



**NETWORK
ACP PILOT
INSTALLATION &
COMMISSIONING
MANUAL**

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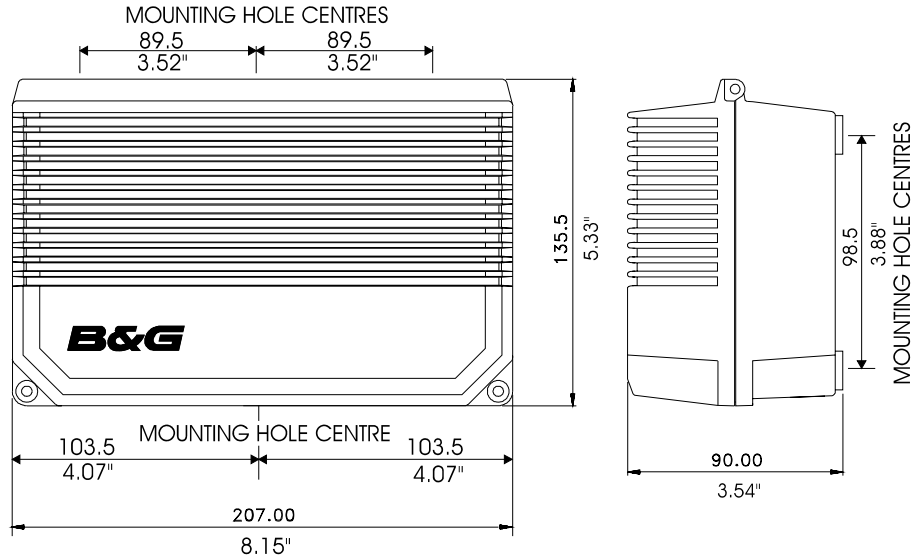
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ADVANCED CONTROL PROCESSOR UNIT



DESCRIPTION

The Advanced Control Processor (ACP) Unit contains all the electronics for the autopilot operation and control of the rudder drive options. It is designed to be mounted on a vertical, flat, smooth surface. The unit has a hinged lid to provide easy access to the electrical connections within. The unit requires the ACP Compass Unit (see next section).

The ACP Unit is available in two configurations:

- ACP 1 12V only 12 amps max. output current**
- ACP 2 12/24V 25 amps max. output current**

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

- Size 1/12V Hydraulic Ram Drive RAM-T1-12V blue
- Size 1/12V Hydraulic Pump PMP-T1-12V blue
- 12V Rotary Drive Unit RDU-T1-12V
- Stern Drive Unit SDU-T1-12V

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

- 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 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

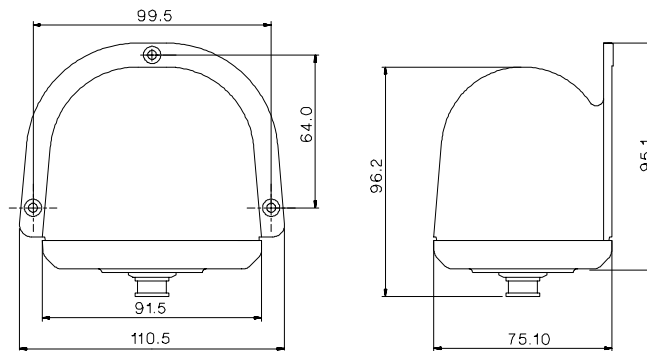
SITING THE ACP UNIT

- 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

- 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.

ACP REMOTE COMPASS UNIT



DESCRIPTION

IMPORTANT NOTE: This external fluxgate compass unit can **ONLY** be used with ACP Pilot Systems or Network Compass displays. Remove the transit screw after mounting on bulkhead and before inserting cable connector.

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 installed in a vessel with a steel or reinforced concrete hull it may be necessary to install the external compass unit outside the magnetic screening affect of the hull and super-structure.

It is supplied with a 12m/36ft, 6-core screened cable, one end with a sealed connector for the compass unit and the other connecting directly into the ACP Unit.

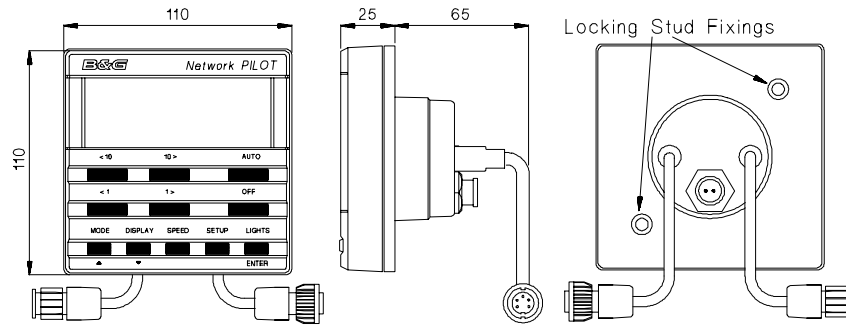
SITING THE COMPASS UNIT

- 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 non-magnetic 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.

NETWORK PILOT DISPLAY



DESCRIPTION

The Network Pilot Display is designed to be mounted above or below deck. The display head allows control of the autopilot and by installing multiple display heads, gives control at any station. It can be connected to all other Network Instruments via the network cable tails to provide an integrated autopilot and navigational system. It is essential that the autopilot is initialised before operation, details are given in the commissioning section of this manual.

In an integrated system boat speed is supplied from Network SPEED or QUAD units and wind speed and wind angle from Network WIND via the system network for Steer to Compass and Steer to Vane modes. Boat speed can also be set using the display head when required. When a GPS^{Plus} is included in the system all required data is carried to the Pilot via the network cable connection. Without a GPS^{Plus} on the system, NMEA 0183 (v1.5) data can be input to the Pilot via the 3 pin socket located on the rear of the display unit.

The display heads are supplied with a clip-in mounting bracket which allows for easy installation, access from behind is not necessary to secure the unit in place. However to prevent theft or if removal of the unit is not required then locking studs and thumb-nuts are supplied to allow for permanent fixing.

SITING THE PILOT DISPLAY HEAD

All Network Instruments are 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")
- Reasonably well protected from physical damage
- Accessible from behind for fitting locking studs if required
- The rear boss of the unit has a breather hole to prevent condensation, protect the rear cover from direct splashes of water.

MOUNTING PROCEDURE

- Use the cutting template supplied to mark the centres of the holes for the self-tapping screw, the fixing stud holes and the mounting bracket.
- The template allows 4mm (5/32") between adjacent units or 118mm/ 4 11/16" between centres for the suncover. Increase this distance if required to maximum of 60mm (2 3/8") between units or 180mm (7 1/8") between centres.
- For greater distances between units extension cables are available.
- Use a 70mm (2 3/4") diameter hole-cutter for the mounting bracket hole.
- Use a 2.9mm(1/8") drill for the self-tapping screws.
- Use a 5mm (3/32") drill for the locking stud holes.
- Secure the mounting bracket to the bulkhead with the self-tapping screws supplied.
- Fit the rubber sealing gasket around the mounting bracket.
- Screw the locking studs into the back of the display head.
- Carefully pass the cable tails through the mounting bracket hole, connect the power, interconnecting and NMEA input cables to the display head (if fitted).

- Clip the display head into the mounting bracket.
- Secure the display head with the thumb nuts supplied (if required).

NMEA INTERFACING

The Network PILOT can be interfaced to any NMEA 0183 (v1.5) compatible position fixer. If more than one source of NMEA data is to be used then it will be necessary to use two Network PILOT display units.

NMEA INPUT

The Network PILOT display head has an NMEA input connector at the rear, use a special 3m NMEA input cable 612-OA-053 (Red sig+, Blue sig-).

The Network PILOT uses the follow data from NMEA:

Cross Track Error (XTE), Speed Over Ground (SOG), Bearing: current position to destination waypoint, Bearing: origin waypoint to destination waypoint, Distance: current position to waypoint
Waypoint number

The following NMEA sentences are decoded, Note \$ID is any NMEA talker:

\$IDAPA XTE, bearing origin to destination waypoint
 \$IDAPB XTE, bearing origin to destination waypoint,
 bearing to waypoint
 \$IDRMB XTE, bearing and distance to waypoint
 \$IDXTE XTE
 \$IDVTG Speed over Ground
 \$IDBWR Bearing and Distance to waypoint rhumb,
 waypoint number
 \$IDBWC Bearing and Distance to waypoint great circle,
 waypoint number

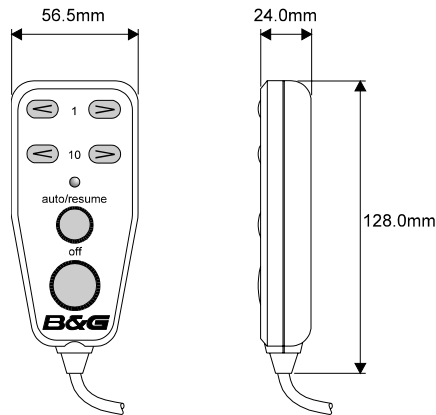
NMEA OUTPUT

NMEA output is via the network cable connection tail, use a special 3m NMEA output cable 610-OA-030 (Red sig+, Blue sig-).

Dependent on system devices, the following sentences are transmitted:

\$IIHDM	Heading
\$IIVHW	Speed and heading
\$IIDBT	Depth below transducer
\$IIVWR	Apparent wind angle and speed
\$IIMTW	Water temperature

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 /30ft straight section, plus a coiled length that extends from 1 metre to 3 metres.

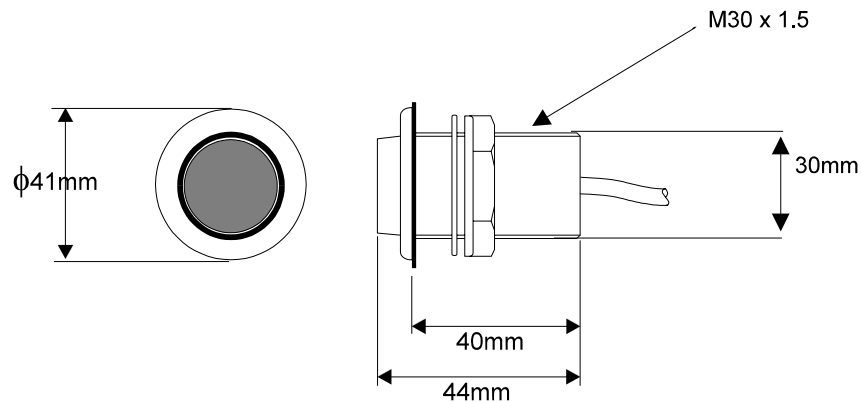
SITING THE HAND-HELD UNIT

- 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

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

MAN OVERBOARD BUTTON (MOB)



DESCRIPTION

The man overboard alarm button (MOB) is a large red waterproof switch with 15 metres/45ft of two-core screened cable. This button starts the MOB sequence of operations when pressed and the audible alarm sounds (if fitted).

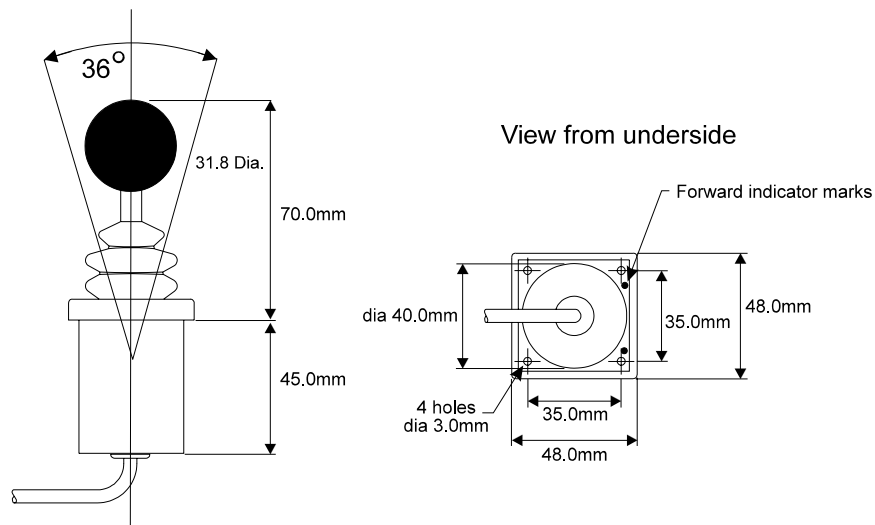
SITING THE MAN OVERBOARD ALARM BUTTON

- 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 inside or outside the 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

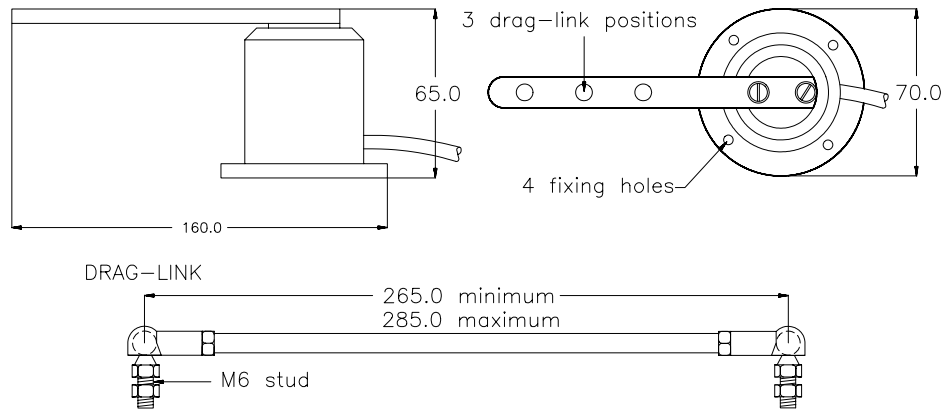
- At a convenient position within easy reach of the helmsman.

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

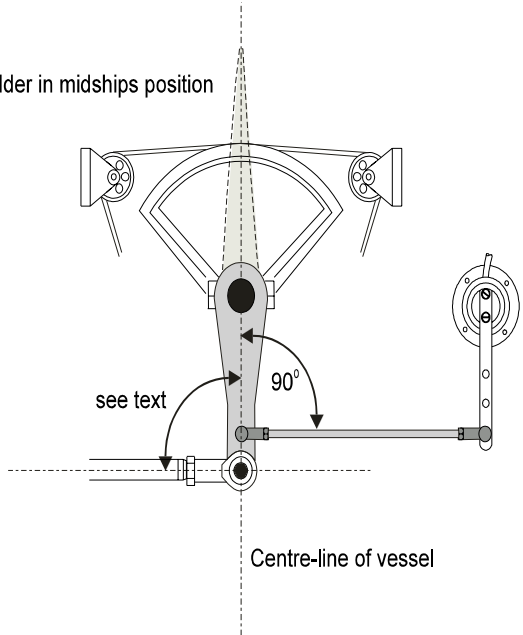
The Rudder Reference Unit (RRU) is a sealed high specification potentiometer in a robust casing, providing rudder position information to the Computer Unit. The operating arm is constructed in aluminium with three positions pre-drilled for the adjustable drag-link. The drag-link, has ball-joints at each 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 m/30ft of 3-core screened cable.

