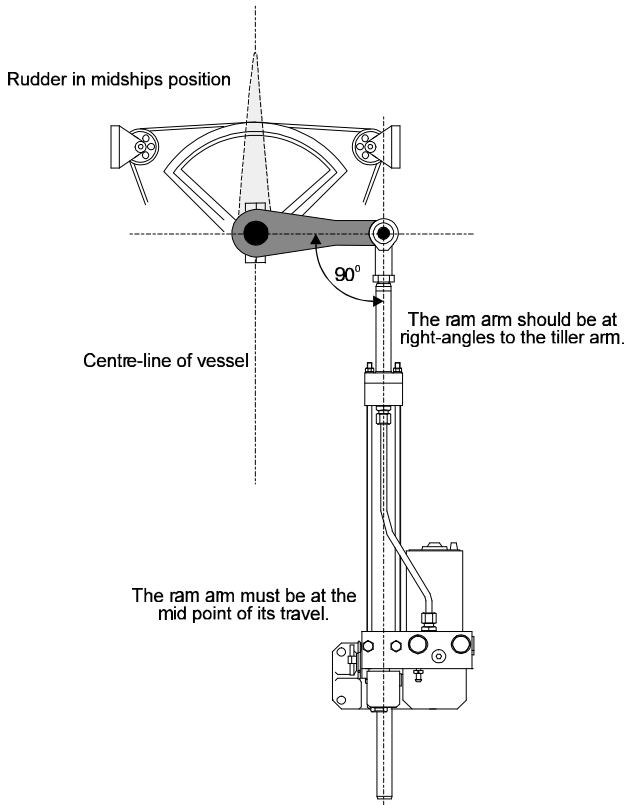
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### 3 : BLACK RUDDER DRIVE OPTIONS

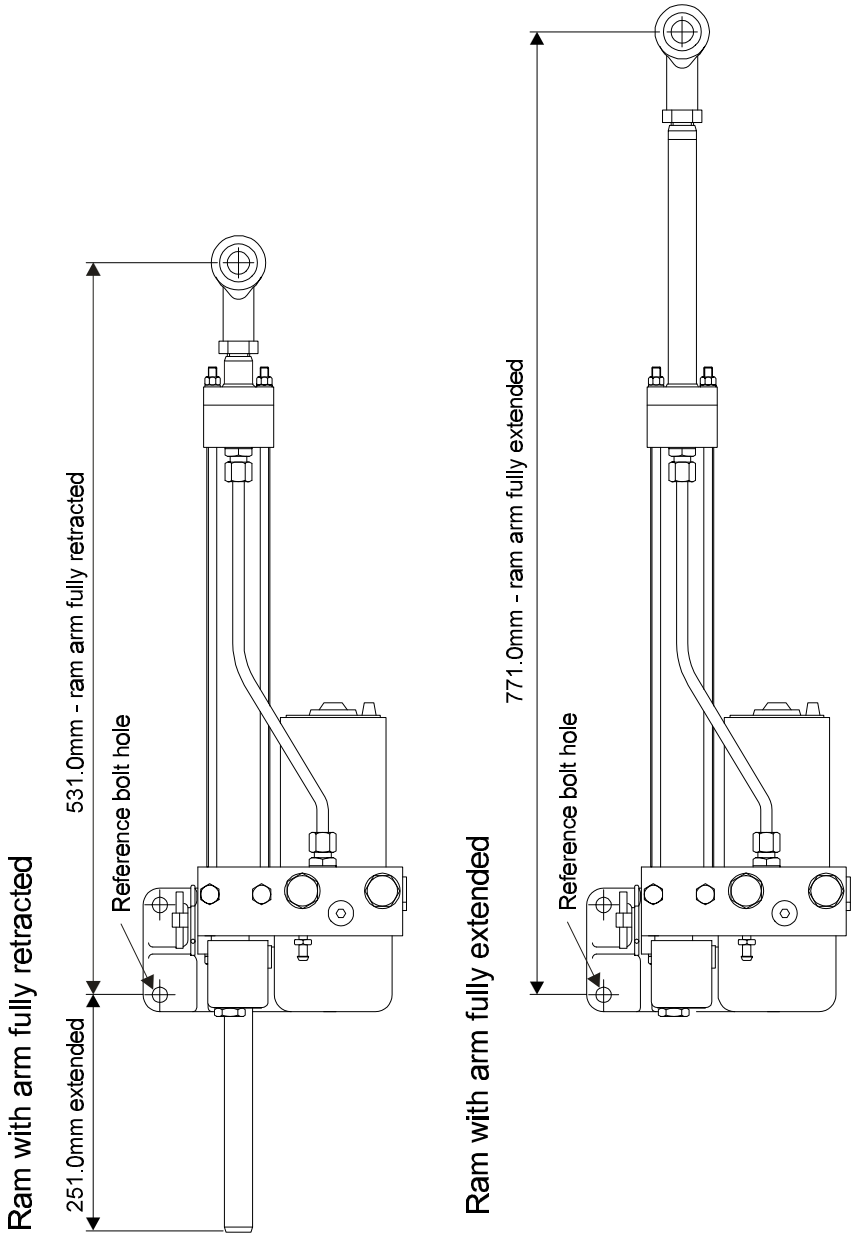
#### RAM MOUNTED PARALLEL TO VESSELS CENTRE-LINE

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- Make sure that the rudder angle is limited by the rudder stops and not the limit of travel of the ram arm.
- Make sure that there is sufficient space at each end of the black unit for the ram arm to extend fully, the ram stroke length is 251mm.

### 3 : RUDDER DRIVE OPTIONS



### **3 : BLACK RUDDER DRIVE OPTIONS**

- Check for full movement and security of the steering gear before applying any power to the autopilot system, refer to the installation check list.

### 3 : RUDDER DRIVE OPTIONS

## MOUNTING A BLACK UNIT ON A VERTICAL BULKHEAD

**IMPORTANT NOTE:** This procedure must be carried out with the ram drive unit on a flat, clean and dry surface before it is installed. Use HM or HV Hydraulic oil: ISO VG 15 temperatures below -5°C, ISO VG 22 temperatures -5°C to +60°C.

- Remove the ram drive unit reservoir filler plug (located above the motor between the two large bolt heads). Ensure that no debris or moisture enters the ram.
- Top-up the ram reservoir until it is full.
- Screw the external tank tube into the filler plug hole.
- Fill the external tank and tube with the recommended hydraulic fluid. Allow time for the air bubbles to escape from the tube.
- Fit the external tank filler cap before attempting to install the ram.
- Install the ram drive unit on a rigid, flat bulkhead as described previously.
- Secure the external tank to an adjacent bulkhead so that it is above the level of the ram.
- Check the level of the fluid in the tank after initial ram operation, top-up as required. Never run the ram with the filler cap loose or missing from the external tank.



## SPLITTING THE RAM DRIVE UNIT

---

**IMPORTANT NOTE:** When dealing with any hydraulic system great care must be taken to ensure that a high degree of cleanliness is observed and no dirt, moisture or foreign objects are allowed to enter the system. Only the recommended fluids must be used. Use HM or HV Hydraulic oil: ISO VG 15 below -5°C, ISO VG 22 temperatures -5°C to +60°C.

### SPLITTER KIT PARTS LIST

---

- 1 off Adaptor Plate, non-thread bolt holes, fits onto cylinder.
- 1 off Adaptor Plate, threaded bolt holes, fits onto pump motor.
- 2 off O-rings, 8.1 x 1.6, for adaptor plates.
- 2 off M8 x 40 Bolts, adaptor plate to cylinder.
- 2 off M8 spring washer, for bolts above.
- 2 off Flexible Hose.
- 4 off Hydraulic Fittings, 2 for adapter plates, 1 for cylinder, 1 for pump motor.
- 1 off Mounting Plate.
- 2 off M6 x 12 Bolts, for mounting plate.
- 2 off M6 spring washer, for bolts above.
- 4 off Rubber Grommet, anti-vibration mounts for mounting plate.
- 4 off Spacer, for grommets.

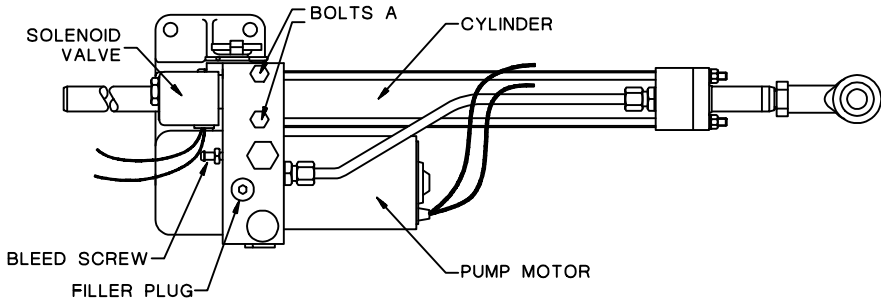
Check that you have all the parts listed above in the Splitter Kit and a supply of the correct hydraulic fluid as bleeding of the assembly will be required.

### 3 : RUDDER DRIVE OPTIONS

#### STEP 1. - IDENTIFY THE PARTS

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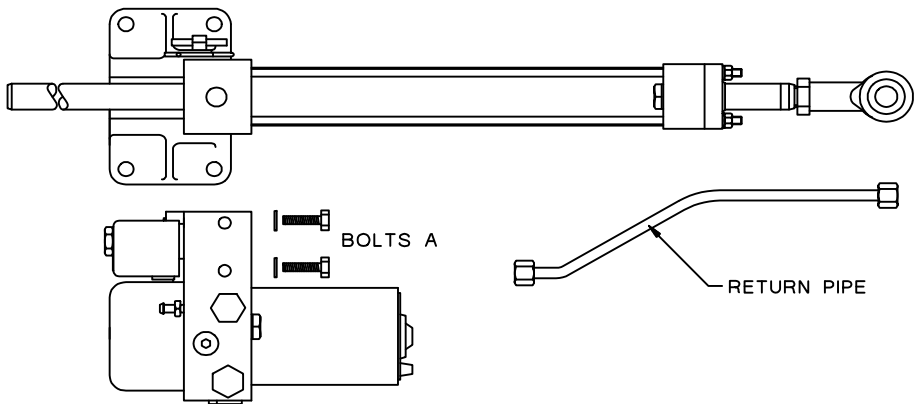
- Familiarise yourself with the parts of the ram drive unit and identify the location of the parts to be removed.



#### STEP 2. - DISASSEMBLE THE UNIT

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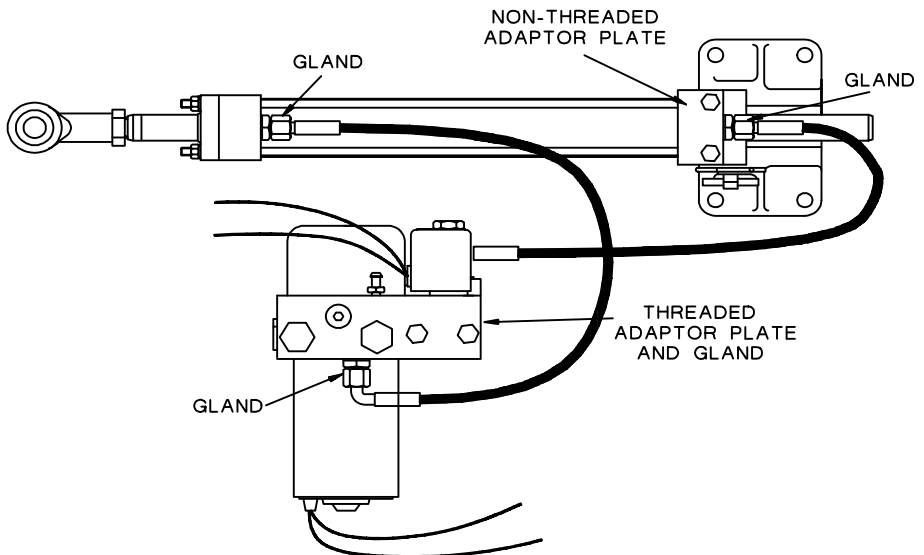
- Loosen the return pipe gland nuts and remove the pipe.
- Remove the two bolts "A" to separate the cylinder from the pump motor unit.
- Keep the pump motor unit upright to prevent excess spillage of the hydraulic fluid.



### 3 : BLACK RUDDER DRIVE OPTIONS

#### STEP 3. - FIT THE SPLITTER PARTS

- Fit the `O' ring into the groove of the non-threaded adaptor plate. Secure the assembly on to the cylinder using the bolts and spring washers supplied. Torque tighten to 1.1 -1.4 Kgm (8 - 10lb.ft).
- Fit the `O' ring into the groove of the pump motor unit. Using the original bolts "A" and spring washers, secure the threaded adaptor plate on to the underside of the pump motor unit. Torque tighten to 1.1 -1.4 Kgm (8 - 10lb.ft).
- Fit the hydraulic fittings supplied to the adaptor plates.
- Replace the original hydraulic fittings on the cylinder and pump motor unit with the ones supplied in the kit.
- Fit the flexible hose assemblies to the fittings and tighten the nuts.

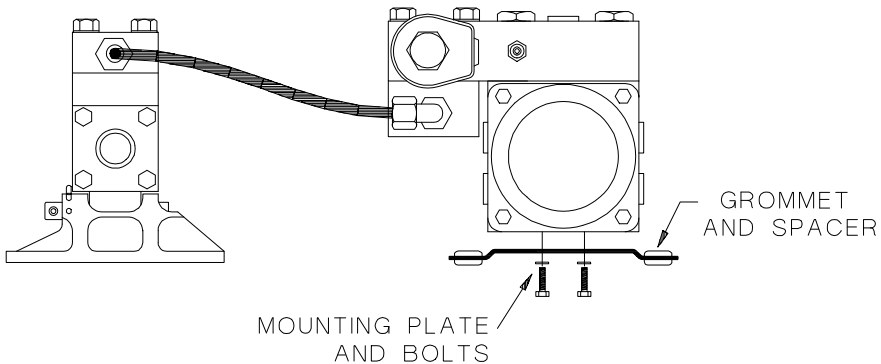


### 3 : RUDDER DRIVE OPTIONS

#### STEP 4 - ATTACH THE MOUNTING PLATE

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- Attach the mounting plate to the pump motor base with the bolts and washers supplied.
- Fit the four rubber grommets and metal spacers into the mounting plate holes.



#### STEP 5 - BLEEDING THE SPLIT RAM DRIVE ASSEMBLY


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**IMPORTANT NOTE :** During this procedure ensure that the fluid level of the pump motor unit is maintained by adding fluid via the filler plug hole. Failure to do this will introduce excessive amounts of air into the pump motor reservoir.

You will need the following items to bleed the assembly:

- HV or HM hydraulic fluid, ISO VG 15, ISO VG 22.
- A length of flexible tubing to fit the bleed screw.
- A high ampere d.c. supply, e.g. a car battery. 12V for Size 1 and 2 Rams, 24V for Size 3 Rams .
- A length of cable, at least 4mm<sup>2</sup> copper area for the pump motor.