KEY POINTS WHEN INSTALLING THE RRU

- General consideration must be given to the steering system and its geometry before starting 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° , 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° , 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 change from hard over to hard over. N.B. If there is less than 1 Volt change 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.
- Ensure that there is no backlash in the linkage between the RRU and the steering gear, otherwise incorrect operation of the autopilot will occur.

The example shown is 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.

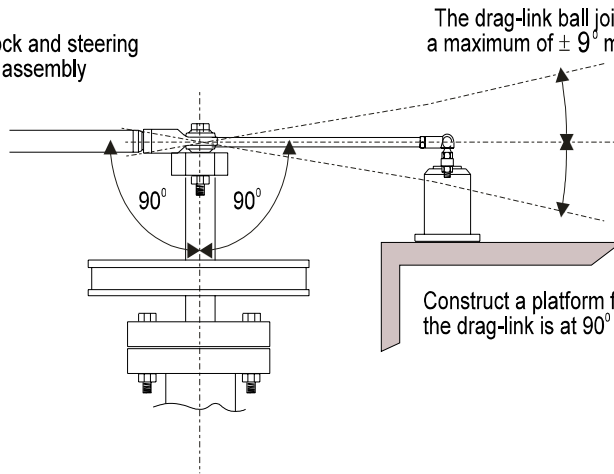
Rudder in midships position



The drag-link should be at right-angles to the tiller arm.

Centre-line of vessel

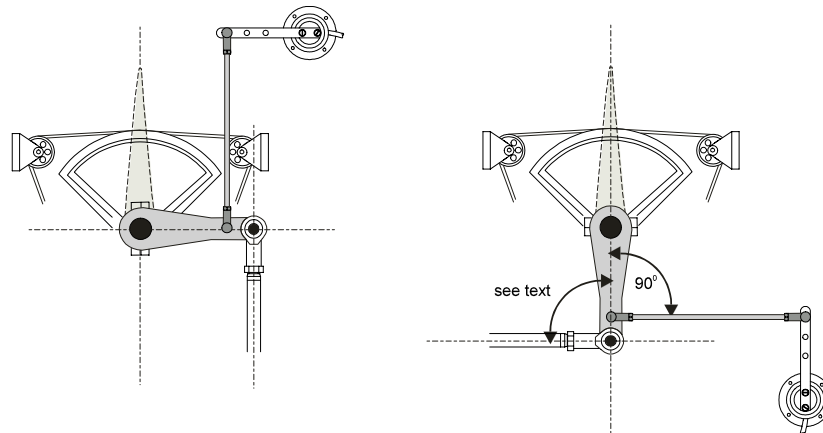
Rudder stock and steering gear assembly



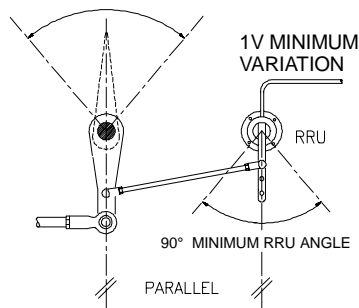
The drag-link ball joints will allow a maximum of $\pm 9^\circ$ mis-alignment.

Construct a platform for the RRU so that the drag-link is at 90° to the rudder stock.

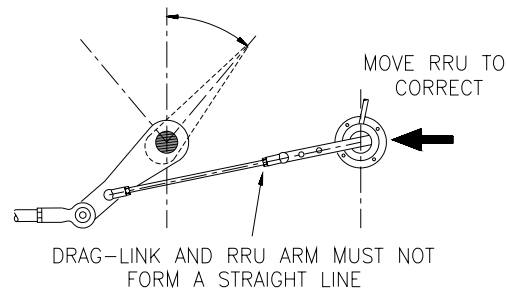
The RRU can be mounted in many different positions and orientations depending on the layout of the steering system.



If the maximum rudder angle is less than 90° 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° 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.



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.



LINEAR FEED BACK UNIT

Where installation of the conventional Rudder Reference unit is difficult or physically impossible a Linear Feedback unit can be used. The Linear Feedback unit comprises of a tube approximately 23mm/ 7/8" in diameter and 324mm/ 12 3/4" long. This assembly is clamped to the side of the Linear actuator using a special bracket kit. The Linear Feed Back shaft is attached to the tiller bracket using the pin supplied with all Blue rams.

This unit requires careful installation and alignment which should be carried out by your dealer / supplier. For electrical connection see section 4.

SECTION 2 RUDDER DRIVE OPTIONS

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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.

BLUE RAMS(DRIVE DATA)

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/ 3ft hoses. Longer hoses are available, contact your dealer. The units can also be mounted on a vertical bulkhead see page 2-12.

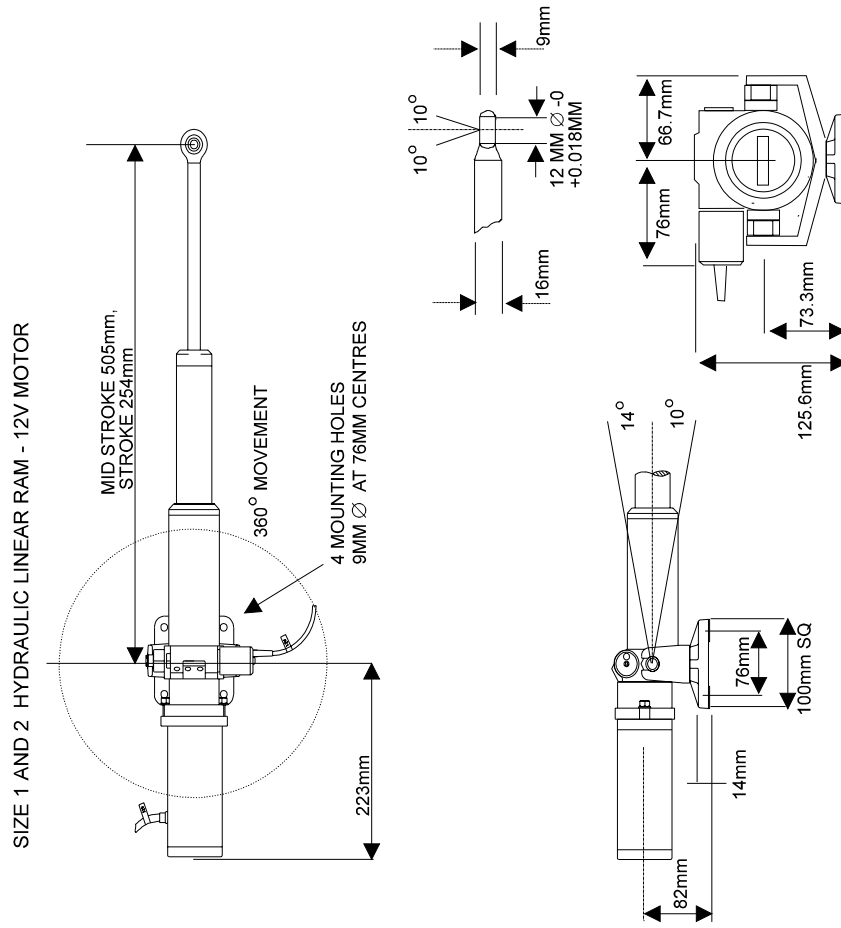
RAM DRIVE TYPE	RAM SIZE 1 BLUE	RAM SIZE 1 BLUE	RAM SIZE 2 BLUE	RAM SIZE 3 BLUE
ACP UNIT	ACP1	ACP2	ACP2 only	ACP2 only
MOTOR SUPPLY	12V DC	12V DC	12V DC	24V DC
SOLENOID VALVE SUPPLY	12V DC 1.25A (max)	12V DC 1.25A (max)	12V DC 1.25A (max)	24V DC 0.8A (max)
PEAK THRUST	425 kg force 935 lbs-force	680 kg 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° rudder	214 mm 8.4 "	214 mm 8.4 "	214 mm 8.4 "	257 mm 10.16 "
MAXIMUM TORQUE	892 Nm 7867 lb.ins	1427 Nm 12574 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	15.7 sec 13.4 sec (8Kg force)	15.7 sec 13.4 sec (8Kg force)	11.9 sec 10.2 sec (200Kg force)	14.6 sec 12.6 sec (200Kg force)

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), amidships position and at the maximum rudder angle, with the latter two with the motor running at 50% duty cycle.

Refer to the diagrams on page 2-6, 2-10, 2-11, 2-13.

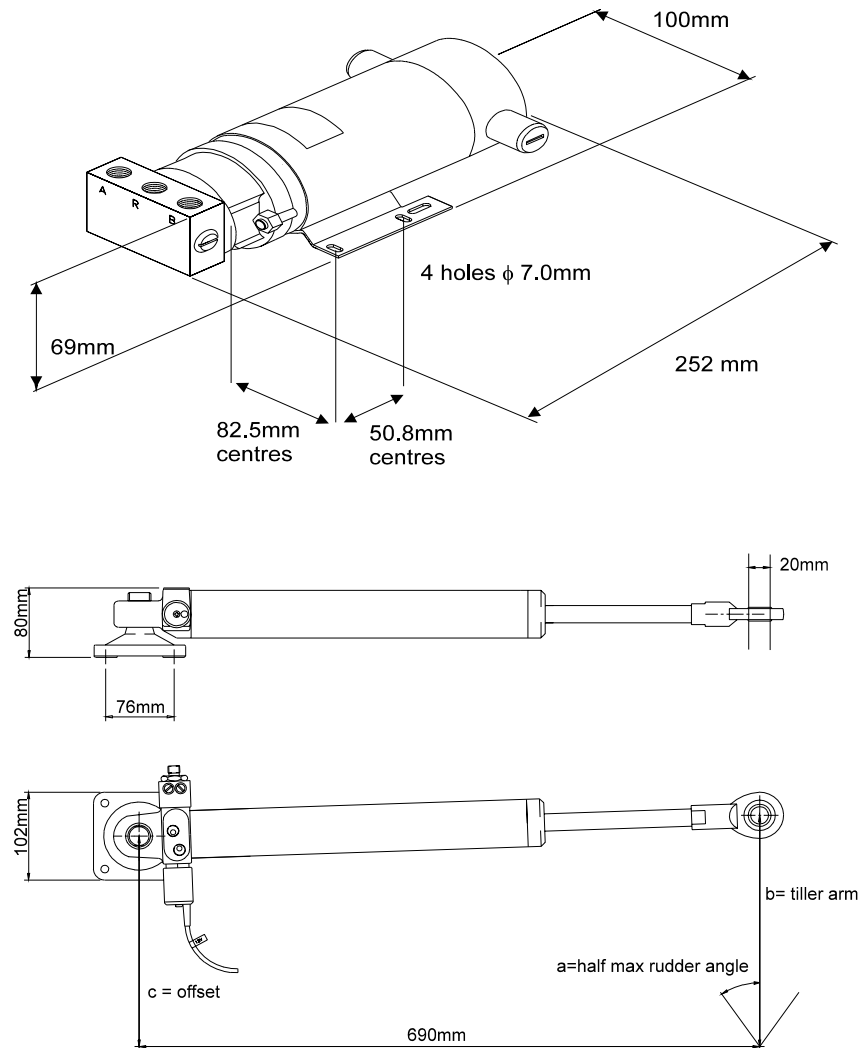
RAM-T1-12V						
		midstroke =	505mm	ACP1 only	d=	73.3
1/2 max	Tiller arm	Offset	Thrust	Torque at	Torque at	Torque
rudder angle	mm	mm	(peak	midships	midships	(at max °
a	b	c	Kgf)	(peak Kgm)	(50% Kgm)	50% Kgm)
25	290	272	425	123	123	118
30	245	227	425	104	104	90
35	214	196	425	91	91	74
40	190	172	425	81	81	62
45	173	155	425	74	74	52
50	160	142	425	68	68	44
RAM-T1-12V						
		midstroke =	505mm	ACP2 only	d=	73.3mm
1/2 max	Tiller arm	Offset	Thrust	Torque at	Torque at	Torque
rudder angle	mm	mm	(peak	midships	midships	(at max °
a	b	c	Kgf)	(peak Kgm)	(50% Kgm)	50% Kgm)
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
RAM-T2-12V						
		midstroke =	505mm	ACP2 only	d=	73.3mm
1/2 max	Tiller arm	Offset	Thrust	Torque at	Torque at	Torque
rudder angle	mm	mm	(peak	midships	midships	(at max °
a	b	c	Kgf)	(peak Kgm)	(50% Kgm)	50% Kgm)
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
RAM-T3-24V						
		midstroke =	690mm	ACP2 only	d=	51mm
1/2 max	Tiller arm	Offset	Thrust	Torque at	Torque at	Torque
rudder angle	mm	mm	(peak	midships	midships	(at max °
a	b	c	Kgf)	(peak Kgm)	(50% Kgm)	50% Kgm)
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

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

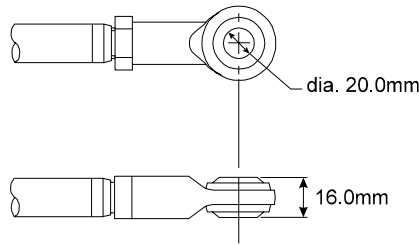


SIZE 1 & 2 HYDRAULIC DRIVE PUMP DIMENSIONS

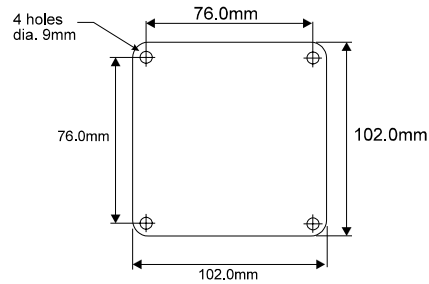
PUMP AND RAM DRIVE UNIT DIMENSIONS - BLUE SIZE 3 (REFERTO TABLE 2-5)



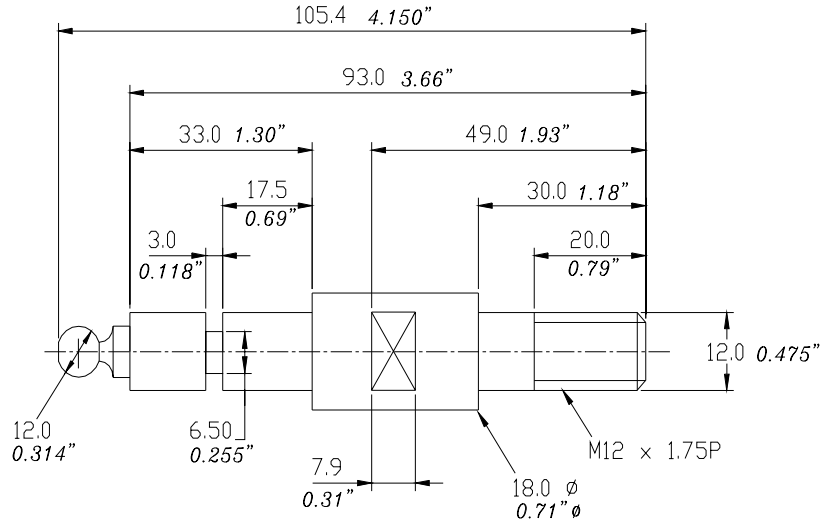
ROSE JOINT DETAIL



MOUNTING PLATE DETAIL



RAM BOLT DETAIL



RAM DRIVE UNIT INSTALLATION

General consideration must be given to the steering system and its geometry before starting 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

- 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.

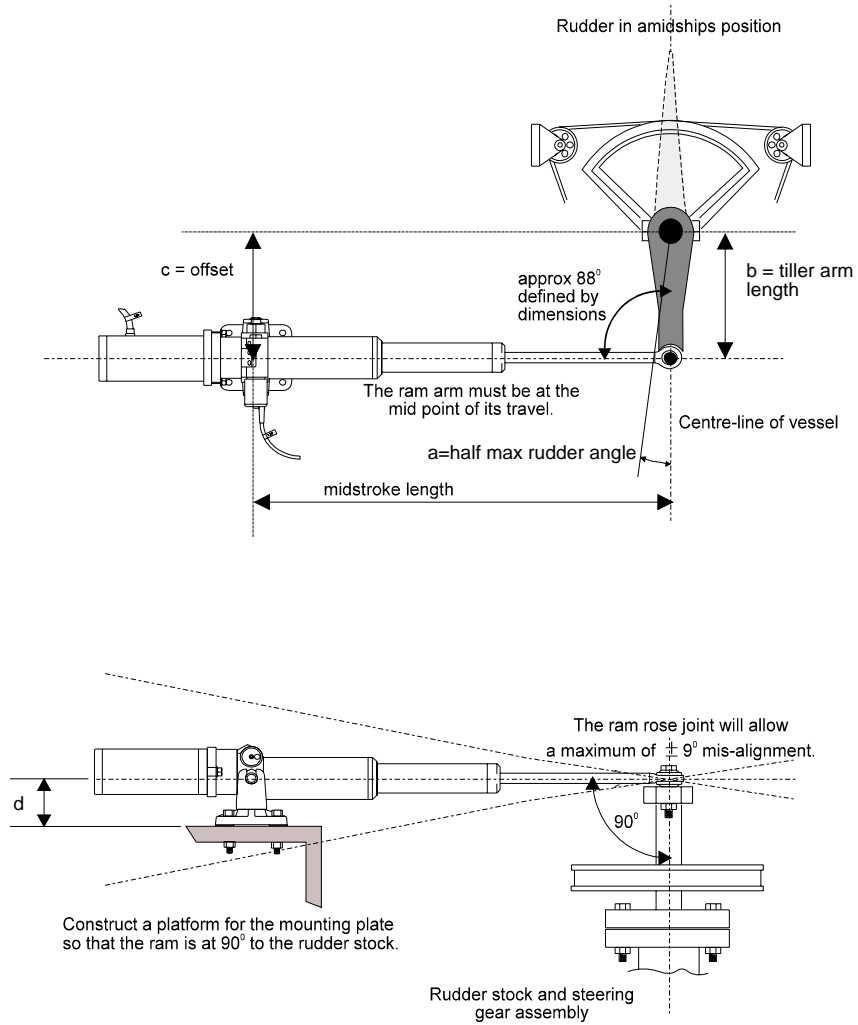
FOR TYPE 3 RESERVOIR INSTALLATION

Do not turn the black reservoir tap on or attempt to move the piston rod until all of the following are completed:

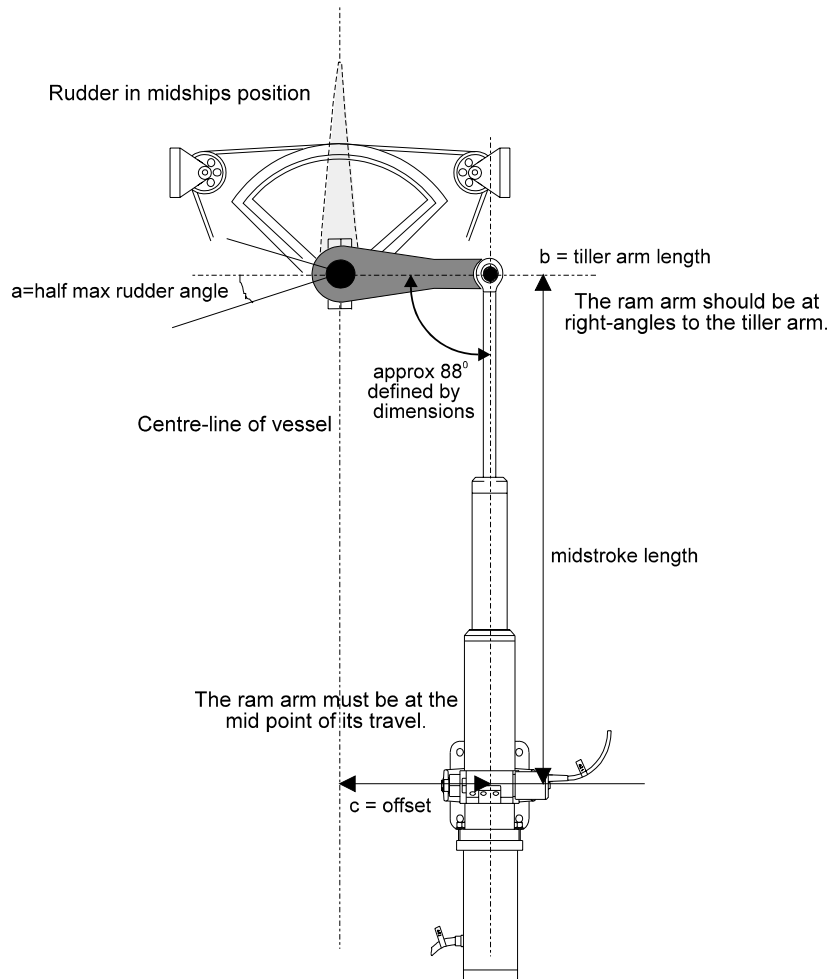
- The base foot of the ram and pump have been bolted into position.
- The reservoir has been fixed to a bulkhead above the ram and pump.
- The sealed reservoir transit cap has been replaced by the breather cap supplied.
- The reservoir has been filled with the oil supplied.
- The reservoir tap has been switched to the 'ON' position allowing the oil to flow between the reservoir and the pipe.

(TAP 'ON' POSITION IS IN LINE WITH THE PIPE)

A TYPICAL RAM DRIVE UNIT LAYOUT (REFER TABLE 2-5)



RAM MOUNTED PARALLEL TO VESSELS CENTRE-LINE (REFER TO TABLE 2-5)



KEY POINTS ON INSTALLATION.

- **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.

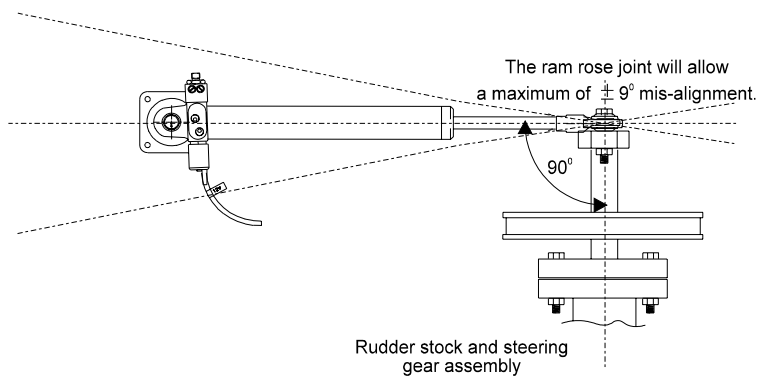
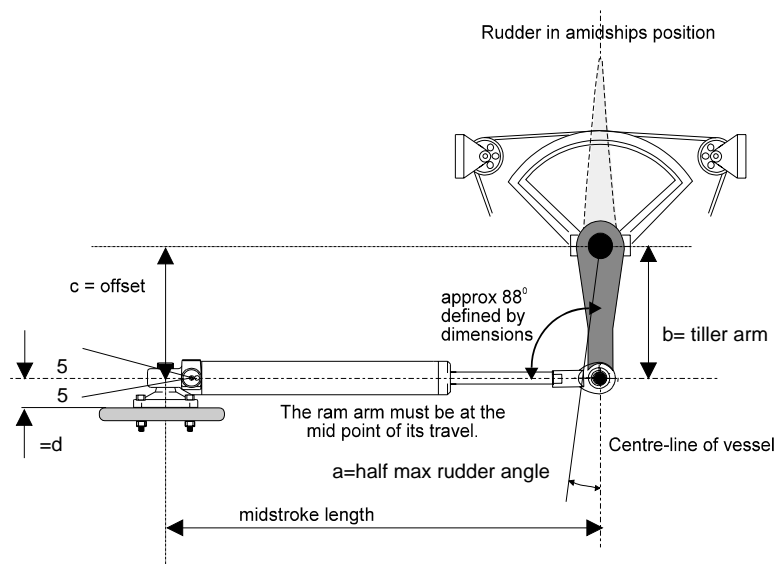
MOUNTING A BLUE RAM ON A VERTICAL BULKHEAD

Due to the restricted movement of the ram of $+14^{\circ}$, 10° 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 on the next page.

FAILURE TO COMPLY WITH THESE DIMENSIONS MAY CAUSE PREMATURE FAILURE OF THE RAM, AND PLACE GREAT STRESS ON THE STRUCTURE OF THE VESSEL.

The Size 1 and 2 **Blue** Ram may be mounted in any orientation, without the need to fit an external reservoir. The Size 3 Ram requires an external reservoir which must be mounted above the unit. Care must be taken to ensure that the connecting pipes are not in anyway kinked or turned through any tight bends.

VERTICAL BULKHEAD INSTALLATION.(REFER TABLE 2-5)



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. When filling or topping up the external reservoir only use a good quality ISO 10 hydraulic oil e.g., Q8 DYNOLUBEAR 10 (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 also available. 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.

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 in ³ /min	1420 cc/min, 87in ³ /min	1980 cc/min, 121 in ³ /min
CYLINDER CAPACITY	100-300cc, 6.1 to 18.3 in ³	275 to 550cc, 16.8 to 33.6in ³	525 to 750cc, 32 to 46in ³
WEIGHT	3 kg 6.6 lbs	3 kg 6.6 lbs	4 kg 8.8 lbs

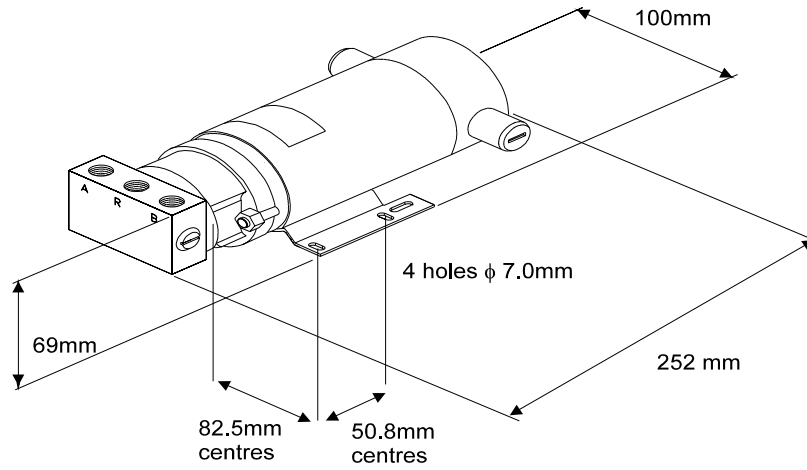
KEY POINTS ON INSTALLATION

A position should be chosen convenient for the steering system hydraulic delivery lines.

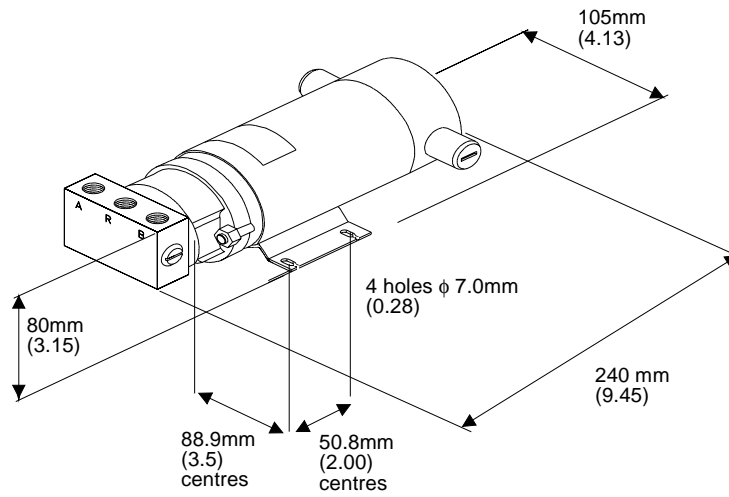
- The site should be rigid and flat to prevent excess vibration.
- Shielded from the direct effects of the elements.
- Minimise the lengths of the hydraulic lines from the pump to the cylinder and where possible the pump motor supply cables.

HYDRAULIC DRIVE PUMP DIMENSIONS

Type 1 and 2



Type 3



HYDAULIC DRIVE PUMP INSTALLATION

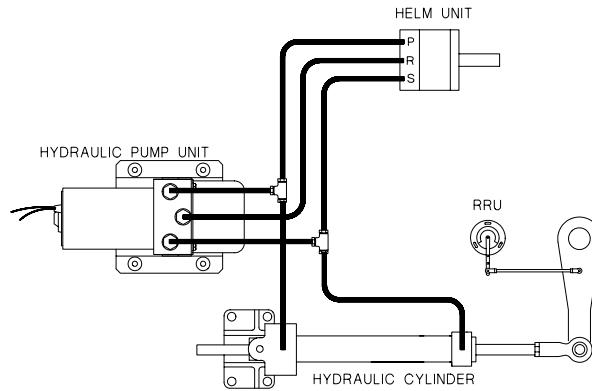
IMPORTANT NOTE: When dealing with any hydraulic system great care must be taken to ensure that a high degree of cleanliness is observed and no dirt, moisture or foreign objects are allowed to enter the system. When bleeding your hydraulic steering system only use a good quality ISO10 hydraulic oil e.g. 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.
9. Repeat in the opposite direction and continue in this manner until topping up is no longer necessary.