### 3 : BLACK RUDDER DRIVE OPTIONS

1. Push the ram arm (from the rose joint end) all the way in.
  2. Attach the length of flexible tubing to the bleed screw. Place the free end in to a container of hydraulic fluid.
  3. Remove the filler plug with a 6mm Allen key.
  4. Open the bleed screw and pull the ram arm fully out. Keep the free end of the tube submersed in hydraulic fluid.
  5. Close the bleed screw.
  6. Connect the Solenoid Valve wires to the d.c. supply to energise the valve.
  7. Connect the BLACK wire of the pump motor to the NEGATIVE of the d.c. supply.
  8. Power the ram in short bursts by switching the supply, until the ram arm is near the end of its stroke. **DO NOT POWER RAM FULLY TO THE END OF STROKE.** Top up the reservoir as required as the ram arm is powered along.
  9. Disconnect the supply to the Solenoid Valve.
  10. Repeat operations 4. to 9. as necessary to obtain smooth and quiet operation of the split ram drive assembly.
- 

### 3 : RUDDER DRIVE OPTIONS

## **HYDRAULIC DRIVE PUMPS**

### **DESCRIPTION**

The Reversible Hydraulic Drive Pump has a small high speed pump driven by a 12 or 24V DC permanent magnet motor. The pump has pilot check valves to prevent back driving and a pilot operated reservoir valve to enable the unit to drive balanced or unbalanced cylinders. The unit has Port and Starboard 1/4" BSP service ports and a 1/4" BSP reservoir port. Adapters for 1/4" BSP to NTP are available.

### **PUMP DATA**

<b>HYDRAULIC PUMP TYPE</b>	<b>SIZE 1 12/24</b>	<b>SIZE 2 12/24</b>
<b>PUMP TYPE</b>	Reversible DC motor	Reversible DC motor
<b>SUPPLY VOLTAGE</b>	12/24V DC	12/24V DC
<b>TYPICAL OPERATING CURRENT</b>	4-6 Amps	12-14 Amps
<b>MAXIMUM PRESSURE</b>	1000 psi	1000 psi
<b>MAXIMUM FLOW RATE</b>	1000 cc/min, 61 ins <sup>3</sup> /min	2000 cc/min, 128 in <sup>3</sup> /min
<b>CYLINDER CAPACITY</b>	100 - 225 cc, 6.1 - 13.75 in <sup>3</sup>	200 - 450 cc, 12.2 - 27.5 in <sup>3</sup>
<b>WEIGHT</b>	3.9 kg 8.6 lbs	3.9 kg 8.6 lbs

## **3 : BLACK RUDDER DRIVE OPTIONS**

### **KEY POINTS ON INSTALLATION**

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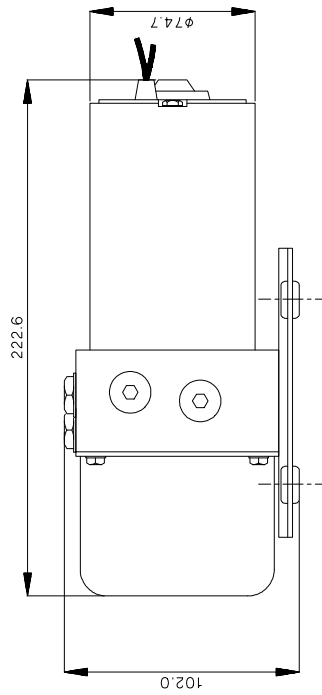
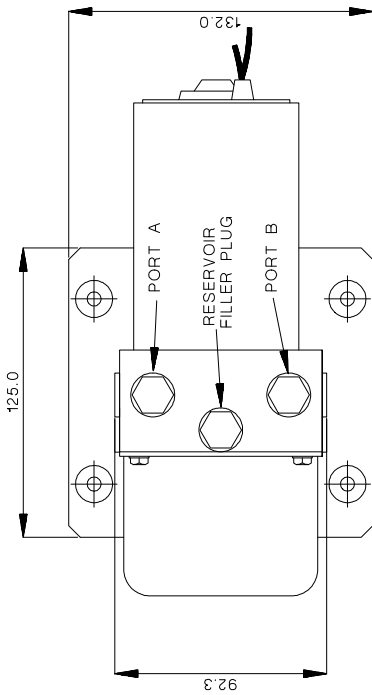
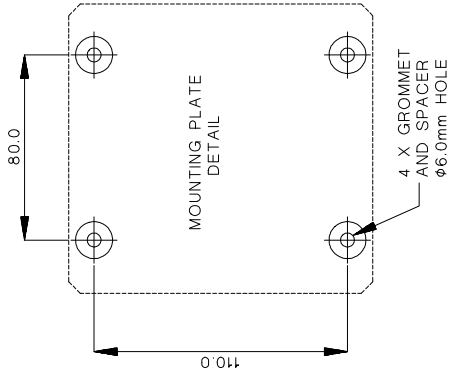
- A position should be chosen convenient for the steering system hydraulic delivery lines.
- The site should be rigid and flat to prevent excess vibration.
- Shielded from the direct effects of the elements.
- Minimise the lengths of the hydraulic lines from the pump to the cylinder and where possible the pump motor supply cables.

### 3 : RUDDER DRIVE OPTIONS

### HYDRAULIC DRIVE PUMPS DIMENSIONS

---

ALL SIZES OF PUMP





## 3 : BLACK RUDDER DRIVE OPTIONS

### HYDRAULIC DRIVE PUMP INSTALLATION

---

**IMPORTANT NOTE:** When dealing with any hydraulic system great care must be taken to ensure that a high degree of cleanliness is observed and no dirt, moisture or foreign objects are allowed to enter the system. Only the recommended fluids are allowed to enter the system. Only the recommended fluids must be used. Use HM or HV Hydraulic oil: ISO VG 15 temperatures below -5°C, ISO VG 22 temperatures -5°C to +60°C.

1. Drain the steering system from the lowest point, usually at a cylinder coupling.
2. Fit T-pieces into the port and starboard delivery lines, couple the lines to the appropriate service ports of the pump using flexible hydraulic hose.
3. Couple the reservoir port to the reservoir/balance line from the helm units. A low pressure, transparent plastic tube can be used. Ensure that this line rises gradually with no down turns.
4. Refill the steering system as recommended by the manufacturer, using clean hydraulic fluid.
5. Fill the cylinder by temporarily removing the cylinder couplings and hoses at each end, refit the hoses securely.
6. Starting at the highest helm unit, fill the helm reservoir.
7. Slowly turn the steering wheel two turns to port and then to starboard, checking the level of fluid in the helm unit reservoir at all times.

### **3 : RUDDER DRIVE OPTIONS**

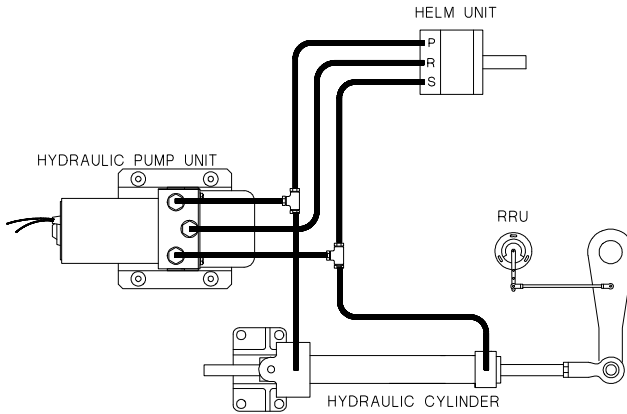
- 8.** Next turn the wheel fully in one direction until a slight pressure is felt, continuously monitor the reservoir level.
- 9.** Repeat in the opposite direction and continue in this manner until topping up is no longer necessary.
- 10.** When satisfied that the steering is fully bled manually, apply power to the pump unit.
- 11.** Turning the wheel fully from lock to lock will cause the pump to self purge.
- 12.** Check the fluid level in the helm unit reservoir.
- 13.** When the system appears to be fully functional, with the pump running and the helm hard over check for leaks.
- 14.** Secure all hoses and cables to prevent damage.

### 3 : BLACK RUDDER DRIVE OPTIONS

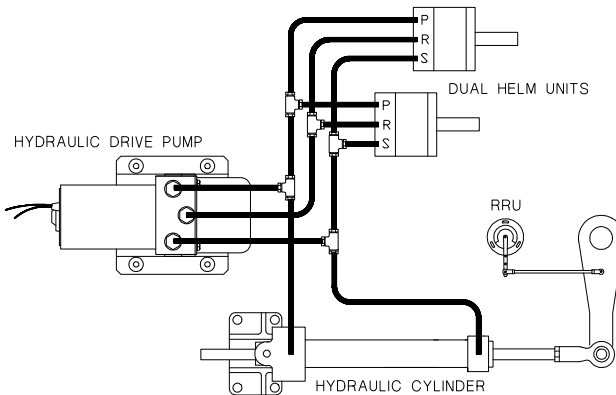
#### HYDRAULIC DRIVE PUMP INSTALLATION EXAMPLES

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##### Single Station System Example

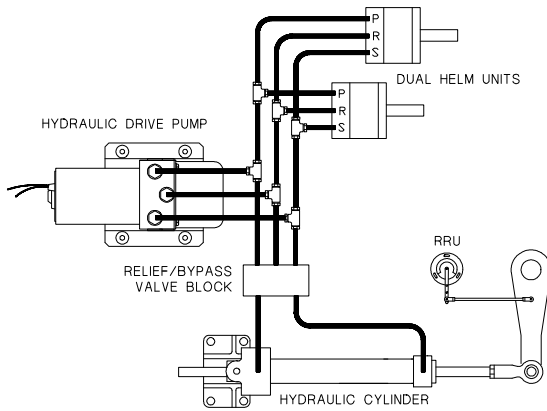


##### Dual Station System Example

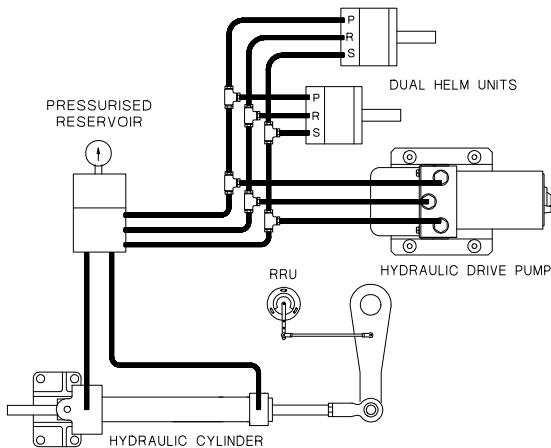


### 3 : RUDDER DRIVE OPTIONS

#### Dual Station System With Bypass Example



#### Dual Station Pressurised System Example



## **OUTDRIVE DRIVE UNIT**

### **DESCRIPTION**

---

A compact reversible 12V DC hydraulic pump/reservoir unit with actuating cylinder for autopilot control of outdrive power-assisted hydraulic steering systems. Mounting brackets for attaching the cylinder to the power steer unit depends upon engine type and are listed below. Other brackets available on request. Mechanical installation instructions are supplied with the brackets.

### **OUTDRIVE DRIVE UNIT DATA**

---

<b>PUMP TYPE</b>	Reversible DC motor
<b>SUPPLY</b>	12V DC
<b>WEIGHT</b>	2.7kg

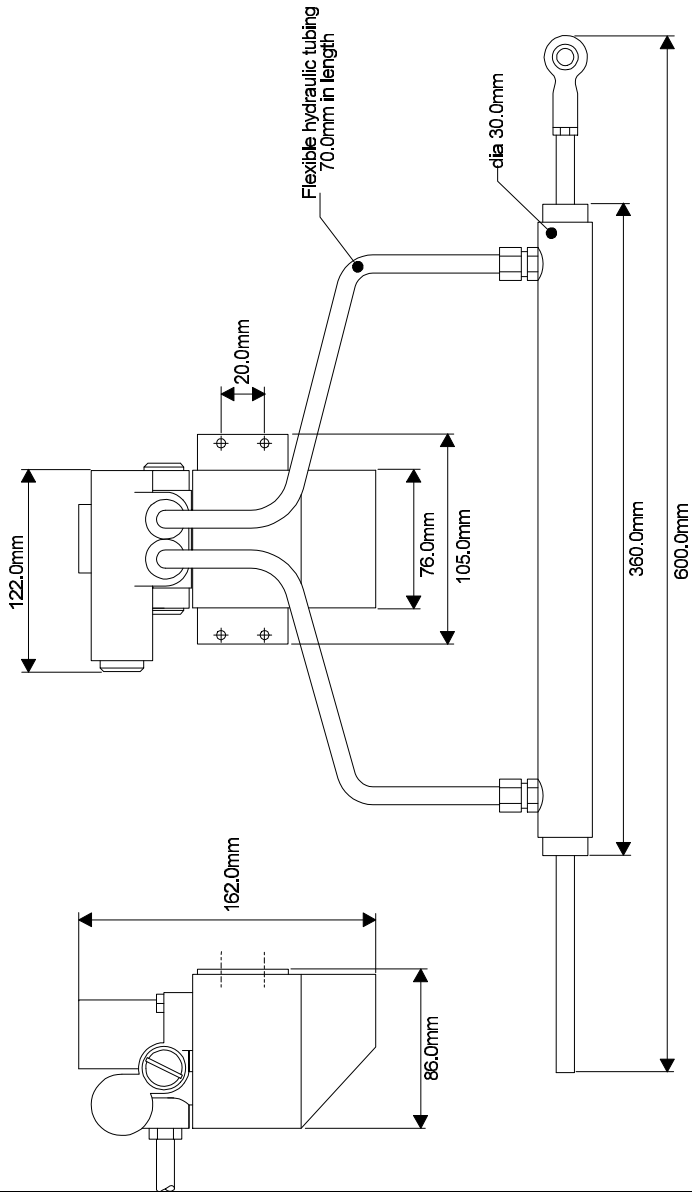
### **MOUNTING BRACKET KITS**

---

VOLVO STANDARD	345-30-280
VOLVO AQ. D40	345-30-281
MERCUISER	345-30-282
OMC	345-30-283
YAMAHA	345-30-284

### 3 : RUDDER DRIVE OPTIONS

#### OUTDRIVE DRIVE UNIT - DIMENSIONS



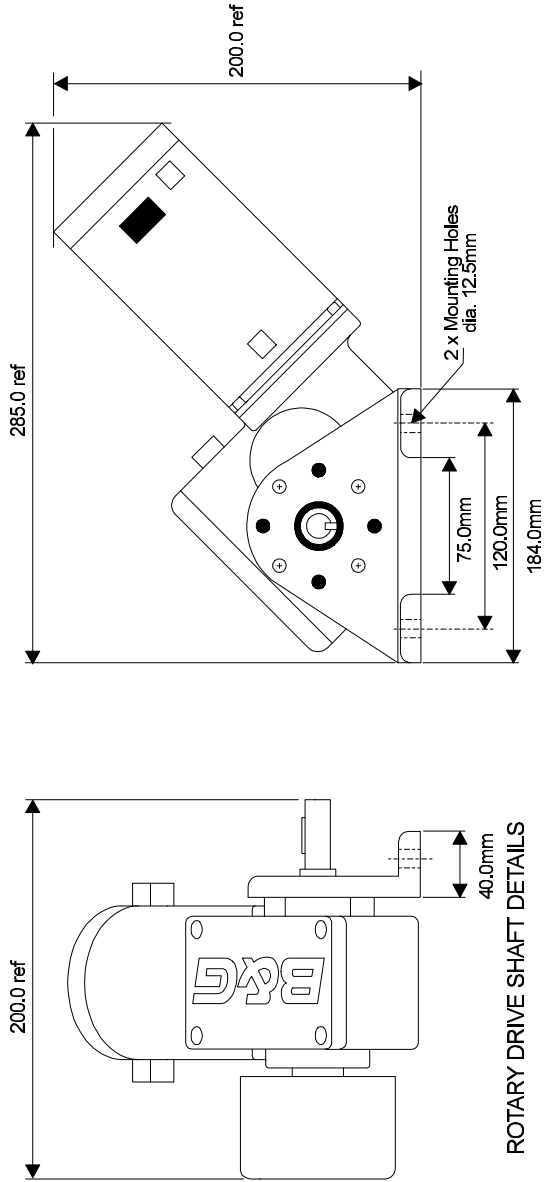


### 3 : RUDDER DRIVE OPTIONS

#### ROTARY DRIVE UNIT DIMENSIONS

---

#### ROTARY DRIVE UNIT - 12V/24V MOTOR



#### ROTARY DRIVE SHAFT DETAILS

- Diameter 5/8" (15.875mm)
- Key 3/16" (4.763mm)
- Length 1" (25.4mm)