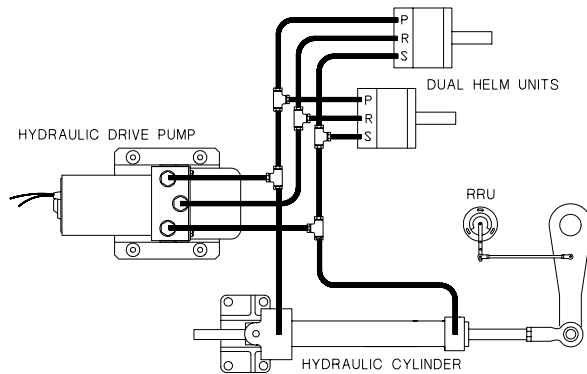
- 10.** When satisfied that the steering is fully bled manually, apply power to the pump unit.
- 11.** Turning the wheel fully from lock to lock will cause the pump to self purge.
- 12.** Check the fluid level in the helm unit reservoir.
- 13.** When the system appears to be fully functional, with the pump running and the helm hard over check for leaks.
- 14.** Secure all hoses and cables to prevent damage.

HYDRAULIC DRIVE PUMP INSTALLATION EXAMPLES

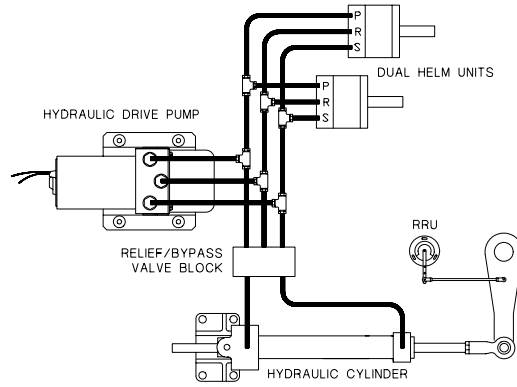
Single Station System Example



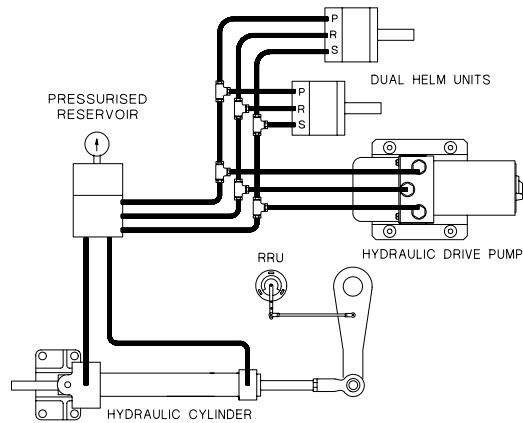
Dual Station System Example



Dual Station System With Bypass Example



Dual Station Pressurised System Example



SECTION 3

ADDITIONAL RUDDER DRIVE OPTIONS

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ROTARY DRIVE SPROCKET WHEEL SELECTION	6

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.

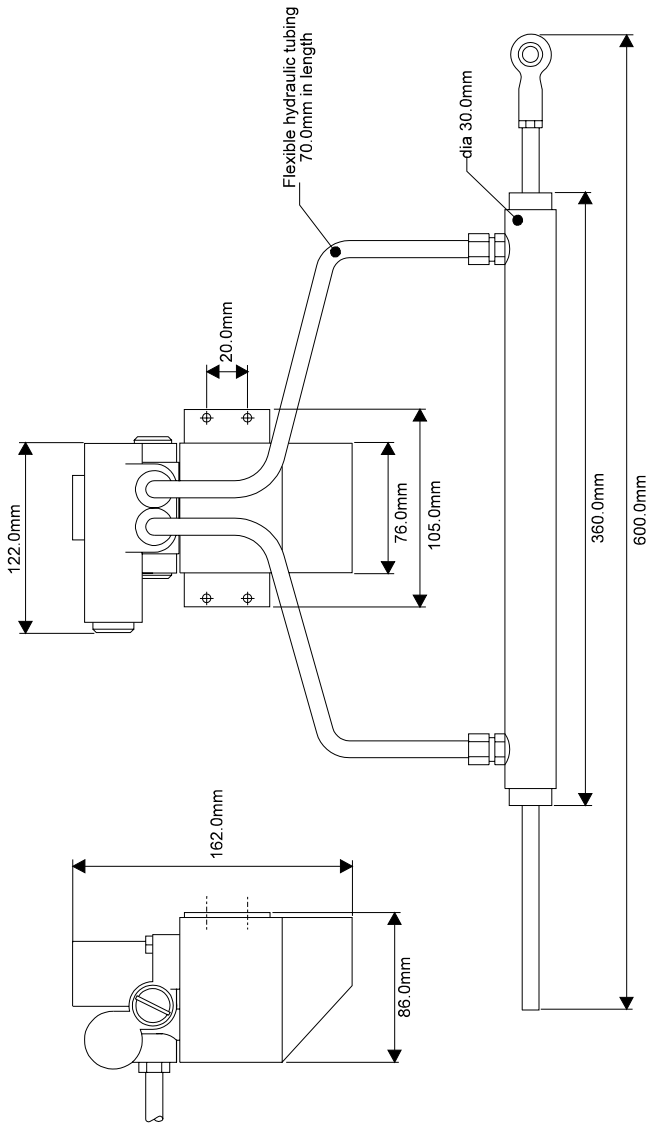
OUTDRIVE DRIVE UNIT DATA

PUMP TYPE	Reversible DC motor
SUPPLY	12V DC
WEIGHT	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

OUTDRIVE DRIVE UNIT - DIMENSIONS



ROTARY DRIVE UNIT

DESCRIPTION

A compact reversible 12V or 24V DC motor and gearbox, with an electrically operated clutch acting on the output shaft for autopilot control of mechanical steering systems. Connection to the steering system is most commonly via sprocket gears and chain. These to be supplied by the installer. As a guide the following should be considered for the drive sprocket:

UK/Euro 13 tooth 3/8" pitch (steel)

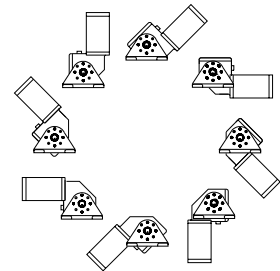
USA 10-20 tooth (steel) for Type 40 or 41 chain.

The recommended target hardover to hardover time should be 10 to 12 seconds.

ROTARY DRIVE DATA

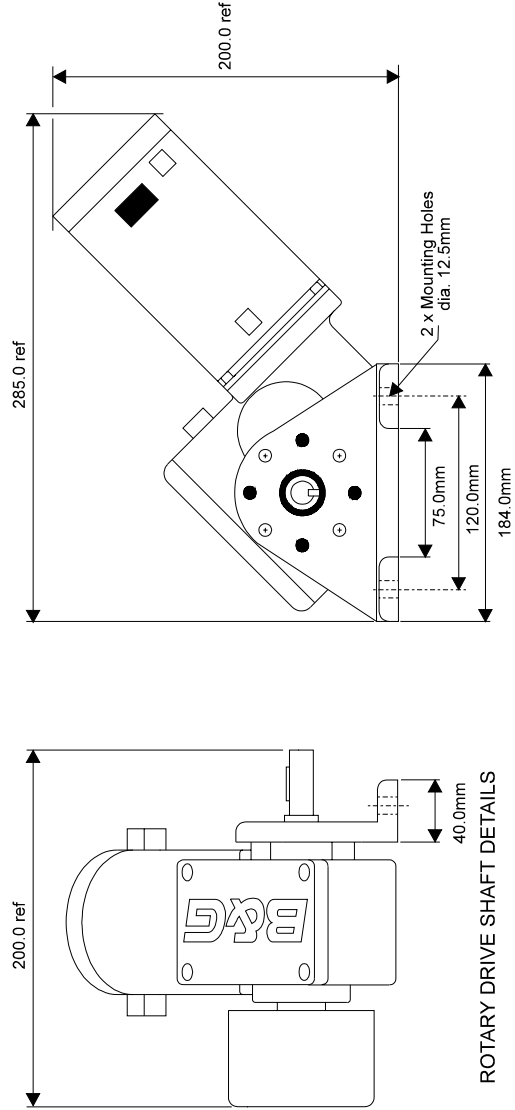
SUPPLY VOLTAGE	12V or 24V Options
PEAK OUTPUT TORQUE Type 1	15 Nm / 132lb ins
Type 2	45 Nm / 398lb ins
MAXIMUM SHAFT SPEED	20 rpm
TYPICAL POWER CONSUMPTION	3 to 7 amps
CLUTCH SUPPLY	12V or 24V , 1 amp max.
MOUNTING FOOT	variable in 45° steps
WEIGHT	8Kg / 17.64lbs

The Rotary Drive Unit has a mounting foot that can be rotated in 45° steps to allow for most installation requirements.



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)

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**

- 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 ACP UNIT INSTALLATION

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CABLE AND CONNECTION INFORMATION

EMC COMPLIANCE

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.

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

IMPORTANT NOTE: DO NOT APPLY POWER TO THE PILOT SYSTEM UNTIL ALL UNITS ARE CONNECTED AND THE WIRING HAS BEEN CHECKED.

- 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.
- 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 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.

PILOT DRIVE UNIT CABLES

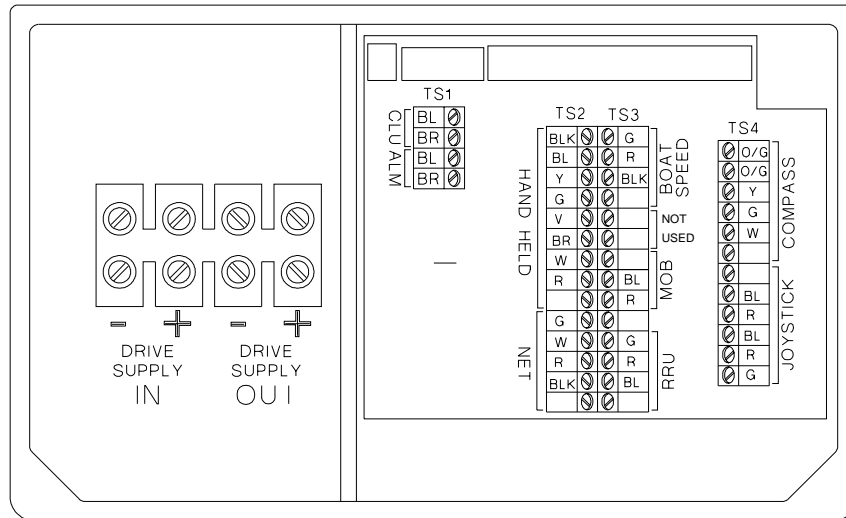
ALL RUDDER DRIVES - HEAVY DUTY POWER CABLES

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

RAMS AND ROTARY DRIVES - CLUTCH/VALVE CABLES

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

ACP UNIT TERMINAL DETAILS



WIRE COLOUR CODING AND ABBREVIATIONS

WIRE COLOUR TABLE			
R	Red	V	Violet
BLK	Black	Y	Yellow
BL	Blue	O	Orange
BR	Brown	W	White
G	Green	BLANK	Silver (Not Used)

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.

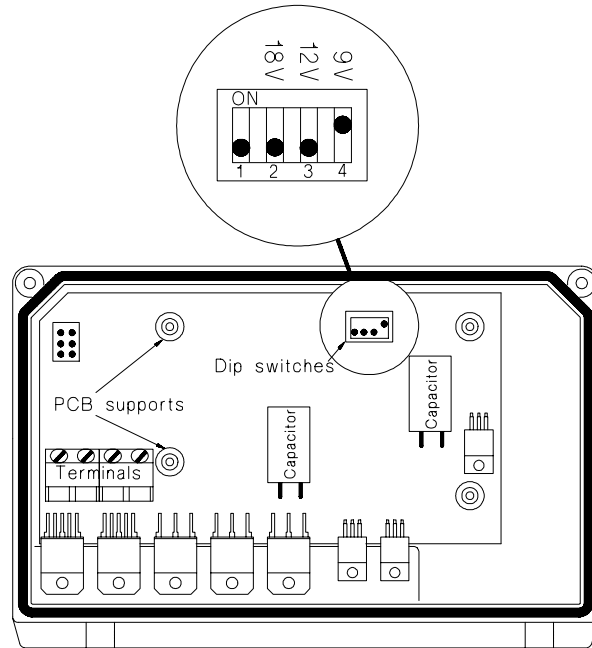
The ACP2 Computer Unit can output different clutch/solenoid voltages depending upon the size of rudder drive unit fitted, the clutch/solenoid valve is only required for rams or rotary drive units. This is achieved by setting dip switches on the Computer Drive PCB. Access to the switches is obtained by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

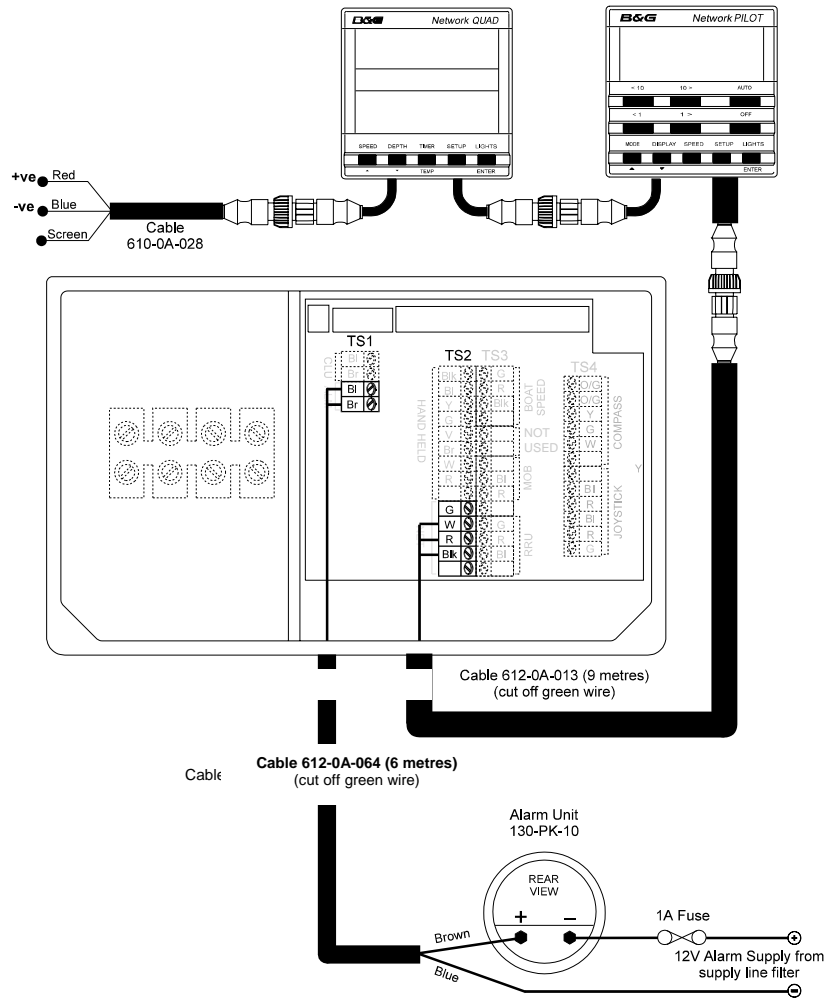
DIP SWITCH	CLUTCH VOLTAGE	DRIVE SIZE/TYPE
1	24V	24V ROTARY
2	18V	SIZE 3/24V RAM
3	12V	12V ROTARY
4	9V	SIZE 1/2 12V RAMS (to save power)