### 3 : BLACK RUDDER DRIVE OPTIONS

#### ROTARY DRIVE SPROCKET WHEEL SELECTION

The number of teeth on the drive sprocket wheel must be chosen to match each installation. The following guide may be used to select an appropriate sprocket. The aim is to achieve a hardover to hardover time of 10 to 12 seconds.

**Note:** The Rotary drive has a speed of 20 RPM or 1 revolution per 3 seconds or 3.7 revolutions in 11 seconds

- Turn the wheel from hardover port to hardover starboard and count the number of turns of the driven sprocket

$$\underline{\text{number of turns} = N} \quad \text{e.g. } N = 3.1$$

- Divide 3.7 by **N** to give the required reduction ratio.

$$\underline{\text{ratio} = 3.7 / N} \quad \text{e.g. } \text{ratio} = 1.19$$

- Count the number of teeth on the Driven sprocket and divide by the ratio to give the required number of teeth on the Driver sprocket.

$$\underline{\text{driver teeth} = \text{driven teeth} / \text{ratio}}$$

e.g. if driven teeth = 25

$$\underline{\text{driver teeth} = 25 / 1.19 = 20.9}$$

- Select a sprocket with the number of teeth closest to calculated value

e.g. select driver sprocket with **20 teeth**

### 3 : RUDDER DRIVE OPTIONS

- Check hardover time using formula:

Hardover time = Number of turns of Driven sprocket  
x 3 x (Driven teeth/Driver teeth)

**e.g. hardover time = 3.1 x 3 x (25/20)= 11.6**

The calculated value for the hardover time using a driven sprocket with 25 teeth and a driver sprocket with 20 teeth would be suitable for this boats steering system.

**NOTE:** For larger boats a longer hardover time of up to 15 seconds may be more appropriate, in this case choose a driver sprocket with fewer teeth.

## **SECTION 4 CONTENTS**

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## 4 : ACP UNIT INSTALLATION

### **CABLE AND CONNECTION INFORMATION**

#### **EMC Compliance**

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B&G equipment is designed to be operated in leisure craft. Every care has been taken in its design and testing to ensure compliance with the European EMC Directive, provided it is installed and operated in accordance with the instructions as supplied, and the units and cables are used unmodified. Specific attention is drawn to the requirements to maintain cable separation, where stated.

To comply with these regulations, a supply line filter is required. This may be obtained from your installer using B&G part number: 990-00-001.

Transmissions from poorly installed or maintained Single Sideband equipment may adversely affect the functioning of this equipment. On vessels fitted with SSB, it is essential that such equipment is installed following good installation practice and as recommended by the manufacturer.

#### **General wiring notes**

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<p><b>IMPORTANT NOTE: DO NOT APPLY POWER TO THE PILOT SYSTEM UNTIL ALL UNITS ARE CONNECTED AND THE WIRING HAS BEEN CHECKED.</b></p>
---

- Where spade connectors are supplied always use the correct crimping tool to attach them to the cable. This is extremely important where high currents are to be passed i.e. rudder drive unit supply cables.
- Keep supply cables as short as possible to reduce the possibility of a voltage drop in the cables.

## 4 : ACP UNIT INSTALLATION

- Always fit a fuse or circuit breaker in supply cables. A 25Amp MCB is recommended for the heavy duty power cables.
- Clearly identify each cable to prevent incorrect connection.
- Cables that have a screening braid must have the screen connected as shown on the connection diagrams. The method for connecting screened cables may vary according to model and are shown in detail on the accompanying **installation sheet: IS-0777**.
- All cables should be routed at least 1m / 3ft from cables or components that carry or generate high currents, e.g. alternators, starter motors and cabling, trim-tab cables, etc.
- To minimise interference avoid routing Network cables alongside high power radio or Radar cables, allow 3m/10ft spacing, or within 1m/3ft of engine starter motors and cables and other cables carrying heavy current.
- To prevent damage to cabling always secure in position using cable clips or tie-wraps. Where cables pass through bulkheads always protect the cable from chafing by fitting grommets.
- Do not allow cables to rest in the bilges where prolonged immersion in water, fuel, etc. could occur.
- Always fit splash covers and lids on processors, computer units and junctions boxes, where supplied.

## 4 : ACP UNIT INSTALLATION

### Pilot drive unit cables

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---

#### All rudder drives - heavy duty power cables

---

TOTAL CABLE LENGTH	B&G CABLE PART No.	COPPER AREA	CABLE GAUGE
UPTO 8m/26ft	135-0A-128	4.0mm <sup>2</sup>	12 AWG
UPTO 12m/40ft	Not available	6.0mm <sup>2</sup>	10 AWG
UPTO 20m/65ft	Not available	10.0mm <sup>2</sup>	7 AWG

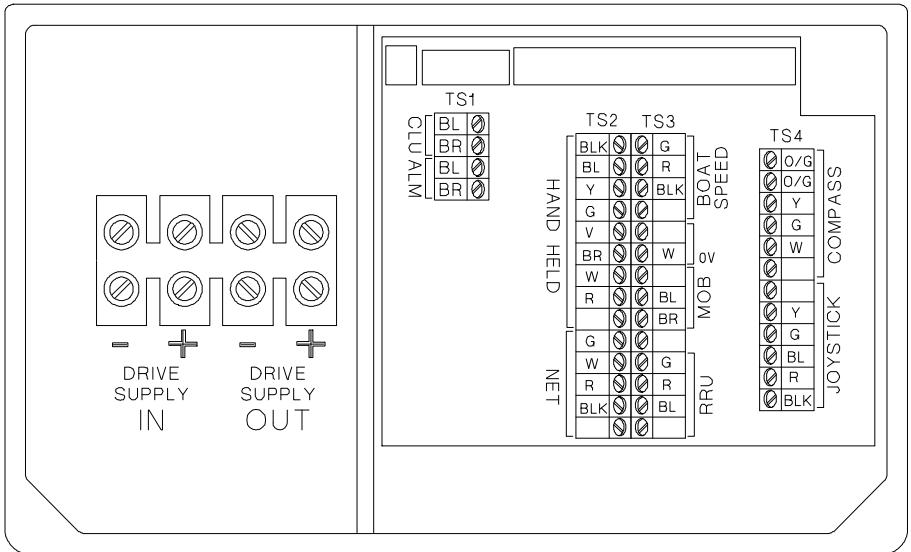
#### Rams and rotary drives - clutch/valve cables

---

UPTO 9m/30ft	135-0C-096	0.5mm <sup>2</sup>	22 AWG
UPTO 15m/50ft	135-0B-096	0.5mm <sup>2</sup>	22 AWG

## 4 : ACP UNIT INSTALLATION

### ACP UNIT TERMINAL DETAILS



### WIRE COLOUR CODING AND ABBREVIATIONS

WIRE COLOUR TABLE			
<b>R</b>	Red	<b>V</b>	Violet
<b>BLK</b>	Black	<b>Y</b>	Yellow
<b>BL</b>	Blue	<b>O</b>	Orange
<b>BR</b>	Brown	<b>W</b>	White
<b>G</b>	Green		

## 4 : ACP UNIT INSTALLATION

### **CLUTCH VOLTAGE SELECTION**

**NOTE:** The ACP1 Computer Unit does not have dip switches for clutch voltage selection. The clutch output voltage is fixed at 12V and is therefore only suitable for Size 1/12V Rams and pumps and 12V rotary drives.

The ACP2 Computer Unit can output different clutch/solenoid voltages depending upon the size of rudder drive unit fitted, the clutch/solenoid valve is only required for rams or rotary drive units. This is achieved by setting dip switches on the Computer Drive PCB. Access to the switches is obtained by removing the 4 screws holding the Computer PCB in the lid of the Computer Unit, carefully lift the PCB clear.

Set the switches as per the table below. The default setting is 9V, switch 4 ON, suitable for Size 1/12V Rams and Size 2/12V Rams.

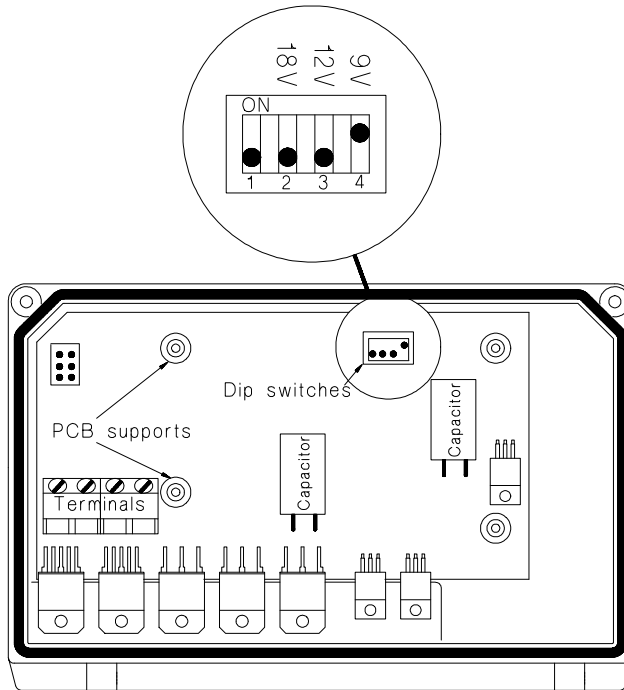
#### **ACP 2:**

DIP SWITCH	CLUTCH VOLTAGE	DRIVE SIZE/TYPE
1	24V	24V ROTARY
2	18V	SIZE 3/24V RAM
3	12V	12V ROTARY
4	9V	SIZE 1/2 12V RAMS (to save power)



### ACP2 Dip switch location

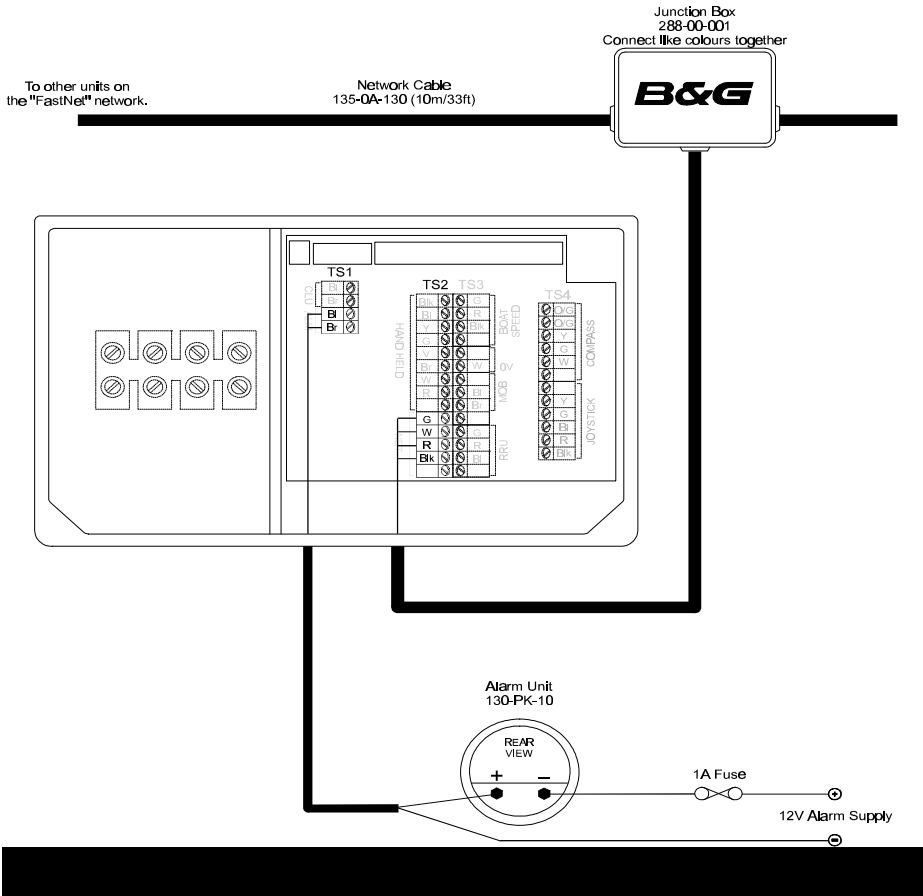
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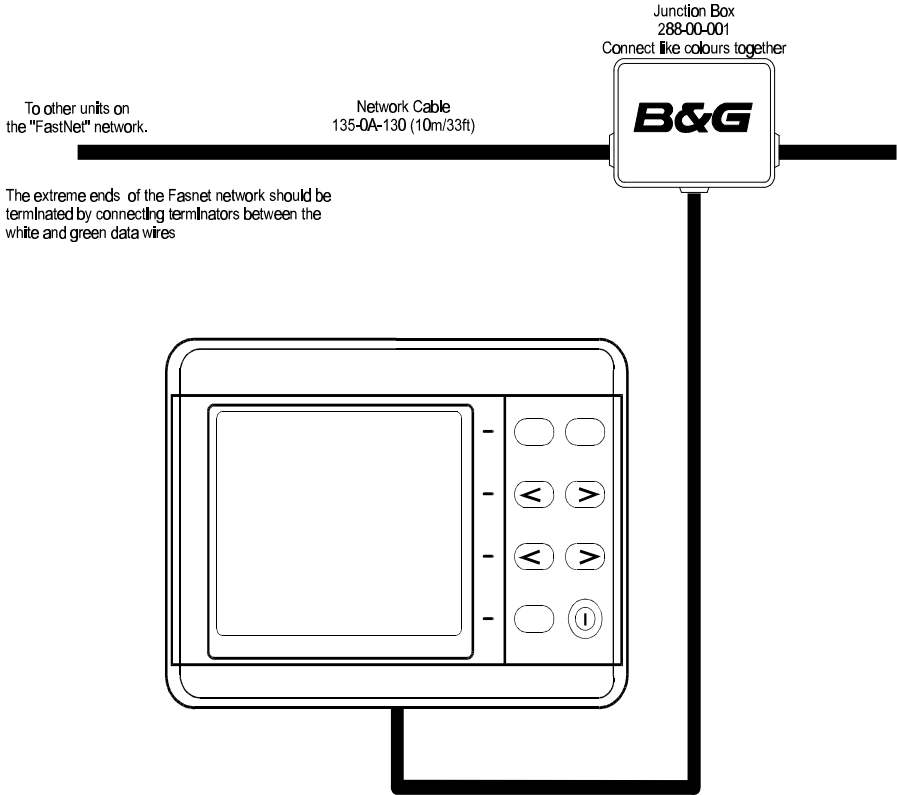
**NOTE:** When reassembling the computer unit ensure that the connector in the top lefthand corner of the PCB mates together properly.