ACP2 DIP SWITCH LOCATION

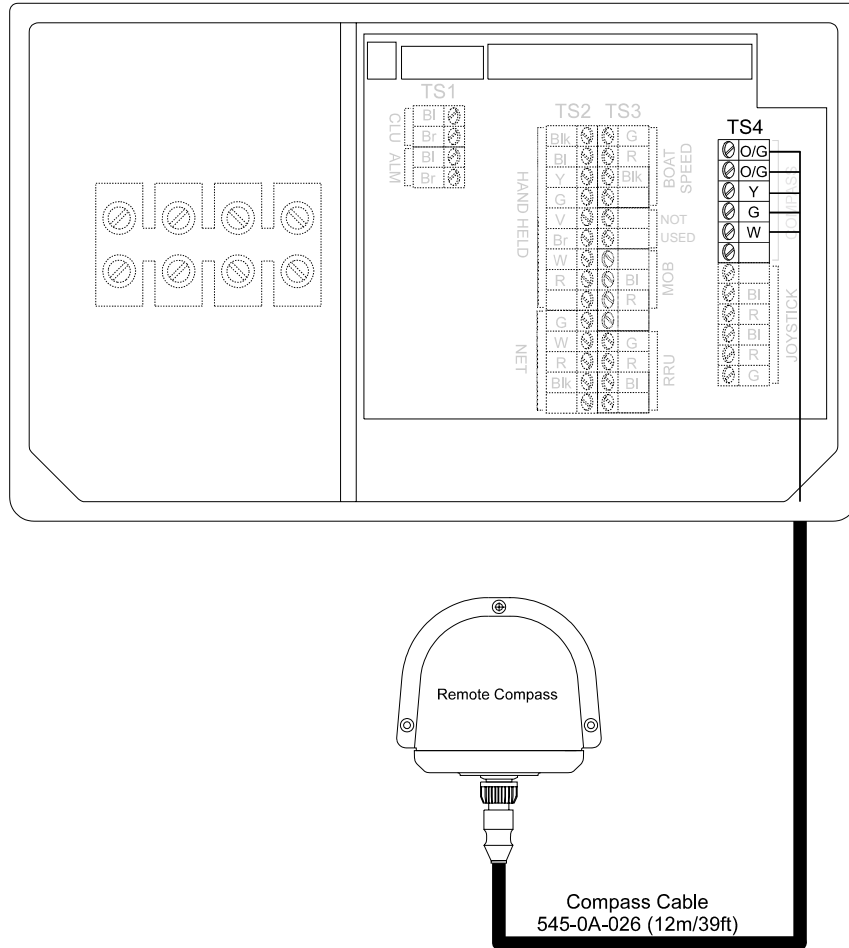


NOTE: When reassembling the computer unit ensure that the connector in the top left-hand corner of the PCB mates together properly.

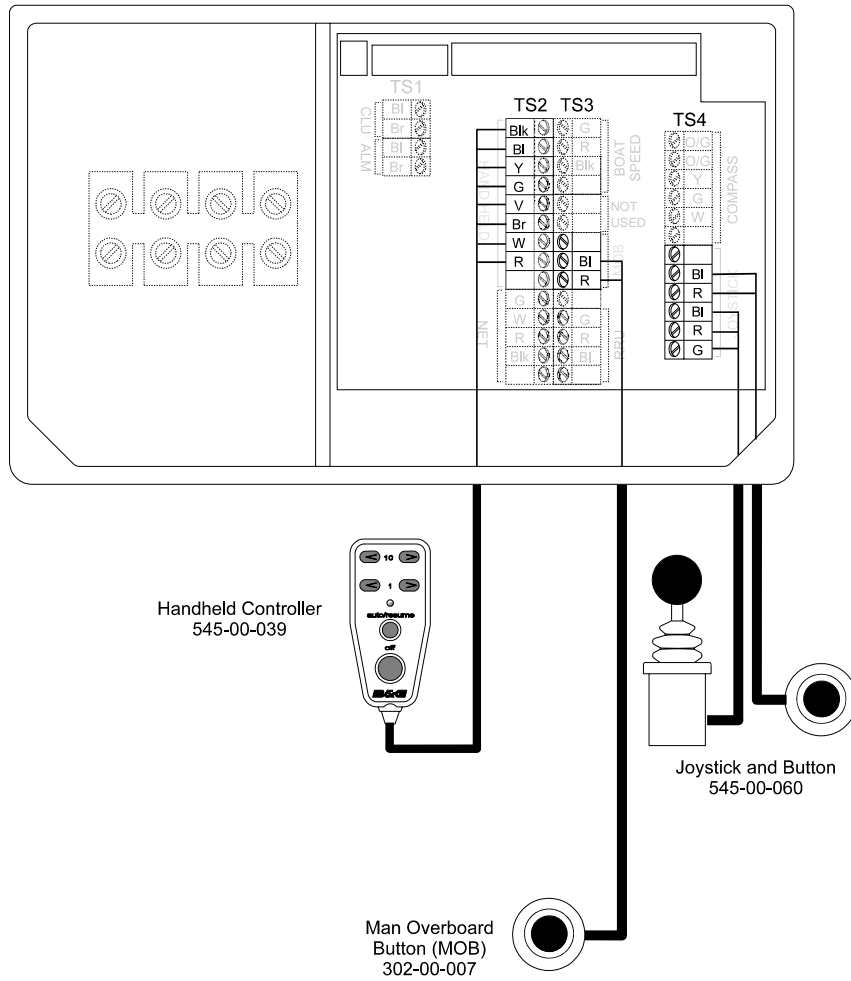
NETWORK AND ALARM CONNECTIONS



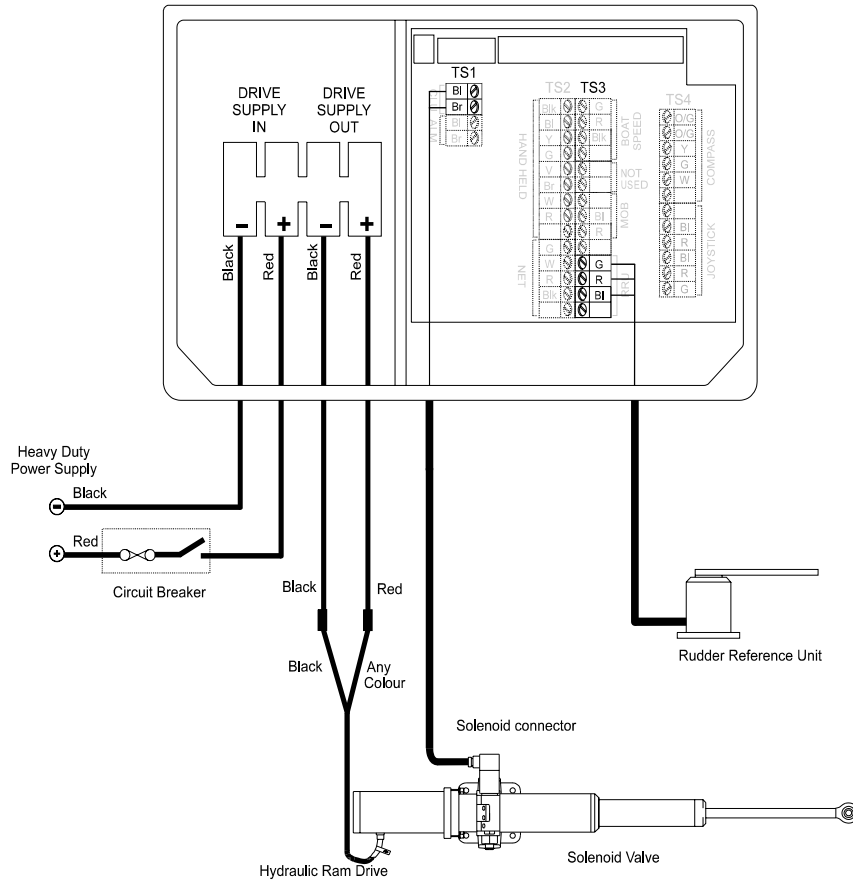
REMOTE COMPASS CONNECTIONS



HANDHELD, MOB AND JOYSTICK



HYDRAULIC RAM DRIVE CONNECTIONS



BLUE RAM SOLENOID WIRING DETAILS

The following information applies to the Size 1, Size 2 and Size 3 Blue Rams only.

1. Remove the solenoid wiring connector by unscrewing the centre screw.
2. Remove the screw from the connector housing.
3. Remove the rubber gasket.
4. Use a small screwdriver through the screw hole to carefully push against the connector block. This will push the front of the connector block out ready for wiring.
5. Run the cable through the cable entry in the cover and then connect as follows:-

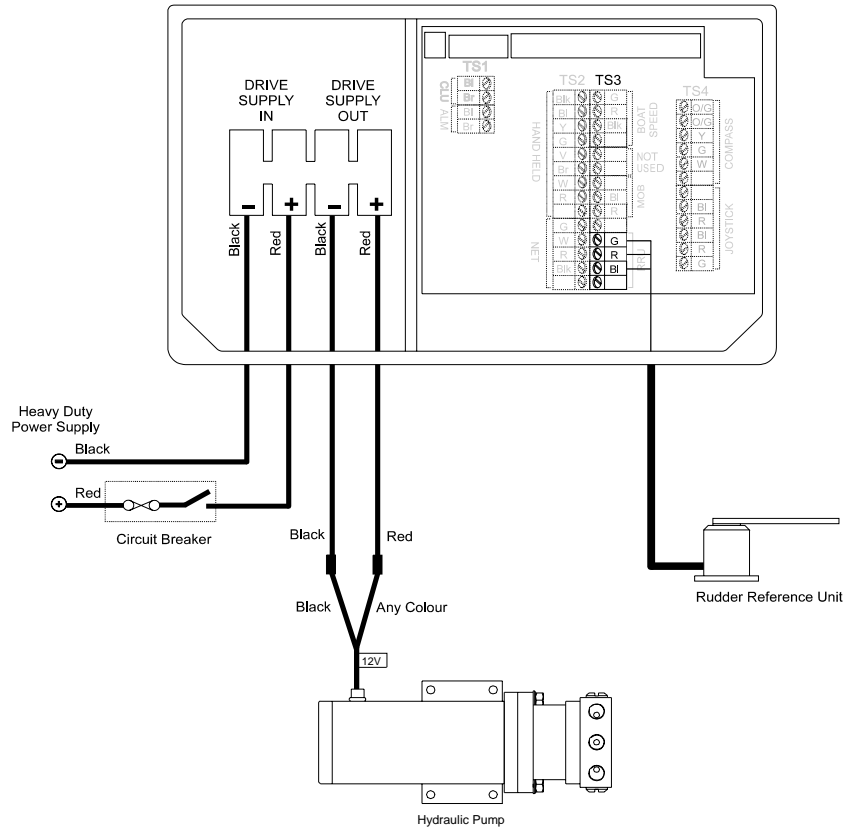
Pin 1 Blue Wire

Pin 2 Brown Wire

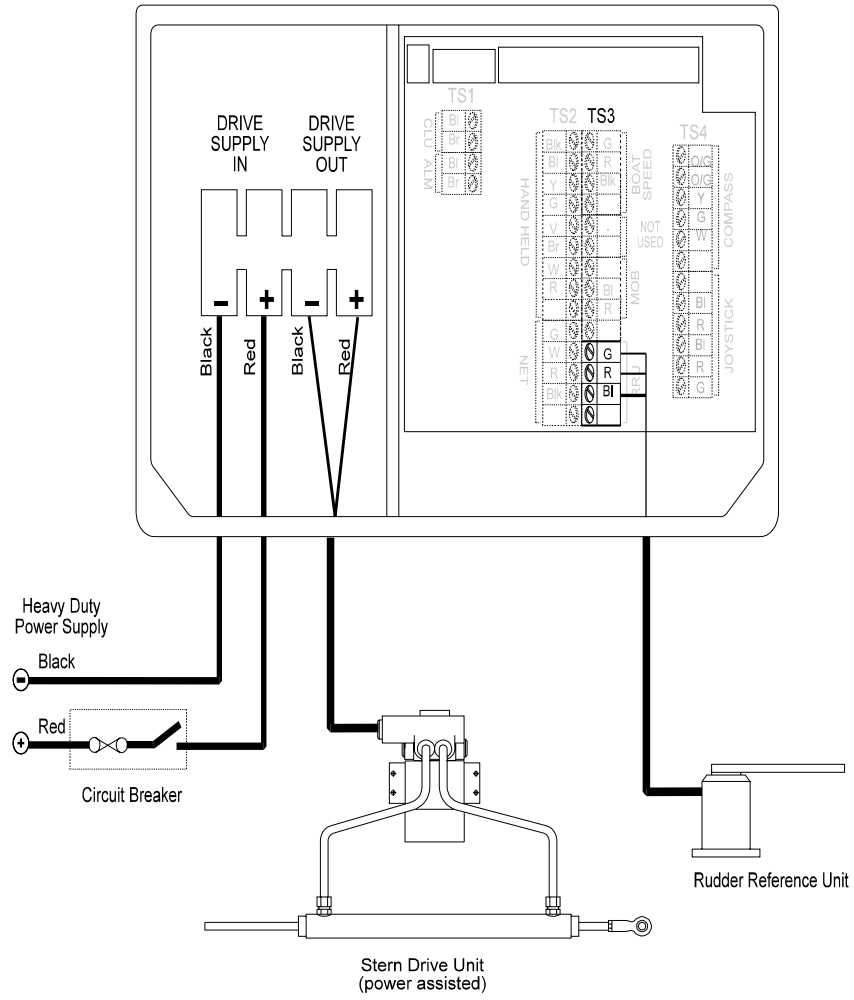
6. The cable screen must be cut back and sleeved.

Connect the two halves of the connector back together, tighten the plastic cable clamp nut, replace the rubber seal and refit the connector onto the solenoid using the centre screw to fully secure it.