# 4 : ACP UNIT INSTALLATION

## NETWORK AND ALARM CONNECTIONS

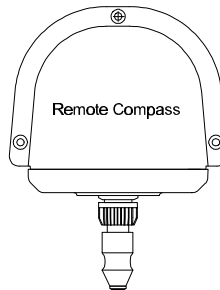
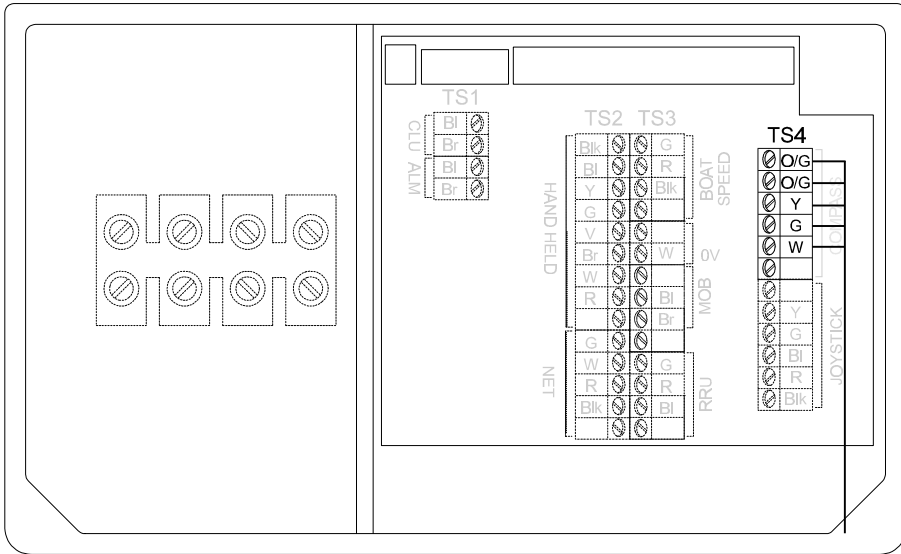


# PILOT DISPLAY CONNECTIONS



## 4 : ACP UNIT INSTALLATION

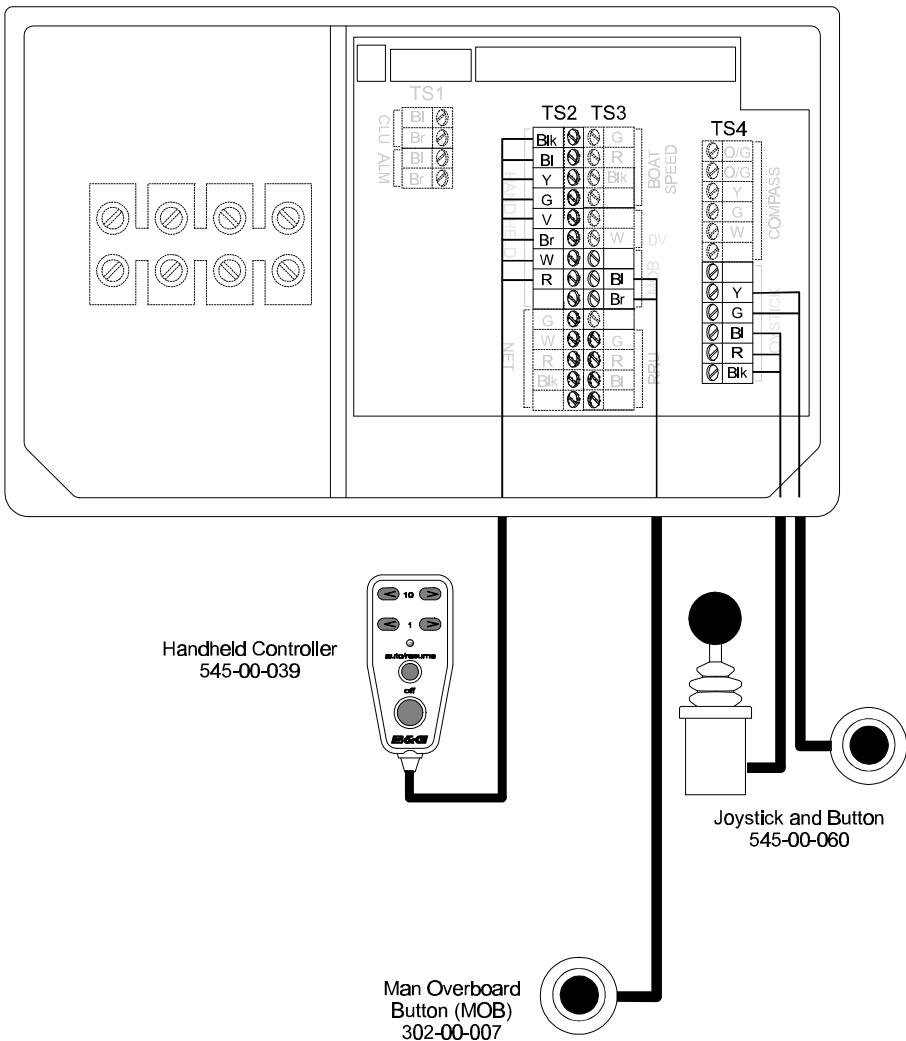
# REMOTE COMPASS CONNECTIONS



Compass Cable  
545-0A-026 (12m/39ft)