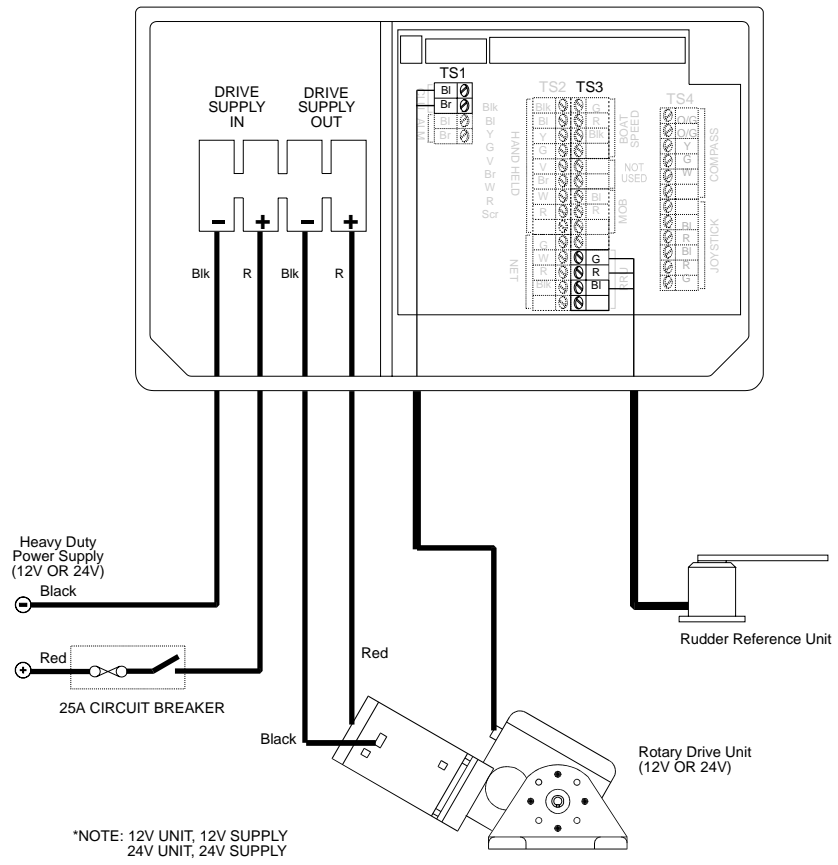
HYDRAULIC PUMP CONNECTIONS



STERNDRIVE DRIVE UNIT CONNECTIONS



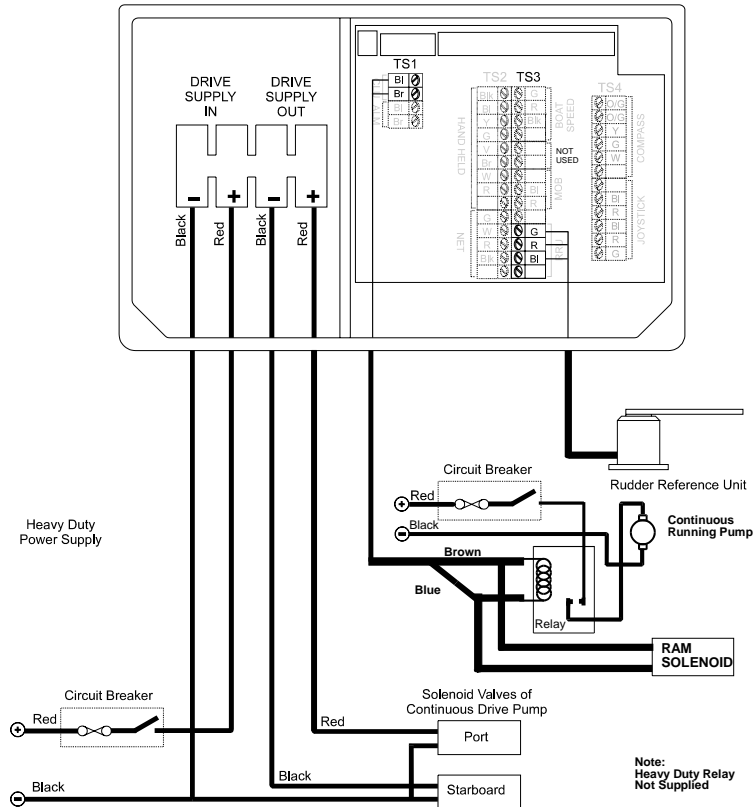
12V/24V ROTARY DRIVE CONNECTIONS



CONTINUOUS DRIVE UNIT CONNECTIONS

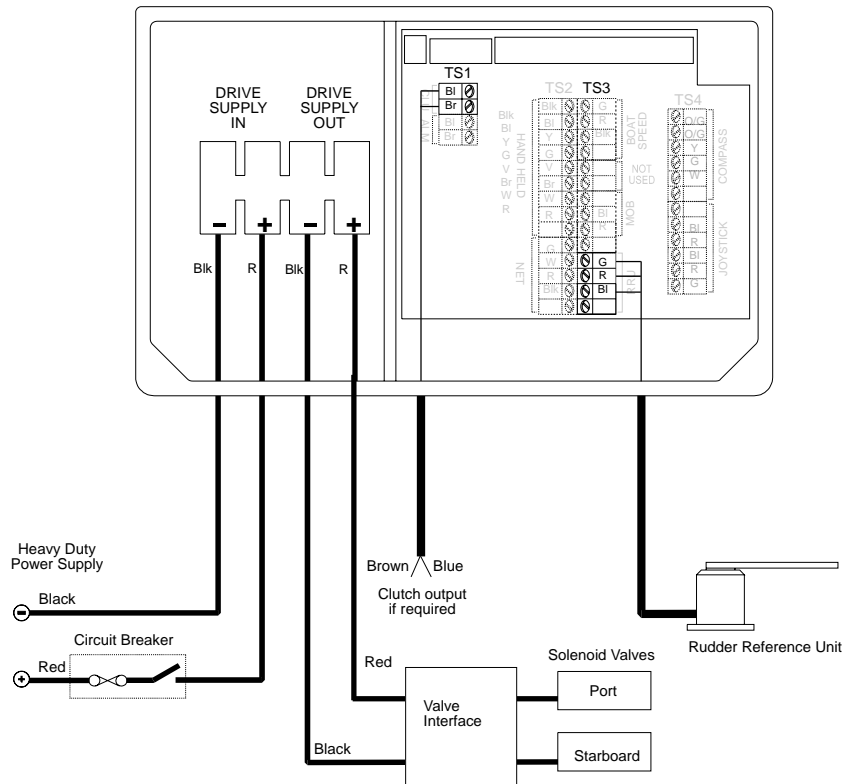
These are general wiring instructions only, showing the installation of the Computer Unit outputs to drive the continuous drive pump solenoid valves. The continuous drive pump motor will also require a heavy duty supply, this is not supplied however suitable units can be obtained from your dealer. Clutch output is used to control the motor supply.

NOTE: The ram solenoid must be designed to operate at the same voltage as the pump.

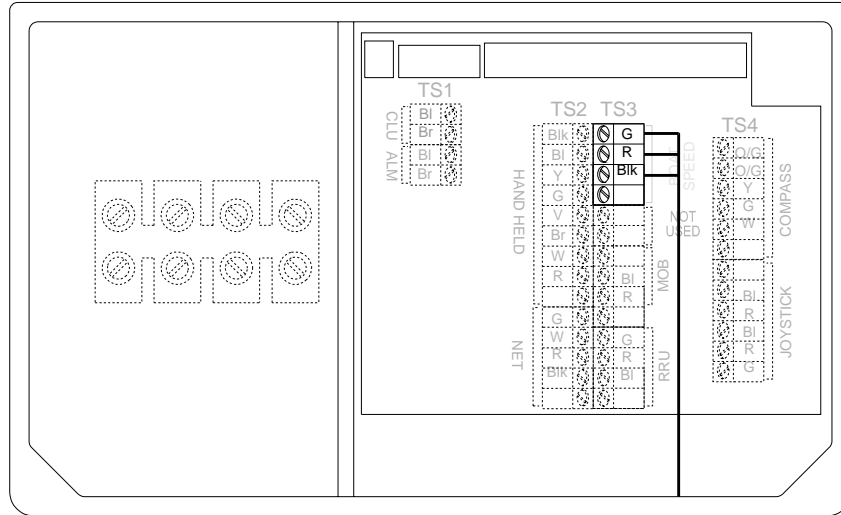


PROPORTIONAL SOLENOID CONNECTION

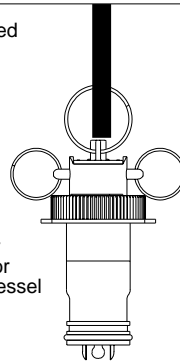
These are general wiring instructions only, showing the installation of the ACP 2 Computer Unit outputs to drive proportional solenoid valves. The continuous drive pump motor will also require a heavy duty supply, this is not shown on this diagram. The clutch output could be used to control the motor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



DIRECT PADDLE INPUT CONNECTION



Cut back the un-used
coloured wires:

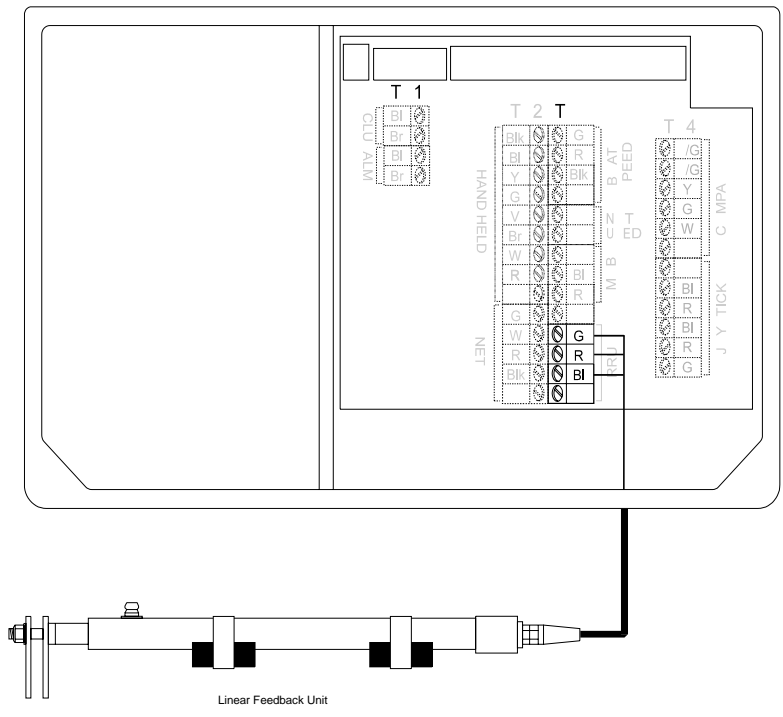


Please consult your dealer
for the specific speed sensor
and housing suitable for your vessel

LINEAR FEEDBACK CONNECTION

For Linear Feedback installations, connect the wires from the sensor to the processor using the reference table below.

Linear Feedback Unit	Network ACP Rudder Reference
Red	Red
Black	Blue
White	Green

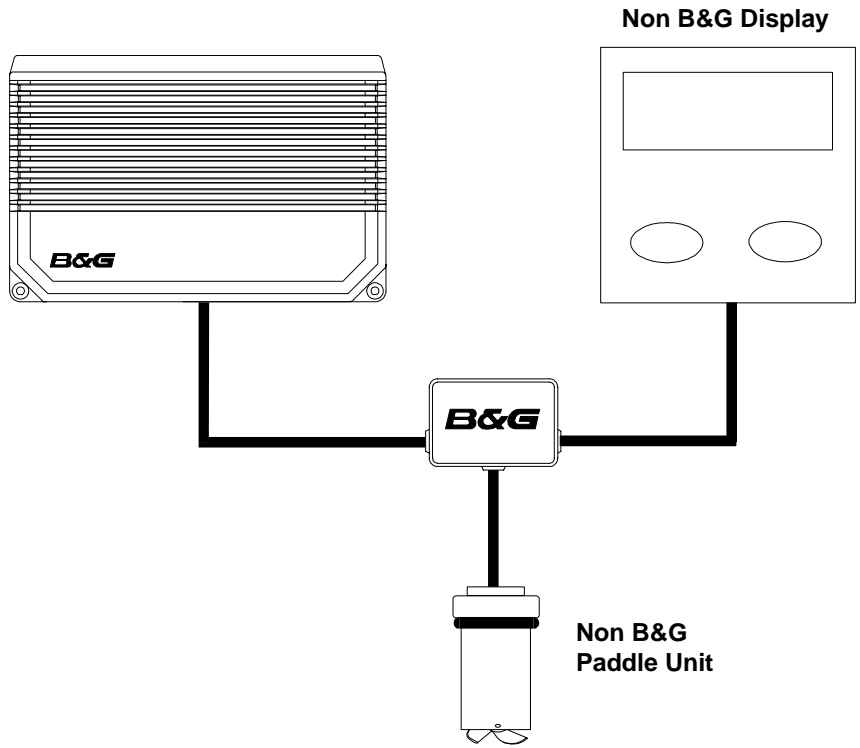


NON-B&G PADDLEWHEEL CONNECTION

Using a non-B&G speed sensor (SEE PAGE 4-21).

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 ACP computer unit.
4. Calibrate the speed input in accordance with the instructions given in the COMMISSIONING (5-30) section of this manual.



ACP UNIT PADDLE 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

SECTION 5 COMMISSIONING

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NETWORK PILOT COMMISSIONING

Before the Network 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

BLUE SIZE 3 RAM INSTALLATION CHECK LIST

1. The base foot of the ram and pump have been firmly bolted into position
2. The Reservoir has been fixed to a bulkhead ABOVE the Ram and Pump.
3. The sealed reservoir transit cap has been replaced by the Breather cap supplied.
4. The Reservoir has been switched to the ON position allowing oil to flow between the reservoir and the pipe.
5. TAP ON POSITION IS IN LINE WITH THE PIPE. The piston rod can now be extended or retracted and the pump run.

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

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.....

LINEAR FEEDBACK UNIT INSTALLATION

1. Ensure that the Linear Feed back unit is firmly clamped to the side of the Linear actuator using the bracket kit supplied.
2. Check to see the shaft of the Linear Drive Unit has sufficient lubrication, use only high quality grease.
3. Ensure that the Ram stroke does not exceed the stroke of the Linear Feedback Unit.