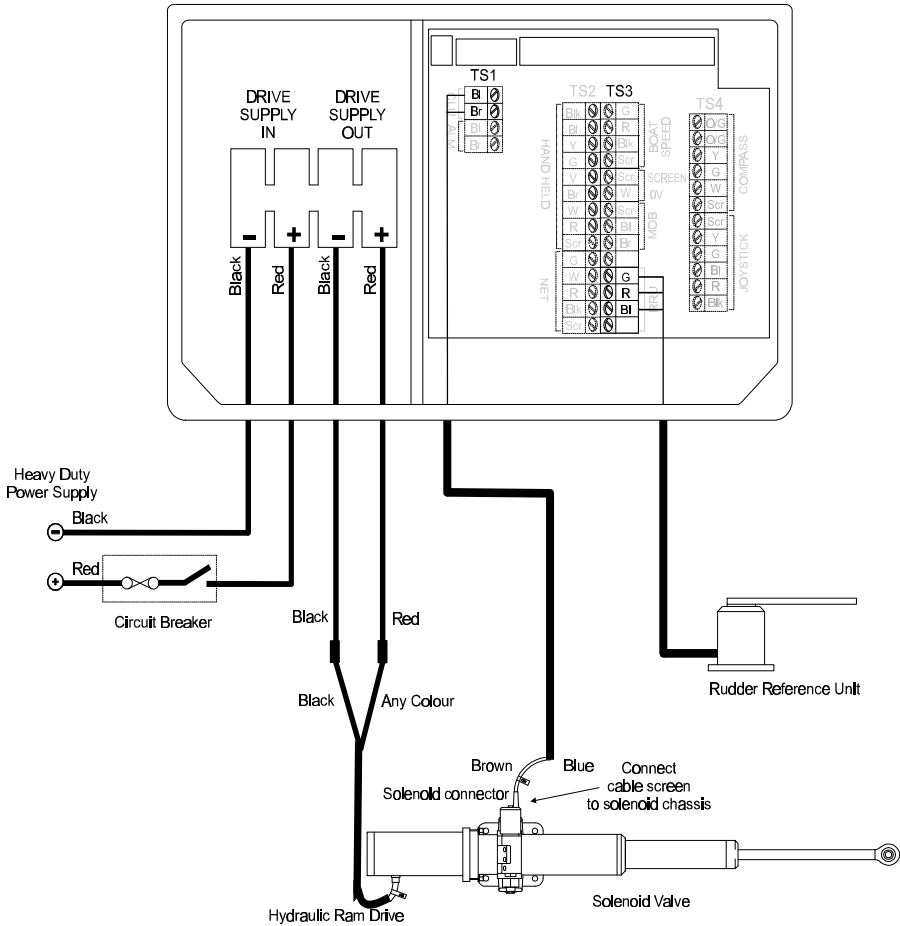
## 4 : ACP UNIT INSTALLATION

### HANDHELD, MOB AND JOYSTICK



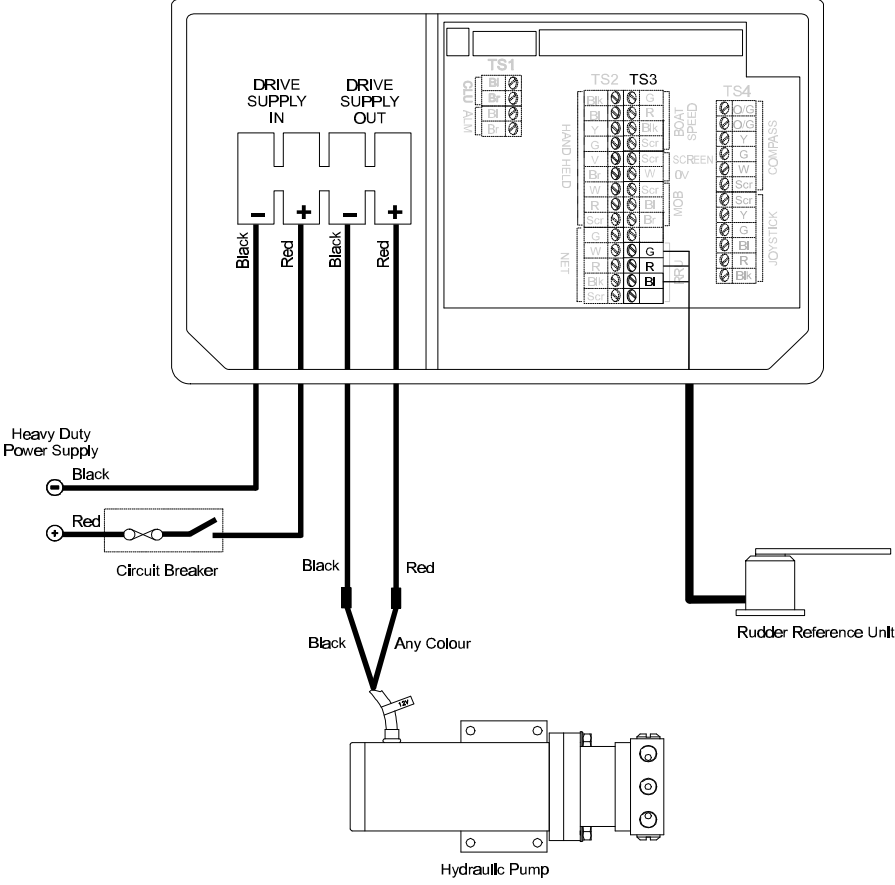
## 4 : ACP UNIT INSTALLATION

# HYDRAULIC RAM DRIVE CONNECTIONS



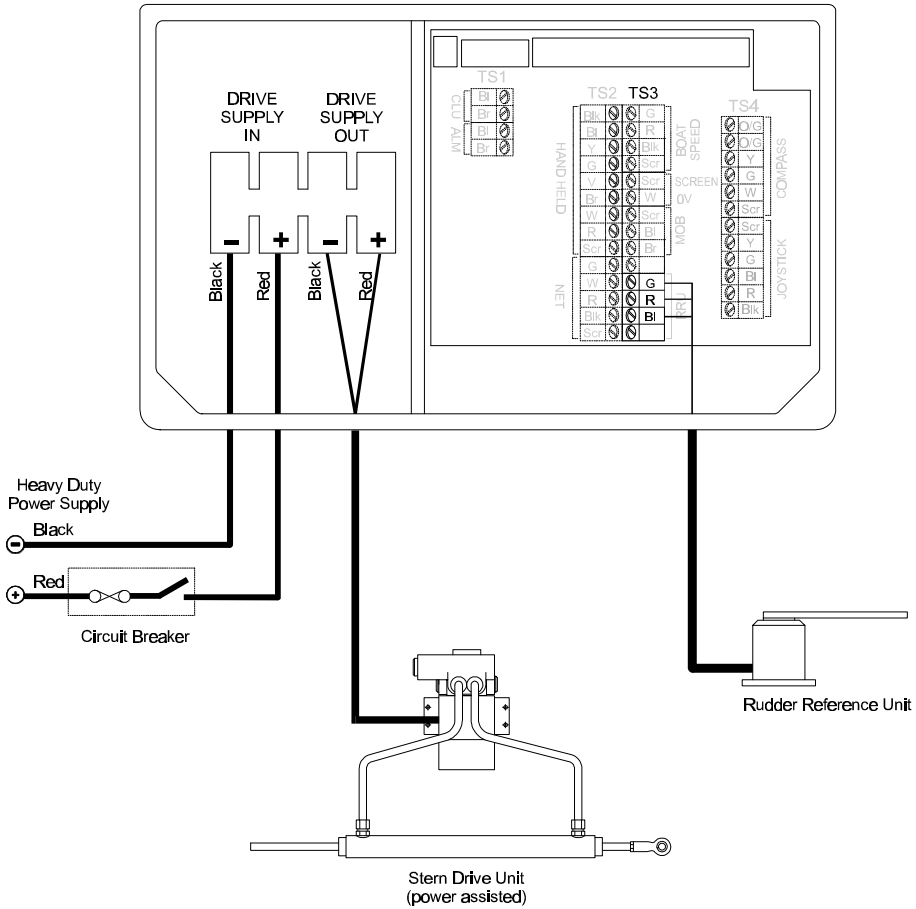
# 4 : ACP UNIT INSTALLATION

## HYDRAULIC PUMP CONNECTIONS



## 4 : ACP UNIT INSTALLATION

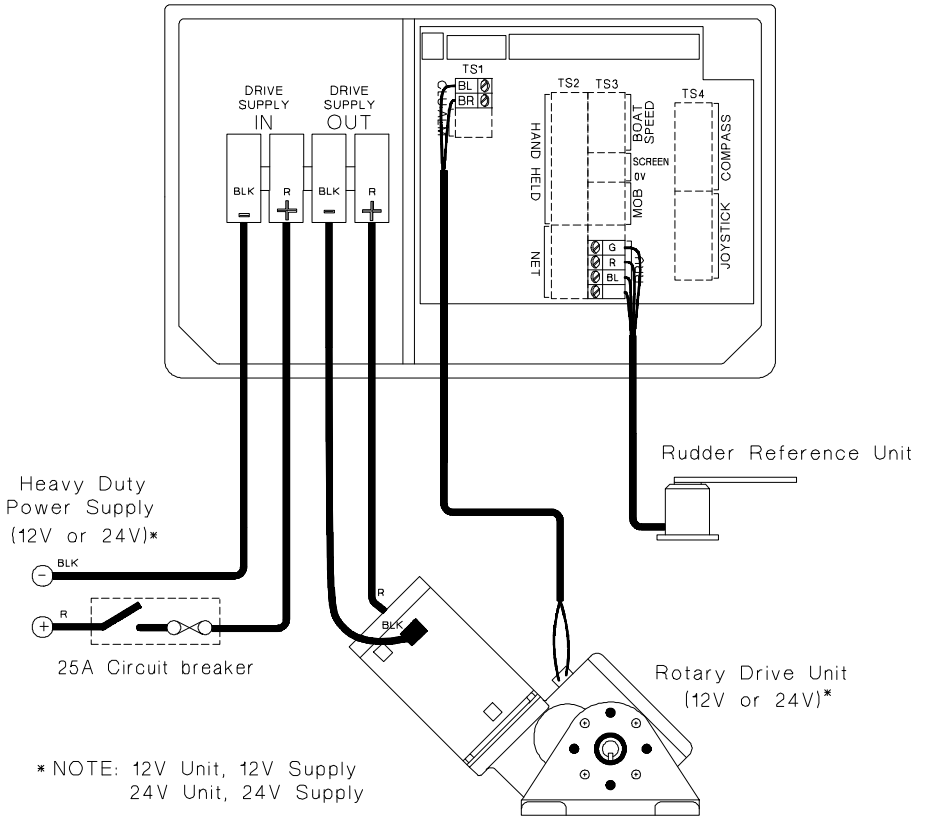
# STERNDRIVE DRIVE UNIT CONNECTIONS





# 4 : ACP UNIT INSTALLATION

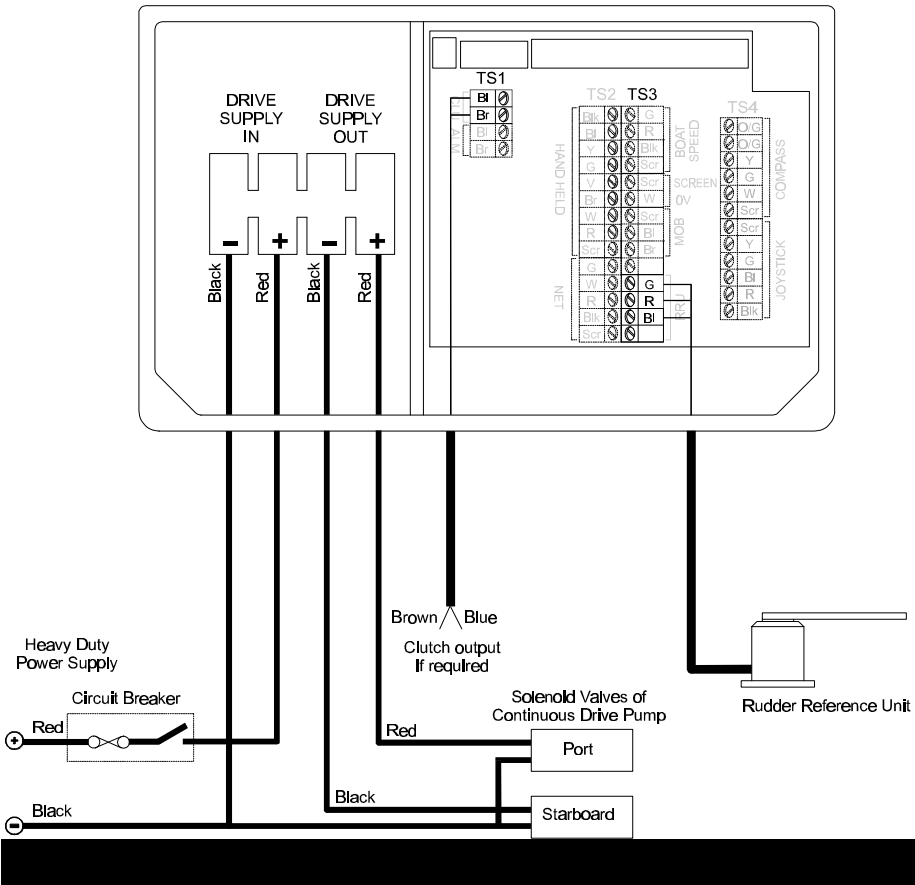
## 12V/24V ROTARY DRIVE CONNECTIONS



## 4 : ACP UNIT INSTALLATION

### **CONTINUOUS DRIVE UNIT CONNECTIONS**

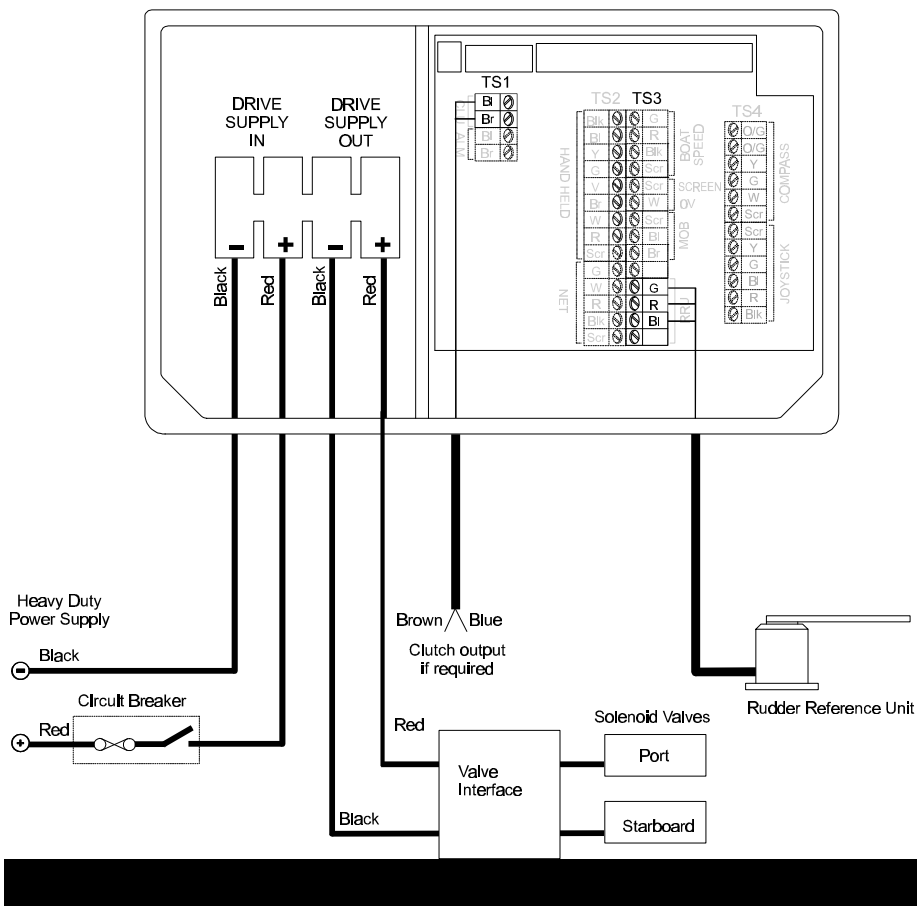
These are general wiring instructions only, showing the implementation of the Type 2 Computer Unit outputs to drive the continuous drive pumps solenoid valves. The continuous drive pump motor will also require a heavy duty supply, this is not shown on this diagram. The clutch output could be used to control the motor supply, however this is beyond the scope of this handbook.



## 4 : ACP UNIT INSTALLATION

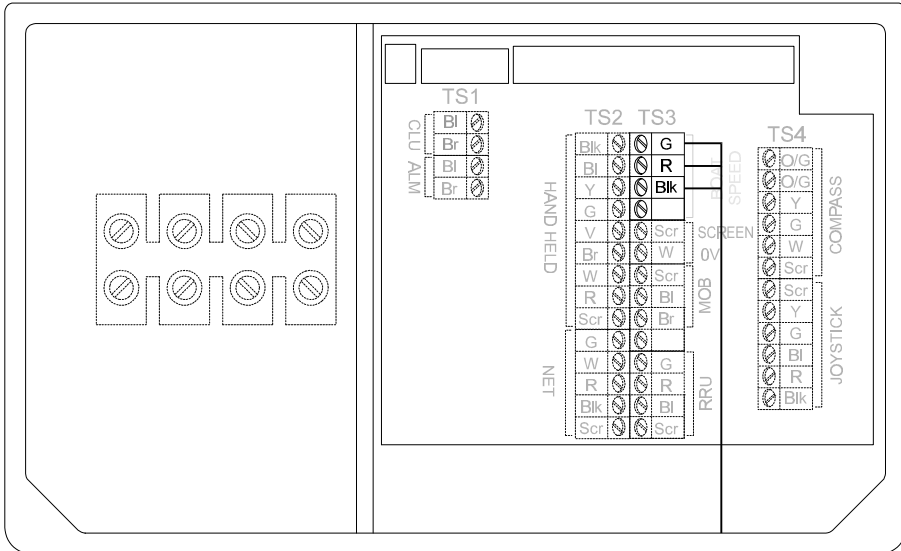
### **PROPORTIONAL SOLENOID CONNECTION**

These are general wiring instructions only, showing the implementation of the ACP 2 Computer Unit outputs to drive proportional solenoid valves. The continuous drive pump motor will also require a heavy duty supply, this is not shown on this diagram. The clutch output could be used to control the motor supply, the clutch output is only active while the rudder is being moved. (See Setting The Rudder Drive Type in Section 5).



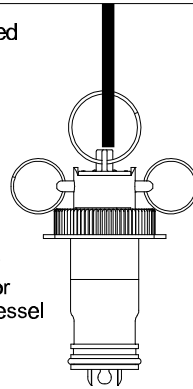
## 4 : ACP UNIT INSTALLATION

### ***DIRECT PADDLE INPUT CONNECTION***



Cut back the un-used  
colouredwires:

Please consult your dealer  
for the specific speed sensor  
and housing suitable for your vessel



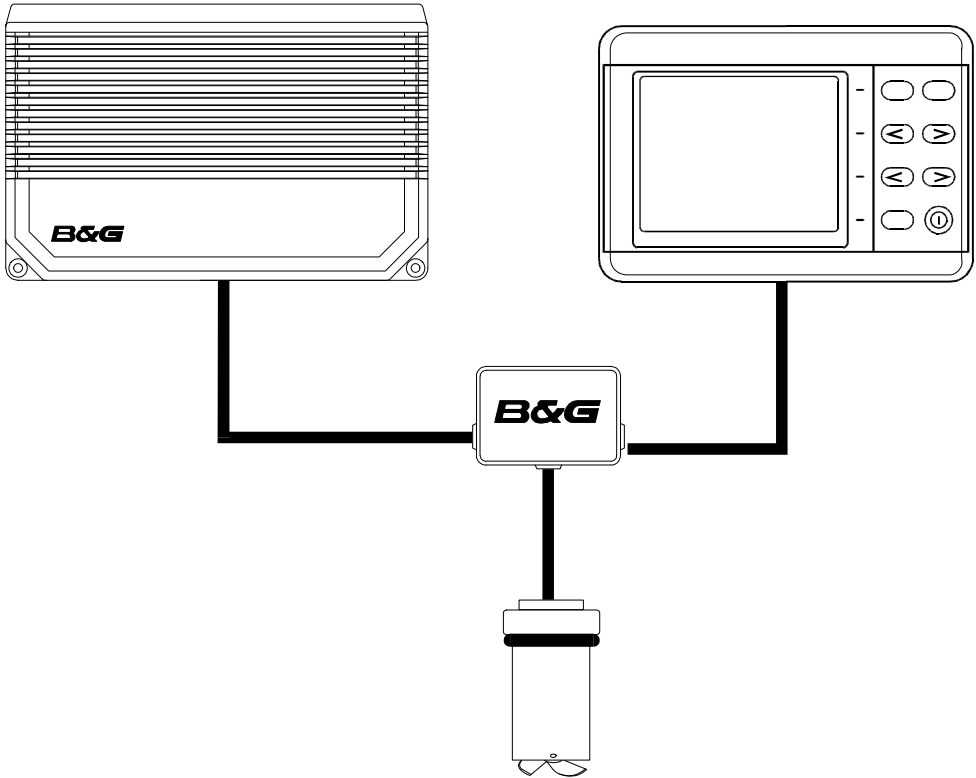
### ***NON-B&G PADDLE CONNECTION***

#### **Using a non-B&G speed sensor**

The speed sensor must have a speed signal output from a hall-effect device giving positive pulses of 12v maximum.

1. Locate the cable from the speed sensor to the instrument input.
2. Cut cable (if necessary) and insert a junction box (B&G part no. 288-00-001). Connect like colour to like colour.
3. Use a length of 2-core screened cable (B&G part no. 135-0B-098 9m/29.5ft) to connect the speed signal and ground of the paddle sensor to the speed input of the Type 2 computer unit.
4. Calibrate the speed input in accordance with the instructions given in the COMMISSIONING section of this manual.

## 4 : ACP UNIT INSTALLATION



ACP 2 UNIT BOAT SPEED TERMINALS [TS3]	FUNCTION	CABLE 135-0B-098
GREEN	SPEED SIGNAL INPUT	RED WIRE
RED	NOT USED	NOT USED
BLACK	GROUND	BLUE WIRE
SILVER	SCREEN	SCREEN

## COMMISSIONING CONTENTS

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## 5 : COMMISSIONING

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## 5 : COMMISSIONING ALONGSIDE

### **H-RANGE PILOT COMMISSIONING**

Before the H-Range Pilot can be used, it is necessary to set and calibrate various parameters. This procedure is called Commissioning. This manual covers both ACP 1 and ACP 2 Pilot systems.