COMPASS INSTALLATION

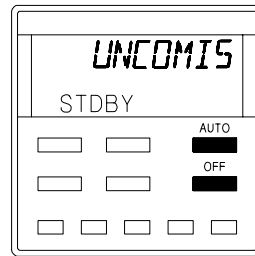
1. Clear of sources of magnetic interference, including power cables to other equipment, if in doubt check 1 metre around with small hand compass. Look on the other side of the bulkhead!
2. Fitted as near to centre of motion of boat as other factors allow, aft of centre preferred because usually less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

ELECTRONICS INSTALLATION

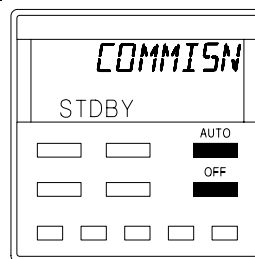
1. Cables secure
2. Cables undamaged
3. No loose bits of wire
4. Screens connected in accordance with wiring instructions and sleeved where appropriate

TO ENTER COMMISSIONING MODE

With the autopilot in Standby, press **AUTO** and **OFF** key at the same time. The display will change to the following display.

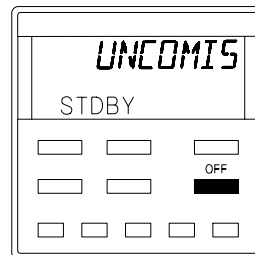


READY TO BEGIN COMMISSIONING



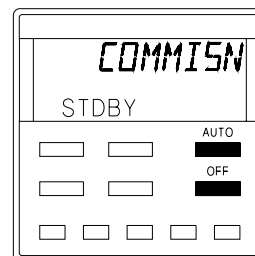
TO EXIT COMMISSIONING MODE

Press the RED **OFF** key.



RE-ENTERING COMMISSIONING MODE

When the autopilot has been commissioned it is possible to change the values that have been set by pressing the **AUTO** and **OFF** keys together. The display will now show **COMMISN**. Use the **SETUP** key to select the parameter to be changed.



COMMISSIONING PARAMETERS

The following is a list of the parameters that have to be set, they are selected by pressing the **SETUP** key while in Commissioning mode.

- BT TYPE -Select boat type: Sail, Power P, Power D
- SET RDP -Rudder end stop Port
- SET RDS -Rudder end stop Starboard
- SET RDM -Rudder Mid position
- DRIVE A -Rudder drive type selection
- ST RDT -Rudder Hard-over time
- BLN10.0M -Boat waterline length in Metres
- BLN 32F -Boat waterline length in Feet
- BLG 0.3 -Boat lag value
- DIP 0 -Magnetic Dip Angle compensation
- SWING -Compass Deviation Correction
- CMP 000° -Compass alignment correction
- RGN 0.50 -Rudder gain value
- SC 6.25 -Speed sensor calibration
- POWER -Power steer mode

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 out is not necessarily the order in which they appear when the **SETUP** key is pressed, continue pressing the key until the one that is required is displayed.

COMMISSIONING ALONGSIDE

Set the following parameters prior to a sea trial.

BT TYPE Select type of boat
SET RDP Rudder end stop Port
SET RDS Rudder end stop Starboard
SET RDM Rudder Mid position
DRIVE A Select the rudder drive type
ST RDT Rudder Hard-over time
BLN10.0M Boat waterline length in Metres (or Feet)
BLN 32F Boat waterline length in Feet
DIP 0 Magnetic Dip Angle correction
CMP 000° Compass alignment correction
POWER Power steer mode to verify that the autopilot can drive the rudder

COMMISSIONING DURING A SEA TRIAL

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

SET RDM Rudder Mid position (reset)
SWING Internal Compass Deviation Correction
BLG 0.3 Boat Lag value
RGN 0.50 Rudder Gain value
SC 6.25 Speed sensor calibration Hz/Knot (availability is software version dependant)
POWER Power steer mode

COMMISSIONING ALONGSIDE

The following commissioning parameters will be set in this section of commissioning:

- | | |
|--------------|--------------------------------------------------------------------|
| 1. BT TYPE | Select type of boat |
| 2. SET RDP | Rudder end stop Port |
| 3. SET RDS | Rudder end stop Starboard |
| 4. SET RDM | Rudder mid position |
| 5. DRIVE A | Select the rudder drive type |
| 6. ST RDT | Rudder Hard-over time |
| 7. BLN10.0M | Boat waterline length in Metres |
| 8. BLN 32F | Boat waterline length in Feet |
| 9. DIP 0 | Magnetic Dip Angle correction |
| 10. CMP 000° | Compass alignment correction |
| 11. POWER | Power steer mode to verify that the autopilot can drive the rudder |

SELECTING THE BOAT TYPE

There are three selections available:

SAIL

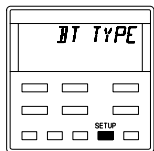
For all sail boats.

POWER D

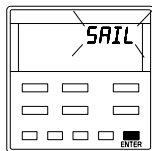
For power boats with displacement.

POWER P

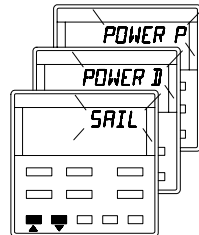
For power boats with planing hulls.



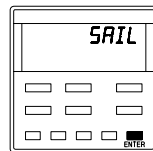
Press
SETUP
key, select
BT TYPE.



Press
ENTER
key.
Display
flashes.



Use ▲ or ▼ to select
the boat
type.

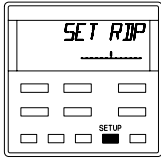


Press the
ENTER
key to
memorise
the setting.

SETTING THE RUDDER END STOPS

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

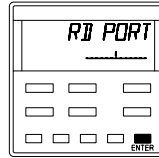
SETTING THE PORT END STOP



Press **SETUP** key, select **SET RDP**

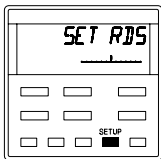


Move the rudder to hard over port position.



Press **ENTER** to set **PORT** end stop, the display confirms setting is successful.

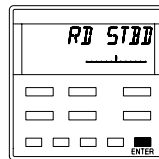
SETTING THE STARBOARD END STOP



Press **SETUP** key, select **SET RDS**.

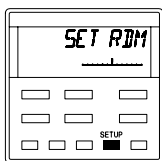


Move the rudder to hard-over starboard position.

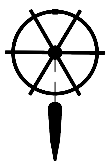


Press **ENTER** to set **STBD** end stop, the display confirms setting is successful.

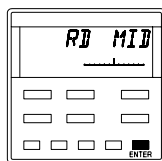
SETTING THE MIDSHIPS POSITION



Press **SETUP** key, select **SET RDM**.



Move the rudder to the amidships position.



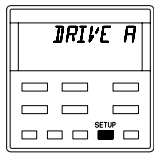
Press **ENTER** to set the **MID** position, the display confirms setting is successful.

SELECTING THE RUDDER DRIVE TYPE

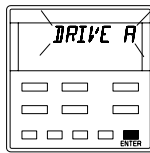
Depending upon the type of rudder drive unit fitted the PILOT controls the rudder drive motor in different ways, this optimises the autopilot steering response.

There are three selections available:

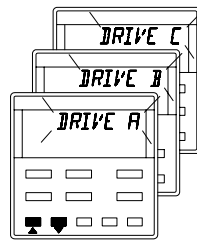
- 1. DRIVE A** Ram drives, Hydraulic pumps, Rotary drives, all sizes and voltages.
- 2. DRIVE B** Pedestal drive motors fitted by some steering gear manufactures.
- 3. DRIVE C** Outdrive drive units and Continuous drive units.



Press
SETUP
key, select
DRIVE A.



Press
ENTER
key. The
display
flashes.



Use ▲ or
▼ to select
the drive
type.



Press
ENTER
key to
memorise
the setting.

RUDDER HARD-OVER TIME

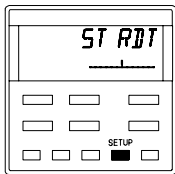
To finish the rudder end stop commissioning procedure the autopilot must calculate the rudder hard-over port to hard-over starboard time.

The following points must be observed before carrying out the procedure:

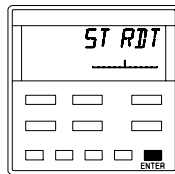
1. If the boat is equipped with hydraulic power assisted steering the engines must be running during setting the rudder end stops.
2. The rudder hard-over to hard-over time can only be calculated with the boat stationary.

If during timing the display shows the error message ***ERR 18***, check:

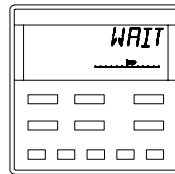
- The boat speed is less than 3 knots.
- The rudder reference unit must move through an angle of at least 90° when the wheel is turned from hardover to hardover.
- The output variation from the rudder reference unit is greater than 1 volt from hard-over port to hard-over starboard. Refer to Section 1 Rudder Reference Unit for installation details and check the installation.
- The separate power supply to the ACP control unit is switched on.



Press the **SETUP** key to display **ST RDT**.



Press **ENTER** key, the autopilot will drive the rudder to the port end stop position. Then it will measure the time taken from port to starboard and back, coming to rest in the midships position.

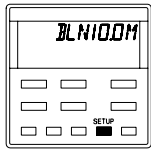


During the timing calculation, the autopilot display will show **WAIT**. The Rudder Angle Bar Display now indicates rudder angle, check that it indicates correctly.

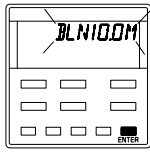
BOAT LENGTH

Boat waterline length must be entered into the autopilot for it to steer accurately. This value can be entered in Metres or Feet.

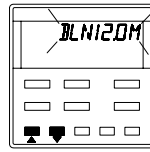
SETTING IN METRES



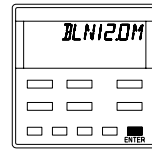
Press **SETUP** key to select **BLN10.0M**.



Press **ENTER** key. Display flashes.

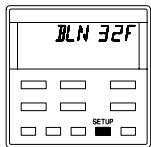


Adjust the value, **▲**= value up **▼**= value down

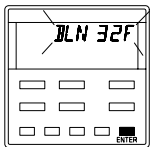


Press **ENTER** key, the new value is memorised.

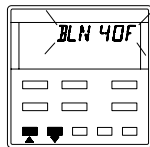
SETTING IN FEET



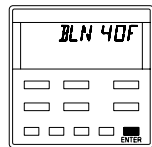
Press **SETUP** key to select **BLN 32F**.



Press **ENTER** key. Display flashes.



Adjust the value, **▲**= value up **▼**= value down



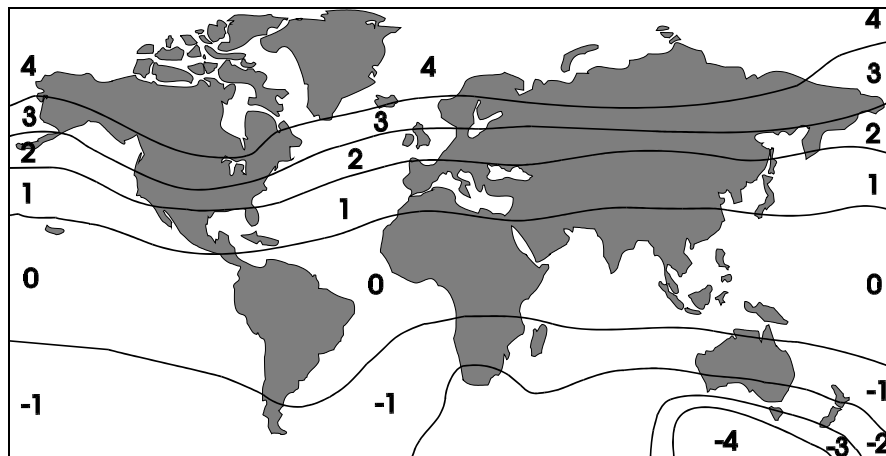
Press **ENTER** key, the new value is memorised.

MAGNETIC DIP ANGLE

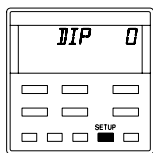
BOATS FASTER THAN 20 KNOTS ONLY

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.

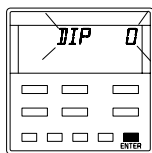
MAGNETIC DIP ANGLE COMPENSATION CHART



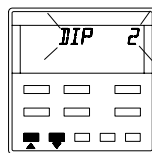
SETTING THE MAGNETIC DIP VALUE



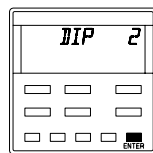
Press
SETUP
key, select
DIP 0.



Press
ENTER
key,
Display
flashes.



Adjust the
value,
▲= value
up
▼= value
down



Press
ENTER
key,
the value
is
memorised

COMPASS ALIGNMENT

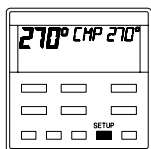
The Compass Alignment electronically compensates for the misalignment between the autopilot's fluxgate compass and the Earth's magnetic field. Use the following procedure:

1. The boats actual heading must be known, use a compensated bowl compass or hand-held compass for reference.
2. Enter the actual heading to correct the misalignment.

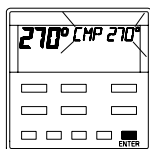
For Example:

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

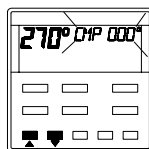
Compass Offset should be checked during a sea trial to ensure that it has been entered accurately.



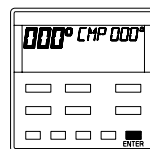
Press
SETUP
key, select
CMP.



Press
ENTER
key,
Display
flashes.



Adjust the
value,
▲= value
up
▼= value
down

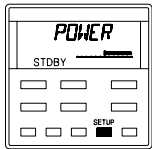


Press
ENTER
key, the
value is
memorised
.

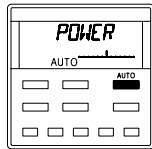
VERIFY OPERATION OF RUDDER DRIVE

- Power Steer mode can be used to verify that the Rudder Drive is operating correctly.
- Turn the wheel so the rudder is in the midships position (if possible).

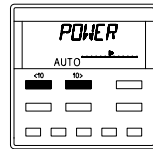
NOTE: When the **AUTO** key is pressed the rudder will return to the position it was in when **POWER** steer was engaged. If the rudder was set at the midships position then **AUTO** key will return it to that position.



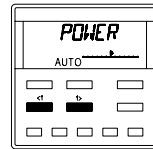
Press **SETUP** key, select **POWER**.



With the rudder amidships. Press **AUTO** key to engage power steer.



Use the **<10** or **10>** keys to move the rudder **3°** to port or starboard for each press.



Use the **<1** or **1>** keys to move the rudder **0.6°** to port or starboard for each press.

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.

COMMISSIONING SEA TRIAL

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 to maintain a constant lookout at all times. Use proper seamanship when clearing turns to ensure the commissioning is carried out safely.

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.