### **PILOT INSTALLATION CHECK LIST**

The check list below should be used prior to the commissioning of the autopilot to ensure that the entire system is correct before applying power.

#### **DRIVE UNIT & STEERING SYSTEM**

---

1. Drive unit securely fixed to a rigid part of the boat structure .
2. Gauge of power cable is appropriate .....

#### **HYDRAULIC RAMS:**

---

1. Boat end stops must limit the rudder movement, not the stroke of the Hydraulic ram .....
2. Split pin that holds the pivot pin in the mounting foot must be secure .....
3. Absence of oil leaks .....
4. Correct diameter bolt in universal ball joint, correct size hole in tiller .....
5. Ram free to move side to side & up and down .....
6. Additional reservoir fitted if black ram mounted on its side.
7. Reservoir at highest point if ram split .....

## 5 : COMMISSIONING ALONGSIDE

### HYDRAULIC PUMPS:

---

1. Absence of oil leaks .....
2. Absence of air in the hydraulic steering.....

### ROTARY DRIVES:

---

1. No backlash or excessive slackness in chain.....

### RUDDER REFERENCE INSTALLATION

---

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1. Base securely fixed to boat structure .....
2. Arm securely fixed to boss .....
3. Ball joint securely fixed to arm.....
4. Linkage has not been over extended .....
5. No slack or backlash in the linkage .....
6. Linkage does not foul when rudder moved hardover to hardover .....
7. Arm moves through at least 90° when rudder moved hardover to hardover (there must be at least 1 volt difference between the end stops) .....
8. Ball joint securely fixed to quadrant/tiller .....

## 5 : COMMISSIONING ALONGSIDE

### COMPASS INSTALLATION

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1. Clear of sources of magnetic interference, including power cables to other equipment, if in doubt check 1 metre around with small hand compass. Look the other side of the bulkhead! .....
2. Fitted as near to centre of motion of boat as other factors allow, aft of centre preferred because usually less motion than fore of centre.....

### ELECTRONICS INSTALLATION

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1. Cables secure .....
  2. Cables undamaged.....
  3. No loose bits of wire.....
  4. Screens connected in accordance with wiring instructions and sleeved where appropriate.....
- 

### **INTRODUCTION TO PILOT COMMISSIONING**

The following is a list of the parameters that have to be set during commissioning. They are selected by pressing the keys indicated on the diagrams while in commissioning mode. Each parameter will be explained in the following sections.

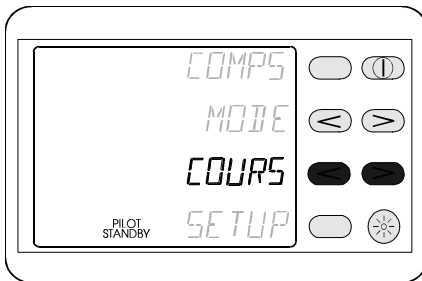
<b>BTYP</b>	Select boat type: Sail, Power P, Power D
<b>SWING</b>	Compass Deviation Correction
<b>H SRC</b>	Heading Source, compass data selection
<b>H OFF</b>	Heading Offset, compass alignment correction
<b>DIP</b>	Magnetic Dip Angle compensation
<b>DRIVE</b>	Rudder drive type selection
<b>RUD P</b>	Rudder end stop Port
<b>RUD S</b>	Rudder end stop Starboard
<b>RUD M</b>	Rudder mid position
<b>RUD T</b>	Rudder Hard-over time
<b>S CAL</b>	Speed sensor calibration
<b>B LEN</b>	Boat waterline length in Metres
<b>B LAG</b>	Boat lag value
<b>R GAN</b>	Rudder gain value
<b>R MAX</b>	Maximum rudder angle value
<b>LOCK</b>	Watch alarm lock facility, disables alarm on/off control

The procedures for commissioning can be divided into two sections. The first to be carried out alongside and the second to be carried out or checked during the course of a sea trial. The order in which the commissioning procedures are carried is not necessarily the order in which they appear when the keys are pressed, continue pressing the key until the one that is required is displayed.

## 5 : COMMISSIONING ALONGSIDE

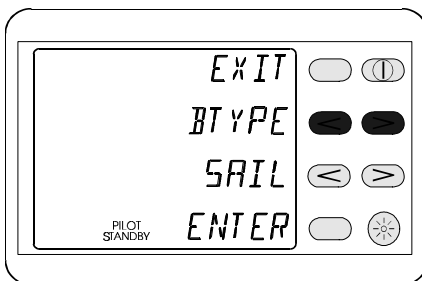
### **ENTERING COMMISSIONING MODE**

To enter commissioning mode, simultaneously press the two keys shown. The autopilot must be in **STANDBY** to do this.



### **LISTING THE COMMISSIONING PARAMETERS**

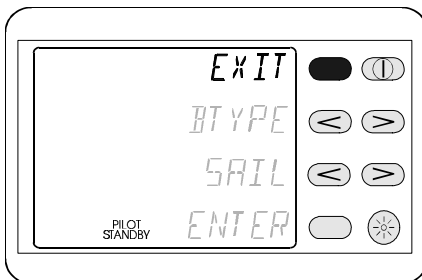
The display will now show the commissioning menu. Press either of the two keys shown to list the commissioning parameters.



**NOTE:** If this is the first time the Pilot has been commissioned **SELCT** will be displayed instead of **SAIL**, **PWR P** or **PWR D**.

### **EXITING COMMISSIONING MODE**

To exit commissioning mode press the key next to the **EXIT** legend.



# COMMISSIONING ALONGSIDE

## INTRODUCTION

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The following parameters should be set prior to a sea trial.

<b><i>BTYPE</i></b>	Select boat type: Sail, Power P, Power D
<b><i>H SCR</i></b>	Heading Source, compass data selection
<b><i>H OFF</i></b>	Heading Offset, compass alignment correction
<b><i>DIP</i></b>	Magnetic Dip Angle compensation
<b><i>DRIVE</i></b>	Rudder drive type selection
<b><i>RUD P</i></b>	Rudder end stop Port
<b><i>RUD S</i></b>	Rudder end stop Starboard
<b><i>RUD M</i></b>	Rudder Mid position
<b><i>RUD T</i></b>	Rudder hard-over Time
<b><i>R MAX</i></b>	Maximum rudder angle value
<b><i>B LEN</i></b>	Boat waterline length in Metres

## 5 : COMMISSIONING ALONGSIDE

### ***BTYPE - SELECTING THE BOAT TYPE***

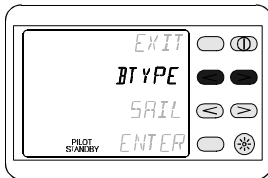
There are three selections available:

**SAIL** For all sail boats.

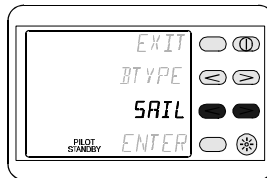
**PWR D** For power boats with displacement hulls.

**PWR P** For power boats with planing hulls.

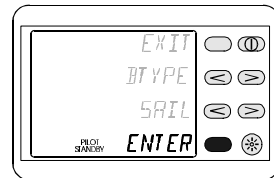
### **SETTING THE BOAT TYPE**



Select **BTYPE** from the menu.



Select **SAIL**  
**PWR P**  
**PWR D.**



Press **ENTER** to store the parameter.



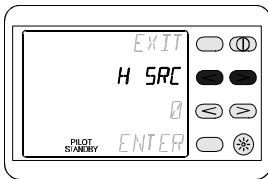
## **H SRC - HEADING SOURCE (COMPASS)**

The Heading Source setting instructs the Pilot from where the compass data is to be supplied. This setting is determined by the H-Range Instruments or the H-Range Pilot system. Most systems will use the Pilot remote compass unit. The compass sensor supplies heading data to the Pilot and the instruments. However, some systems may have a Super Halcyon 3 Compass fitted. This could be in addition or in lieu of the Pilot compass. Settings are available to select any of the compass sensors, select the correct one for the system from the table below.

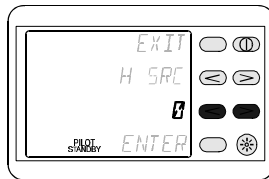
<b>H SRC</b>	<b>COMPASS DATA</b>
<b>0</b>	Default
<b>5</b>	Super Halcyon 3, connected via the H-Range instrument system.
<b>18</b>	ACP Remote Compass Unit.

The node must be set to either 5 to receive heading from a Super Halcyon or 18 to receive heading from Pilot Compass.

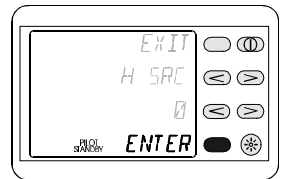
### **SETTING THE HEADING SOURCE VALUE**



Select **H SRC** from the menu.



Select the value from the table.



Press **ENTER** to store the value.

## 5 : COMMISSIONING ALONGSIDE

### **H OFF - HEADING OFFSET**

(COMPASS ALIGNMENT)

The Compass Alignment electronically compensates for the misalignment between the autopilots fluxgate compass and the Earth's magnetic field.

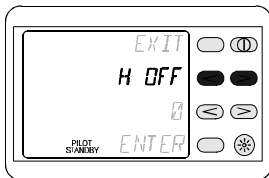
The boats actual heading must be known, use a bowl compass or hand-held compass for reference.

Enter the heading offset (in degrees) to correct the misalignment, in the range -180 to 180. For Example:

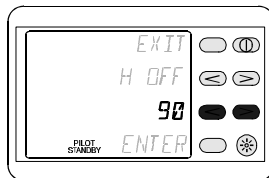
- The boats actual heading is Due North, 000.
- The autopilot display is indicating West, 270.
- Enter the Heading Offset value of 90.

Heading Offset should be checked during a sea trial to ensure that it has been entered accurately.

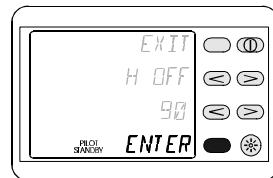
### **ADJUSTING THE HEADING OFFSET**



Select **H OFF** from the menu.



Calculate the correct value for the offset.



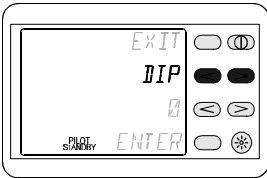
Press **ENTER** to store the value.

## DIP - MAGNETIC DIP ANGLE

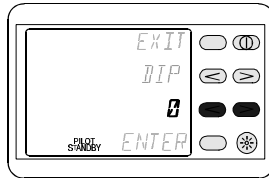
### BOATS FASTER THAN 20 KNOTS ONLY

All magnetic compasses are effected by 'Northerly turning errors' in the Northern Hemisphere or 'Southerly turning errors' in the Southern Hemisphere, which increase with boat speed and magnetic dip angle in higher latitudes. These can cause heading instability at boat speeds greater than 20 knots when steering with an autopilot. By entering the dip value indicated on the compensation chart, the autopilot will be able to correct for these errors and improve the heading stability. Use the minimum value necessary to stabilise the heading.

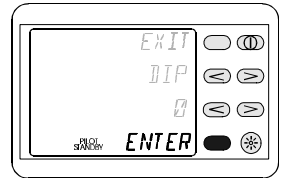
### SETTING THE MAGNETIC DIP VALUE



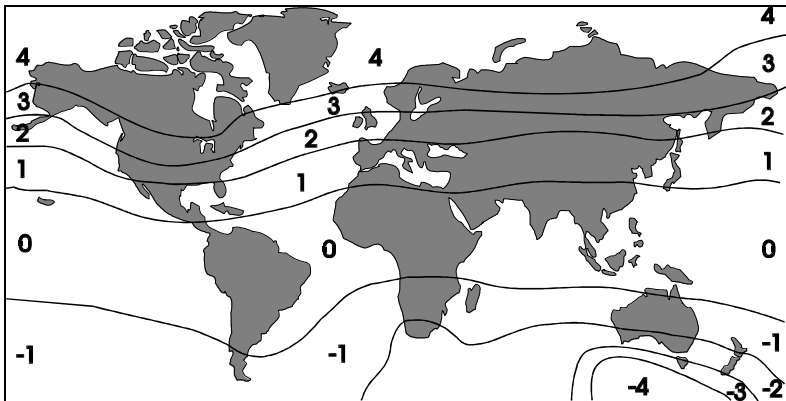
Select **DIP** from the menu.



Select the correct value from the chart below.



Press **ENTER** to store the value.



## 5 : COMMISSIONING ALONGSIDE

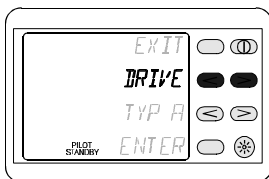
### **DRIVE - RUDDER DRIVE TYPE**

Depending upon the type of rudder drive unit fitted the Pilot controls the rudder drive motor in different ways, this optimises the autopilot steering response.

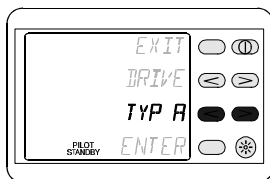
There are four selections for **DRIVE**:

- TYP A** All Linear Rams, Hydraulic pumps and Rotary drives.
- TYP B** Pedestal drive motors fitted by some steering gear manufacturers.
- TYP C** Outdrive drive units and Continuous drive units.
- TYP D** Proportional solenoid valves.

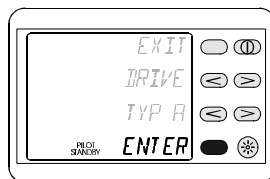
### SETTING THE DRIVE TYPE



Select **DRIVE** from the menu.



Select the correct value from the list above.

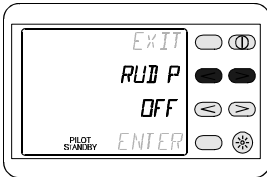


Press **ENTER** to store the drive type.

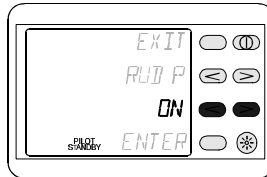
## SETTING THE RUDDER END STOPS

Before the Pilot can be used it must know the position of the rudder end stops.

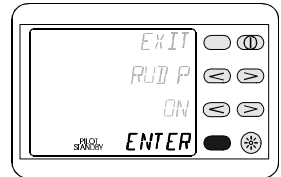
### RUD P - SETTING THE PORT END STOP



Select **RUD P** from the menu.



Turn the wheel until the rudder is hardover to port. Change the **OFF** legend to **ON** with the keys shown.

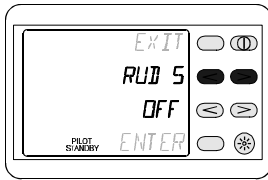


Press **ENTER** to set the port end stop position.

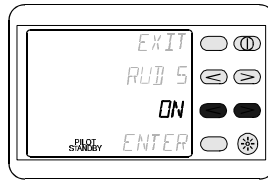
## 5 : COMMISSIONING ALONGSIDE

### **RUD S - SETTING THE STARBOARD END STOP**

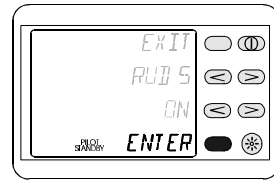
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Select **RUD S** from the menu.



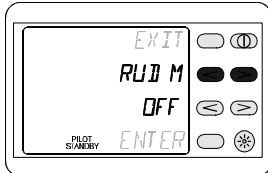
Turn the wheel until the rudder is hardover to starboard. Change the **OFF** legend to **ON** with the keys shown.



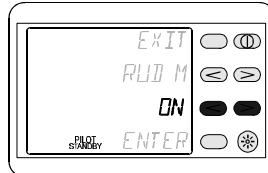
Press **ENTER** to set the starboard end stop position.

### **RUD M - SETTING THE MIDSHIPS POSITION**

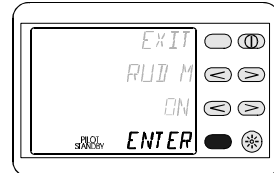
---



Select **RUD M** from the menu.



Turn the wheel until the rudder is amidships. Change the **OFF** legend to **ON** with the keys shown.



Press **ENTER** to set the midships position.

**NOTE:** Due to hull design and steering characteristics the best rudder midships position can only be set when underway, at normal cruising speed. It is therefore necessary to re-adjust the midships position during a sea trial.

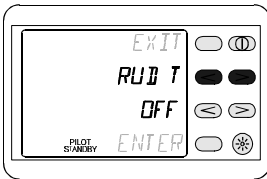
### **RUD T - RUDDER HARD-OVER TIME**

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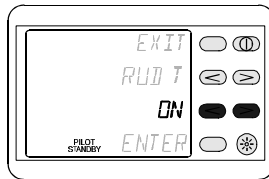
## 5 : COMMISSIONING ALONGSIDE

To finish the rudder end stop commissioning procedure the autopilot must calculate the rudder hard-over port to hard-over starboard time. The following points must be observed before carrying out the procedure:

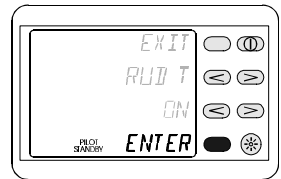
- If the boat is equipped with hydraulic power assisted steering the engines must be running during setting the rudder end stops.
- The rudder hard-over to hard-over time can only be calculated with the boat stationary



Select **RUD T** from the menu.



Change the **OFF** legend to **ON** with the keys shown.



Press **ENTER** to start the timing. The Pilot will drive the rudder to measure the hardover to hardover time.

If **RUD T** fails to work then check the following:

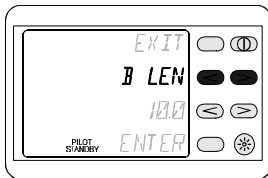
- The boat speed must be less than 3 knots.
- Turn the wheel, check that the rudder bar display on the Pilot display is indicating. If it fails to indicate carry out the end stop procedures again.
- The RRU must move through a minimum of 90° when the wheel is turning from lock to lock

## 5 : COMMISSIONING ALONGSIDE

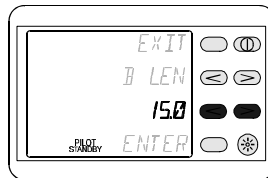
### **B LEN - BOAT LENGTH**

The boats waterline length in Metres must be entered into the autopilot for it to steer accurately.

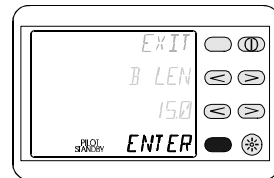
#### SETTING THE BOAT LENGTH



Select **B LEN** from the menu.



Enter the correct waterline length in metres.



Press **ENTER** to set the value.

### **R MAX - SETTING THE RUDDER ANGLE**

This optional menu is only present on some versions of display software.

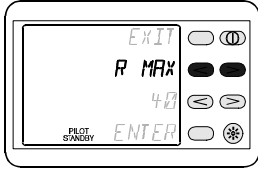
The default rudder angle value is  $\pm 40^\circ$ . If the mechanical rudder angle is significantly different from the default value enter the actual rudder angle value .



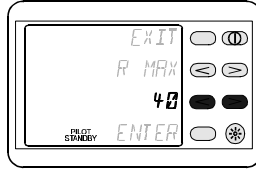
## 5 : COMMISSIONING ALONGSIDE

### SETTING THE MAXIMUM RUDDER ANGLE

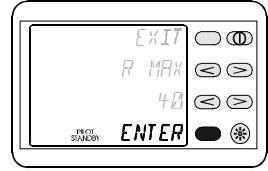
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Select **R MAX** from the menu.



Enter the corrected maximum rudder angle ( $\pm 5^\circ$ ).



Press **ENTER** to set the value.

### **WHAT TO DO NEXT?**

It is now necessary to carry out a Sea Trial to finish the autopilot commissioning.

#### **IMPORTANT NOTE:**

Until all parameters have been set or checked the autopilot should not be used to steer the boat.

## 5 : COMMISSIONING SEA TRIAL

# COMMISSIONING SEA TRIAL

## INTRODUCTION

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---

The following parameters should be set and checked during the initial sea trial.

<b>SWING</b>	Compass Deviation Correction
<b>H OFF</b>	Heading Offset, compass alignment correction
<b>RUD M</b>	Rudder mid position
<b>S CAL</b>	Speed sensor calibration
<b>B LAG</b>	Boat lag value
<b>R GAN</b>	Rudder gain value
<b>LOCK</b>	Watch alarm lock facility, disables alarm on/off control

The commissioning sea trial should be carried out in open water on a calm day. The procedures for the remainder of the commissioning involve continual course and speed changes, it is very important that a constant look out is maintained.

The autopilot will be initially operating from the factory default values for Boat Lag (**B LAG**) and Rudder Gain (**R GAN**), these are different for sail or power boats. During the sea trial the Pilot learning algorithm will automatically set and adjust the value for Rudder Gain. The values for boat lag and rudder gain will be checked and adjusted to finely tune the autopilot steering performance when necessary. The default values are automatically set depending upon the type of vessel by the setting **BTYPE**.

### ***IMPORTANT NOTE***

- On the initial sea trial ***DO NOT EXCEED 15 KNOTS.***
- Always maintain a proper lookout.
- If in doubt, disengage the autopilot with the red OFF key on any Pilot Display or Hand-held Controller, and return to manual steering.

### **ENGAGING THE PILOT**

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- Steer the boat onto a suitable heading, allow time for the boat to settle on this course.
- Engage Pilot in **COMPS** (compass) mode.
- The autopilot will now be steering the boat on the selected heading. Alter course in multiple increments using the 10° and 1° course change buttons on any Pilot Display or Hand-held Controller.

### **DISENGAGING THE PILOT**

---

- Press the red off key to disengage the autopilot and return to manual steering.

For full instructions on using the Pilot refer to the Pilot Operation handbook.

### ***POWER - VERIFY RUDDER DRIVE***

#### **USE OF POWER STEER MODE**

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Power Steer mode can be used to verify that the Rudder Drive is operating correctly. This mode allows the user to directly control the boats rudder by using any Pilot Display or Hand-held Controller course change keys.

This could be used in an emergency if the normal manual steering system becomes defective, e.g. a broken steering quadrant cable or control rod. It can also enable faults in the ram drive unit or drive pump, the rudder reference unit and its linkage to the steering system to be diagnosed because the autopilot normal course control software is by-passed.

#### **SELECTING POWER STEER MODE**

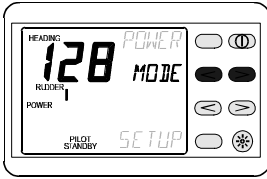
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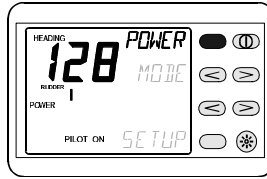
- The Pilot must be in STANDBY.
- Turn the wheel so the rudder is in the amidships position (if possible).
- Press the key next to the **POWER** legend.
- To exit power steer mode press the red **OFF** key.

**NOTE:** When the **MID** key is pressed the rudder will return to the position it was in when **POWER** steer was engaged. If the rudder was set at the amidships position then **MID** key will return it to that position.

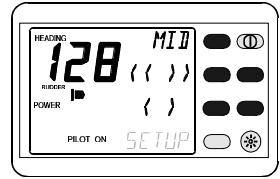
## 5 : COMMISSIONING SEA TRIAL



Press the keys next to the **MODE** legend until **POWER** is displayed on the top line.



With the rudder amidships, press the key next to **POWER** legend to engage the Pilot in power steer mode.



Use the << or >> keys to adjust the rudder position by 3°. Use the < or > keys to adjust the rudder position by 0.6°. Press **MID** to return the rudder to the amidships position. (See note on previous page.)

### POWER STEER CHECK

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1. Engage the Pilot, check clutch / bypass valve operation.
2. With the Pilot engaged, try to move rudder with the wheel. The backlash should be less than 1° of rudder movement. Investigate and rectify any backlash steering problems immediately.
3. Use the << >> keys to move the rudder, check that the Pilot can move the rudder by large amounts, verify by watching the rudder angle on the display, each press should give about 3° rudder movement
4. Use the < > keys to move the rudder, check that the Pilot can move the rudder by small amounts, verify by watching the rudder angle on the display, each press should give about 0.6° rudder movement

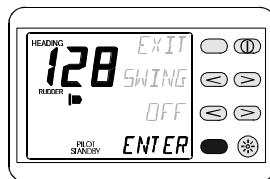
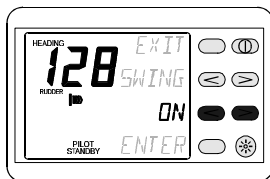
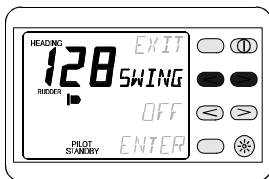
## 5 : COMMISSIONING SEA TRIAL

### **SWING - COMPASS CALIBRATION**

This procedure will automatically correct the ACP remote compass unit for any deviation errors. It should be carried out in open water, preferably on a calm day, with minimal wind and waves.

**IMPORTANT NOTE:** If the Pilot is using a Super Halcyon 3 Compass as its Heading Source then it must be calibrated at this point. Refer to the calibration procedure in the Super Halcyon 3 Compass handbook.

### **CALIBRATING THE PILOT COMPASS**



1. Press **SETUP** key, until the display shows **SWING**.

2. Use the keys to change **OFF** to **ON**.

3. Press **ENTER** to start the swing.

**NOTE:** The **SWING** can be stopped at any time by pressing the **EXIT** key.

- With the speed below 5 knots, turn the boat through 360° at a rate of turn not greater than 2° per second i.e. the turn should take about 3 minutes to complete. The display will show the amount of turn completed so far in degrees.
- Keep turning until **PAS** or **FAIL** is displayed.

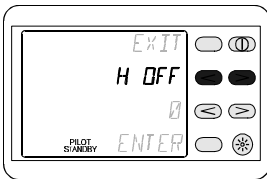
## 5 : COMMISSIONING SEA TRIAL

- **PAS** will alternately be displayed with a number which indicates the amount of correction applied. If this is greater than approximately  $15^{\circ}$ , consider re-siting the remote compass unit in a more favourable position away from external magnetic influences. (Some versions of the display software only.)
- If **FAIL** shows the swing was unsuccessful, the display will return to **000°** and the procedure will have to be repeated.

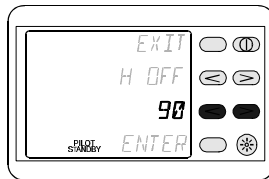
### **H OFF - CHECKING THE HEADING OFFSET**

The heading offset was originally set while the boat was alongside. It would be advisable to check that the offset value is correct now that the Pilot compass has been swung. Refer to Setting the Heading Offset to review the procedure in full.

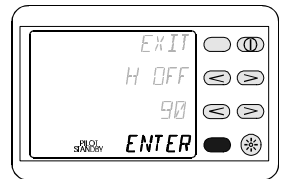
### **SETTING THE HEADING OFFSET VALUE**



Select **H OFF** from the menu.



Calculate the correct value for the offset.



Press **ENTER** to store the value.

## 5 : COMMISSIONING SEA TRIAL

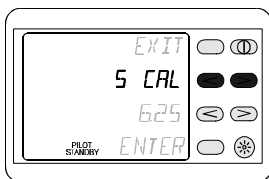
### **S CAL - CALIBRATION OF SPEED INPUT**

The ACP computer unit can take a direct speed input from a Paddle Wheel with a hall effect output. Normally the Pilot uses boat speed supplied via the system network from the instrument system, this facility is only used when the installation does not include an H-range instrument system.

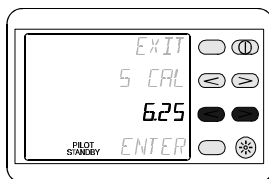
All B&G Speed Sensors (paddle wheel types) are compatible. The Hertz/Knot value is entered into the system to ensure the autopilot steering response is controlled with reference to boat speed. The default Hertz/Knot value is 6.25, this is the setting for B&G speed sensors.

To determine if the value is correct compare the boat speed value displayed by the Pilot display (when the SPEED key is pressed) with the displayed value of speed on the log/speedo fitted.

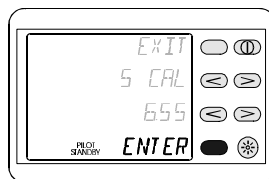
### **SETTING THE SPEED CALIBRATION VALUE**



Select **S CAL** from the menu.



Adjust the value with the keys shown.



Press **ENTER** to set the value.



### **R GAN - RUDDER GAIN**

When the Pilot is part of an integrated system, boat speed data will be supplied via the system network cables from the H-Range Instruments. By monitoring boat speed and rate of turn the Pilot will automatically 'learn' the correct value for Rudder Gain giving a rate of turn of approximate  $6^{\circ}$  per second for a sail boat or  $8^{\circ}$  for a power boat.

If there is no direct speed input or the speed is being set by the Pilot Display Manual Speed Band selections, then the Rudder Gain value must be entered manually, miss out this section and go straight to Manual Rudder Gain.

### **CHECKING RUDDER GAIN LEARNING**

---

- Steer the boat onto a suitable heading, allow time for the boat to settle on this course.
- Engage the pilot in **COMPS** (compass) mode.
- **AT A SPEED NOT EXCEEDING 15 KNOTS**, make at least 6 large course changes of at least  $100^{\circ}$ , by multiple presses of the  $10^{\circ}$  course change buttons on any Pilot Display or Hand-held Controller. This enables the autopilot to learn the rudder gain value.
- When the autopilot has learnt the rudder gain value the rate of turn will be approximately  $6^{\circ}$  (sail) or  $8^{\circ}$  (power) per second. (To estimate the rate of turn the display is updated twice per second, therefore the heading display should jump in 3-4 $^{\circ}$  steps.)
- Press the red off key to disengage the autopilot and return to manual steering.