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

SET RDM	Rudder mid position (reset)
SWING	Internal Compass Deviation Correction
BLG 0.3	Boat Lag value
RGN 0.50	Rudder Gain value
SC 6.25	Speed sensor calibration
POWER	Power steer mode

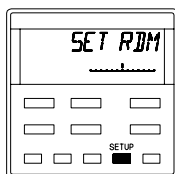
ENGAGING THE AUTOPILOT

1. Steer the boat onto a suitable heading, allow time for the boat to settle on this course.
2. Select autopilot mode **COMP** (compass) with the **MODE** key.
3. Press **AUTO** key on any Network Pilot Display or Hand-held Controller.
4. The autopilot will now be steering the boat on the selected heading.
5. Alter course in multiple increments using the 10° and 1° course change buttons on any Network Pilot Display or Hand-held Controller.
6. Press the red **OFF** key to disengage the autopilot and return to manual steering.

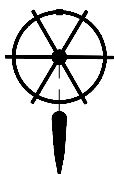
RESETTING THE RUDDER MIDSHIPS POSITION

Due to hull design and steering characteristics the best rudder midships position can only be set when underway at normal cruising speed. Adjust the midships position as follows.

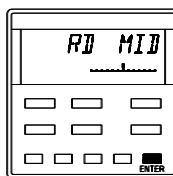
- Steer the boat into the wind.
- Boats with twin engines must have the engine revs balanced.
- Boats with trim tabs must have them in the normal cruising position.
- Enter commissioning mode by pressing **AUTO** and **OFF** keys.



Press **SETUP** key, select **SET RDM**.



Move the wheel to the midships position. Check that the boat settles onto a steady, straight course.

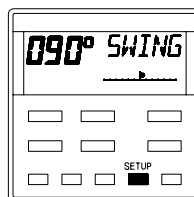


Press **ENTER** to reset the midships position, the display confirms the setting is successful.

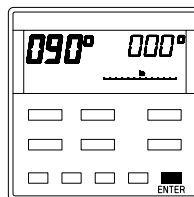
CALIBRATION OF THE PILOT COMPASS

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

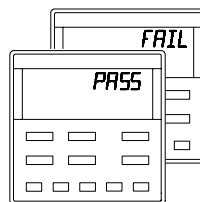
1. Press **SETUP** key, until the display shows **SWING**.



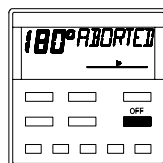
2. Press **ENTER** to start the swing. With the speed below 5 knots, turn the boat through 360° at a rate of turn not greater than 2° per second i.e. the turn should take about 3 minutes to complete. The display will show the amount of turn completed so far in degrees.



3. Keep turning until **PASS** or **FAIL** is displayed. If **FAIL** shows the swing was unsuccessful, the display will return to 000° and the procedure will have to be repeated.



4. The **SWING** can be stopped at any time by pressing the **OFF** key. The display will show **ABORTED** and return to **SWING**.



CHECKING THE COMPASS OFFSET

The compass offset was originally set while the boat was alongside. It would be advisable to check that the offset value is correct now that the internal compass has been swung. Refer to the Compass Offset procedure.

AUTOMATIC RUDDER GAIN

When the Network Pilot is part of an integrated Network system, boat speed data will be supplied via the system network cables from a Network Speed or Network Quad unit. This will allow the autopilot to automatically 'learn' the correct value for Rudder Gain by monitoring boat speed and rate of turn, the rate of turn will be approximately 7.5° per second.

If there is no direct speed input or the speed is being set by the Network Pilot Display Manual Speed Band selections, then the Rudder Gain value must be entered manually, refer to Manual Rudder Gain, section 5-26.

CHECKING THE AUTOMATIC RUDDER GAIN LEARNING

1. Steer the boat onto a suitable heading, allow time for the boat to settle on this course.
2. Select autopilot mode **COMP** (compass) with the **MODE** key.
3. Press **AUTO** key on any Network Pilot Display or Hand-held Controller.
4. The autopilot will now be steering the boat on the selected heading.
5. **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 Network Pilot Display or Hand-held Controller. This enables the autopilot to learn the rudder gain value.
6. When the autopilot has learnt the rudder gain value the rate of turn will be approximately 7.5° per second. (To estimate the rate of turn the display is updated every 1 second, therefore the heading display should jump in 7.5° steps.)
7. Press the red **OFF** key to disengage the autopilot and return to manual steering.
8. Now proceed with checking and adjusting the Boat Lag value.

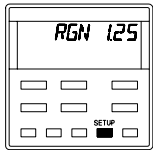
MANUAL RUDDER GAIN

1. Steer the boat onto a suitable heading, allow time for the boat to settle on this course.
2. Select autopilot mode **COMP** (compass) with the **MODE** key.
3. Press **AUTO** key on any Network Pilot Display or Hand-held Controller.
4. The autopilot will now be steering the boat on the selected heading.
5. **At A Speed Not Exceeding 15 Knots**, make course changes of at least 100° , by multiple presses of the 10° course change buttons on any Network Pilot Display or Hand-held Controller.
6. Observe and estimate the rate of turn. It should be approximately 7° to 8° per second. (To estimate the rate of turn the display is updated every 1 second, therefore the heading display should jump in 7° to 8° steps).
7. Observe the performance of the Pilot when changing course.

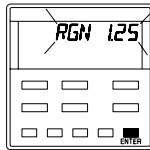
8. If the rudder gain value is too low, the autopilot will understeer, causing sluggish steering. If the rudder gain value is too high, the autopilot will oversteer, causing erratic steering and excessive rudder movements. In high speed boats this could cause a jerky response and dangerous rates of turn.
9. Adjust the Rudder Gain value for best steering performance. Use the minimum value necessary to maintain a good response to course changes and course keeping without excessive rudder movement.

SETTING THE RUDDER GAIN MANUALLY

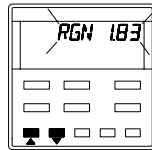
The autopilot must be disengaged and commissioning mode selected to adjust the Rudder Gain value.



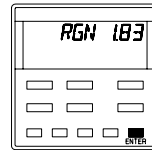
Press
SETUP
key, select
RGN 1.25.



Press
ENTER
key,
Display
flashes.



Adjust the
value,
▲= value
up
▼= value
down



Press
ENTER
key, the
new value
is
memorised

RUDDER GAIN VALUE TABLE

BOAT TYPE	DEFAULT VALUE	TYPICAL VALUES
SAIL BOATS	0.50	0.3 to 1.0
POWER BOATS	1.25	1.0 to 3.0

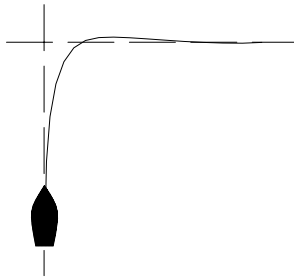
NOTE: The factory set value is selected by setting Boat Type and Rudder Drive Type during commissioning.

BOAT LAG

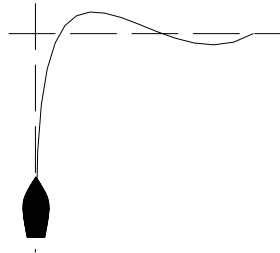
Boat Lag is the time taken for the boat to respond to changes in helm. For example, heavy displacement hulls require a larger value for boat lag.

1. Engage the autopilot as previously explained in Initial Pilot Sea Trial.
2. At a speed not exceeding 15 knots, change course by 90° in each direction.
3. Observe the autopilot steering performance. The boat should turn onto the new heading with minimal overshoot (a slight overshoot is acceptable).
4. 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.
5. It is easier to observe overshoot than undershoot, hence if no overshoot is observed decrease the boat lag in steps of 0.1 until a small overshoot is seen.
6. Use the smallest value of Boat Lag to stop overshoot.

BOAT LAG CORRECT

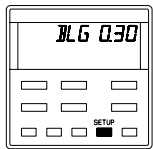


BOAT LAG INCORRECT

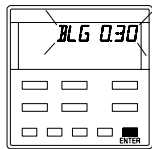


SETTING THE BOAT LAG VALUE

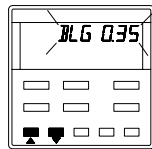
The autopilot must be disengaged and commissioning mode selected to adjust the Boat Lag value.



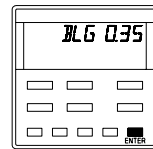
Press **SETUP** key, select **BLG 0.3**.



Press **ENTER** key, Display flashes.



Adjust the value, **▲**= value up **▼**= value down



Press **ENTER** key, the value is memorised

BOAT LAG VALUE TABLE

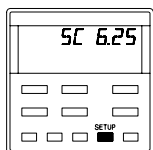
BOAT TYPE	DEFAULT VALUE	TYPICAL VALUE
SAIL BOATS	0.30	0.3 to 1.0
POWER BOATS	0.50	0.3 to 1.0

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

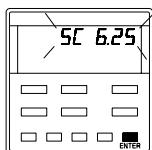
CALIBRATION OF DIRECT SPEED INPUT

The ACP computer unit can take a direct speed input from a Paddle-Wheel with a hall effect output (also refer to sections 4-18 and 4-20). All B&G paddle-wheel type sensors 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.

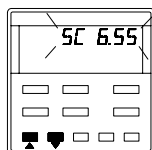
To determine if the value is correct compare the boat speed value displayed by the Network PILOT display (when the **SPEED** key is pressed) with the displayed value of speed on the log/speedo fitted.



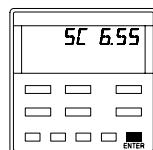
Press
SETUP
key, select
SC
6.25.



Press
ENTER
key,
Display
flashes.



Adjust the
value,
▲= value
up
▼= value
down



Press
ENTER
key, the
value is
memorised

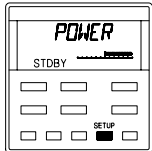
POWER STEER MODE

USE OF POWER STEER MODE

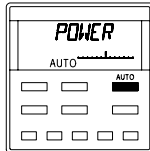
The power steer mode allows the user to directly control the boats rudder by using any Network Pilot Display or Hand-held controller course change keys. This could be used in an emergency if the normal manual steering system become defective, e.g. a broken steering quadrant cable or control rod. It can 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

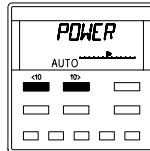
1. With the autopilot in standby, **STBDY**.
2. Select the commissioning mode by pressing **AUTO** and **OFF** keys together.
3. Turn the wheel so the rudder is in the midships position (if possible).



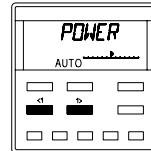
Press
SETUP
key, select
POWER.



With the
rudder
amidships. Press
AUTO key
to engage
power
steer.



Use the
<10 or 10>
keys to
move the
rudder **3°**
to port or
starboard
for each
press.



Use the **<1**
or **1>** keys
to move
the rudder
0.6° to port
or
starboard
for each
press.

NOTE: When the **AUTO** 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 midships position then pressing the **AUTO** key will return it to that position.

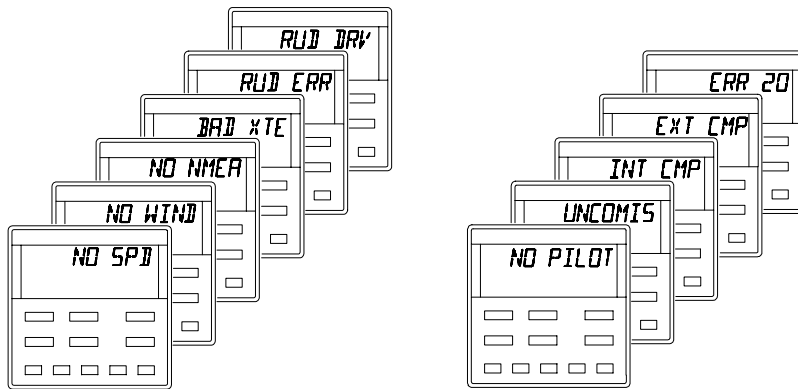
SECTION 6 TROUBLE SHOOTING

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TROUBLE SHOOTING INTRODUCTION

The Pilot Control Unit is continually monitoring the Pilot and Network 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 any of the five lower keys on a Pilot Display or any Network Instrument (with the exception of WIND and TACK). Press the **DISPLAY** key to cancel the displayed error message.



UNCOMIS 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:
 - memory backup battery failure.
 - severe interference, e.g. lightning.
5. Recommission pilot (refer section 5) and contact the nearest B & G dealer for advice.

RUD ERR 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 terminals (section 4-12) The voltage supply

to the rudder reference should be 4.5 to 5.0 volts (between Red-Blue). With someone moving the helm, the signal measured between (Blue-Green) 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.(e.g. Blue -Green Voltage minus Red -Green voltage must be greater than 1 Volt).

3. Set Pilot Display to show digital rudder angle in degrees. Move helm to port and starboard end stops, check that the indicated rudder angle is 40 degrees (+/- 2). 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 40 deg. one side to 40 deg 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.

RUD DRV 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.
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 - up to 2 amps maximum.
 - ACP 2 pilots - up to 2 amps maximum.
 - Check that the dip switches in the ACP 2 Computer Unit are set correctly for the rudder drive unit. See Section 2: Setting The Clutch Voltage.
5. With Pilot engaged in "Power Steer" mode, use 10 & 1 deg, 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.

NO SPD NO BOAT SPEED

Fault description:

The boat is stationary or moving very slowly (less than 1.5 kts) 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.

INT CMP EXTERNAL COMPASS

Fault description:

Compass data from the ACP Compass sensor via Pilot Display unit has stopped or has large errors.

Check list:

1. Check heading display on Pilot Display unit.
2. Check connections from compass sensor to the ACP unit. Refer Page 4-9

NO NMEA NO NMEA DATA

Fault description:

XTE data from position fixer has stopped.

Check list:

1. Check XTE display on Pilot Display unit or Network NAV.
2. Check connections to Pilot system.
3. Check operation of Position Fixer, has NMEA output been selected and enabled? Has autopilot output been enabled? Refer to Position Fixer manual.

BAD XTE 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.

NO WIND 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.

TRIP CURRENT TRIP

Fault description:

The voltage/current limit circuit for the drive motor or the clutch has tripped.

ACP112V Drive Motor - 15A Clutch - 2A

ACP212/24V Drive Motor - 25A Clutch - 2A

Check list:

1. Check installation and wiring for short circuits.
2. Check current to clutch, maximum available 2 amps.
3. Check maximum current to drive motor is less than above.

ERR 17 NETWORK DATA ERROR

Fault description:

No regular messages being received by the Pilot Display or instrument system network, i.e. either the display is not transmitting or receiving network messages.

Check list:

1. If other displays show Pilot data, check installation and operation of Pilot display.
2. If Pilot responds to commands from other displays then Pilot computer is operating correctly.
3. Check installation of network cable.

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.

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. Boat speed. Check that the boat speed input is operating correctly.
4. Settings. Read the commissioning manual carefully and check that the settings are appropriate for the type of boat.
5. 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.
6. Boat Lag. A boat lag value which is too small for the boat can cause instability, try increasing the value.
7. Check location of Compass sensor in vessel. Ensure that the sensor is not effected by cables carrying heavy current cables, Loudspeaker magnets or ferrous metals.