## 5 : COMMISSIONING SEA TRIAL

### SETTING THE RUDDER GAIN MANUALLY

---

- Steer the boat onto a suitable heading, allow time for the boat to settle on this course.
- Engage the pilot in **COMPS** (compass) mode.
- **AT A SPEED NOT EXCEEDING 15 KNOTS**, make at least 6 large course changes of at least 100°, by multiple presses of the 10° course change buttons on any Pilot Display or Hand-held Controller.
- Observe and estimate the rate of turn. It should be approximately 6° to 8° per second. (To estimate the rate of turn the display is updated twice per second, therefore the heading display should jump in 3° to 4° steps).
- Also observe the performance of the autopilot when changing course. If the rate of turn is too **SLOW**, **REDUCE** the value of rudder gain and the Pilot will use more rudder. If the rate of turn is too **FAST**, **INCREASE** the value of rudder gain and the Pilot will use less rudder.
- Adjust the Rudder Gain to give an average rate of turn of approximately 6° to 8° per second.

#### RUDDER GAIN VALUE TABLE

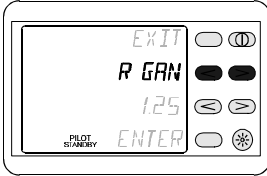
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BOAT TYPE	FACTORY SET VALUE	TYPICAL VALUES
SAIL BOATS	2.0	1.0 to 3.0
POWER BOATS	0.8	0.3 to 1.0

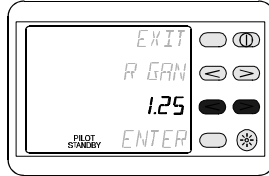
**NOTE:** The factory set value is selected by setting Boat Type and Rudder Drive Type during commissioning.

### SETTING THE RUDDER GAIN VALUE

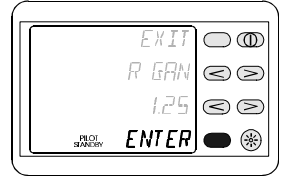
**NOTE:** The autopilot must be disengaged and in commissioning mode to adjust the Rudder Gain value.



Select **R GAN** from the menu.



Adjust the value with the keys shown.



Press **ENTER** to set the value.

## 5 : COMMISSIONING SEA TRIAL

### **B LAG - BOAT LAG**

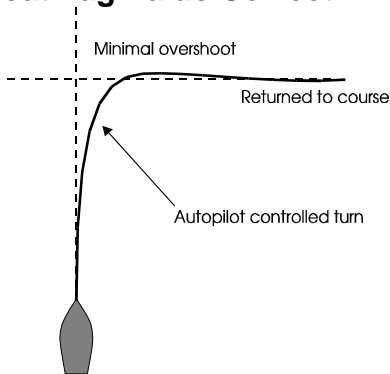
Boat Lag is the time taken for the boat to respond to changes in helm. For example, heavy displacement hulls require a larger value for boat lag.

### **CHECKING THE BOAT LAG**

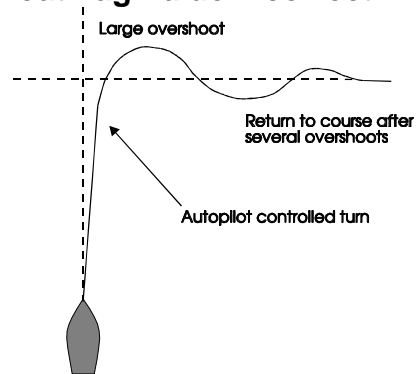
---

- Engage the autopilot as previously explained in Initial Pilot Sea Trial.
- At a speed not exceeding 15 knots, change course by 90° in each direction.
- Observe the autopilot steering performance. The boat should turn onto the new heading with minimal overshoot (a slight overshoot is acceptable).
- If the overshoot is consistently more than 5° for course changes in both directions increase the Boat Lag value in steps of 0.1 until the overshoot is corrected.
- It is easier to spot overshoot than undershoot, hence if no overshoot is observed decrease the boat lag in steps of 0.1 until a small overshoot is seen.
- Use the smallest value of Boat Lag to stop overshoot.

#### **Boat Lag Value Correct**



#### **Boat Lag Value Incorrect**



## 5 : COMMISSIONING SEA TRIAL

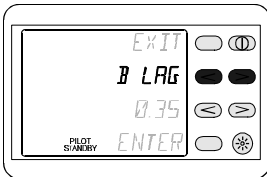
### BOAT LAG VALUE TABLE

BOAT TYPE	FACTORY SET VALUE	TYPICAL VALUE
SAIL BOATS	0.30	0.3 to 1.0
POWER BOATS	0.50	0.3 to 1.0

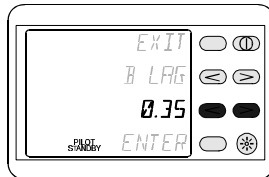
**NOTE:** The factory set value is selected by setting Boat Type and Rudder Drive Type during commissioning.

### SETTING THE BOAT LAG VALUE

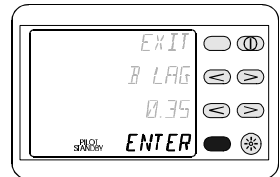
**NOTE;** The autopilot must be disengaged and commissioning mode selected to adjust the Boat Lag value.



Select **B LAG** from the menu.



Adjust the value with the keys shown.



Press **ENTER** to set the value.

## **TROUBLE SHOOTING CONTENTS**

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## 6 : TROUBLE SHOOTING

### **TROUBLE SHOOTING INTRODUCTION**

The ACP Computer Unit is continually monitoring the Pilot and H-Range Instrument System for correct operation. If an error is detected the Pilot Display will show an error message, the Hand-held Controller status LED will flash the error pattern, and the system alarm buzzers will sound.

To silence the alarm press the key adjacent to the **FAULT** legend on any Pilot Display twice, or the = (enter) key on any FFD twice.

### **FAULT 100 UNCOMMISSIONED**

#### **Fault description:**

Rudder not commissioned or memory has been corrupted.

#### **Check list:**

1. Has rudder ever been successfully commissioned ?  
Yes, go to 4.  
No, go to 2.
2. Set rudder end & mid positions, move helm, does rudder indicator work ?  
Yes, go to 4.  
No, go to 3.
3. Rudder indicator will not work until mid and end positions have been entered. The difference in the signal from the rudder reference unit at the port end stop and the starboard end stop must be at least 1.0 volts. Check rudder reference installation and then repeat 2.
4. If rudder has previously been successfully commissioned then fault is due to memory corruption. This may be due to:
  - change of software version.
  - memory backup battery failure.
  - severe interference, e.g. lightning.

## **FAULT 101 REMOTE COMPASS**

### **Fault description:**

The signal from the remote compass unit is too big or too small.

### **Check list:**

1. Check for magnetic interference near compass position.
2. Suspect fault with compass electronics or fluxgate element.

### **IMPORTANT NOTE:**

The electronics and the fluxgate sensor are matched together, if either is replaced, the Pilot commissioning must be reset.

Proceed as follows:

- make a note of all commissioning values.
- without moving the helm, enter the port & starboard end stop positions.
- switch the 12v power off and then on.
- re-commission Pilot in the normal way using previously noted values.

The software will now automatically match the fluxgate sensor to the electronics.



## 6 : TROUBLE SHOOTING

### **FAULT 102 RUDDER REFERENCE**

#### **Fault description:**

The signal from the rudder reference unit is outside the limits set during commissioning.

#### **Check list:**

1. Check installation of rudder reference unit for slack or loose fittings.
2. Check the signal from the rudder reference with a volt meter at the Pilot computer. The voltage supply to the rudder reference should be 4.5 to 5.0 volts. With someone moving the helm, the signal should change smoothly. If the signal is incorrect, suspect a faulty rudder reference unit. Note, the difference between the signal voltages measured at the two end stops must be at least 1.0 volts.
3. Set FFD (Hydra or Hercules) to show digital rudder angle in degrees. Slowly move helm to port and starboard end stops, check that the indicated rudder angle is 40 degrees (+/- 2), (or the maximum rudder angle value entered in the commissioning menu if different). If not, check the rudder reference installation to determine and rectify the reason for the end stop position changing and then re-enter the end stop commissioning values.
4. Move helm slowly from end stop to end stop. Check that indicated rudder angle counts from one side to the other side without "missing" a count.
5. If the fault is always at the same rudder angle, suspect a faulty rudder reference unit.
6. If the fault is at different rudder angles suspect a fault in the wiring, the connections to the Pilot computer, or the Pilot computer electronics.

## **FAULT 103 RUDDER DRIVE**

### **Fault description:**

The Pilot attempted to move the rudder, but did not sense any change in rudder position.

### **Or**

When the Pilot attempted to move the rudder, it moved in the wrong direction.

### **Check list:**

1. Is the Heavy duty power supply circuit breaker for the autopilot drive switched on?
2. Check installation, look for any slack or loose fixings in the drive system or the rudder reference as the helm is moved. Pay particular attention to the possibility of air in hydraulic systems.
3. Move the helm, does the rudder indicator work, if not, check installation of rudder reference unit as detailed above.
4. Select "Power Steer" mode. If drive system includes a clutch or solenoid valve, engage the pilot and check the operation of the clutch or solenoid valve. It should not be possible to move the helm with the Pilot engaged. If clutch fails to operate:
  - Disconnect clutch from Pilot electronics and test operation when connected directly to power supply.
  - Check correct power is applied:
  - ACP 1 pilots - approx. 12V at up to 2 amps.
  - ACP 2 pilots - selected voltage at up to 2 amps.

## 6 : TROUBLE SHOOTING

5. With Pilot engaged in "Power Steer" mode, use 10 & 1 degree, port & stbd. keys to move rudder. If the motor fails to run:
  - Disconnect motor from Pilot electronics and test operation when connected directly to power supply.
  - Check correct power is applied:
  - ACP 1 pilots - 12v up to 12 amps.
  - ACP 2 pilots - 12v or 24v at up to 25 amps.
  
6. If the fault only occurs intermittently or under heavy loads. Use power steer mode to move rudder while restricting movement by holding wheel. Fault only occurring under these conditions could be due to:
  - Excessive motor current.
  - Too much slack or backlash in drive or fixing to tiller, possibly due to air in Hydraulic system.
  - Software allows 3 speed control of drive motor for smoother rudder movement. Later issues of software increase speed of drive motor if the drive motor stalls at slower speeds. Check software issue.
  - ACP 2 Hydra - version 1.2 or later.

### ***FAULT 104 NO BOAT SPEED***

#### **Fault description:**

The boat is stationary or the speed sensor is not working.

#### **Check list:**

1. If boat speed for pilot comes from instrument system, check speed shown on instrument system display.
2. If boat speed connected directly to pilot, check connections.
3. Check boat speed sensor for correct operation.
4. Check the H-Range instrument system depth board software version. It should be 3C or greater.

## ***FAULT 105 EXTERNAL COMPASS***

**Fault description:**

Compass data from Super Halcyon 3 via instrument system network has stopped.

**Check list:**

1. Check heading display on instrument system.
2. Check connections to instrument system.

## ***FAULT 106 NO NMEA DATA***

**Fault description:**

XTE data from position fixer via instrument system network has stopped.

**Check list:**

1. Check XTE display on instrument system.
2. Check connections to instrument system.
3. Check operation of Position Fixer, has NMEA output been selected and enabled? Has autopilot output been enabled? Has a waypoint been entered correctly? Refer to Position Fixer manual.

## ***FAULT 107 NOT USED***

Not currently used.

## 6 : TROUBLE SHOOTING

### ***FAULT 108 BAD NMEA DATA***

#### **Fault description:**

The value of XTE data being received has suddenly changed by more than 0.3 nautical miles.

#### **Check list:**

1. Check XTE on display for stability.
2. Check operation of Position Fixer, especially signal and noise levels. refer to Position Fixer operation manual.

### ***FAULT 109 NO WIND DATA***

#### **Fault description:**

There is no valid wind data being received via the instrument system network, or the wind speed is less than 1kt.

#### **Check list:**

1. Check Wind display on instrument system.
2. Check connections to instrument system.

### ***FAULT 110 NO OPTIMUM WIND***

(HERCULES PILOT ONLY).

#### **Fault description:**

There is no optimum wind angle data being received via the system network.

#### **Check list:**

1. Check optimum wind angle display on instrument system.
2. Check operation of other Hercules Performance unit functions.

**FAULT 111 CURRENT TRIP****Fault description:**

The current limit circuit for the drive motor (25 amps) or the clutch (2 amps) has tripped.

ACP 1	Drive Motor 12A	Clutch 2A
ACP 2	Drive Motor 25A	Clutch 2A

Or excess supply voltage detected by the ACP 1.

**Check list:**

1. Check installation and wiring for short circuits.
2. Check current to clutch, maximum available 2 amps.
3. Check current to drive motor, maximum available 25 amps for the ACP 2, 12 amps for the ACP 1.
4. Check that the ACP 1 pilot is supplied from 12V and not 24V.
5. Check motor brushes.

**FAULT 112 NETWORK****Fault description:**

No regular messages being received by pilot control from pilot display via instrument system network, i.e. either the display is not transmitting or the Pilot computer is not receiving.

**Check list:**

1. If new system that has never worked, check software of display:
  - Hydra Pilot display, version 3.A or later.
2. If other displays show Pilot data, check installation and operation of Pilot display.
3. If Pilot responds to commands from other displays then Pilot computer is operating correctly.
4. Check installation of network cable and terminators.


## 6 : TROUBLE SHOOTING

### ***NO PILOT PILOT DISPLAY***

#### **Fault description:**

No regular messages being received by pilot display from pilot control via instrument system network, i.e. either the display is not receiving or the Pilot computer is not transmitting.

#### **Check list:**

1. If other displays show Pilot data, check installation of Pilot display or suspect faulty Pilot display.
  2. If no Pilot data on any display, check installation of Pilot computer or suspect faulty Pilot computer.
  3. Check installation of network cable and terminators.
- 

### **NOT STEERING A STRAIGHT COURSE**

#### **Fault description:**

The Pilot seems unable to steer straight, it continually overcorrects course errors; the wake has an "S" like appearance as the boat first steers several degrees off course to port followed by several degrees off course to starboard.

#### **Check list:**

1. Drive unit. Check for any slack or backlash in the drive system, see earlier section.
2. Rudder reference. Check for any slack or backlash in the assembly and associated linkages, see earlier section.
3. Rudder reference. Check that the output voltage change is smooth with no jumping of the reading or flat spots when the rudder is moved from hardover to hardover. (Check using rudder angle displayed on FFD.)
4. Boat speed. Check that the boat speed operating correctly.
5. Settings. Read the commissioning manual carefully and check that the settings are appropriate for the type of boat.
6. Rudder gain. Make large course changes using the pilot, if the gain value is correct the rate of turn should be between 6 and 8 degrees per second. Adjust if necessary.
7. Boat Lag. A boat lag value which is too small for the boat can cause instability, try increasing the value.