

# **PROPILOT 700**

(With 618700 Software)

Installation and  
Servicing Manual

## W E L C O M E

All of us at Cetrek would like to welcome you to the world of Cetrek Propilot Systems.



### Your Safety

THE USE OF AN AUTOPILOT DOES NOT AVOID THE NEED FOR NORMAL WATCHKEEPING.



### EMC DIRECTIVE 89/336/EEC

This product has been designed to be compliant with the above Directive.

Maximum performance and compliance with the EMC Directive can only be ensured by correct installation. It is strongly recommended that the installation conforms with the following Standards:

#### SMALL CRAFT - ELECTRICAL SYSTEMS:

- a) ISO 10133 - Extra Low-Voltage DC Installations
- b) ISO 13297 - Alternating Current Installations

ISO - International Standards Organisation

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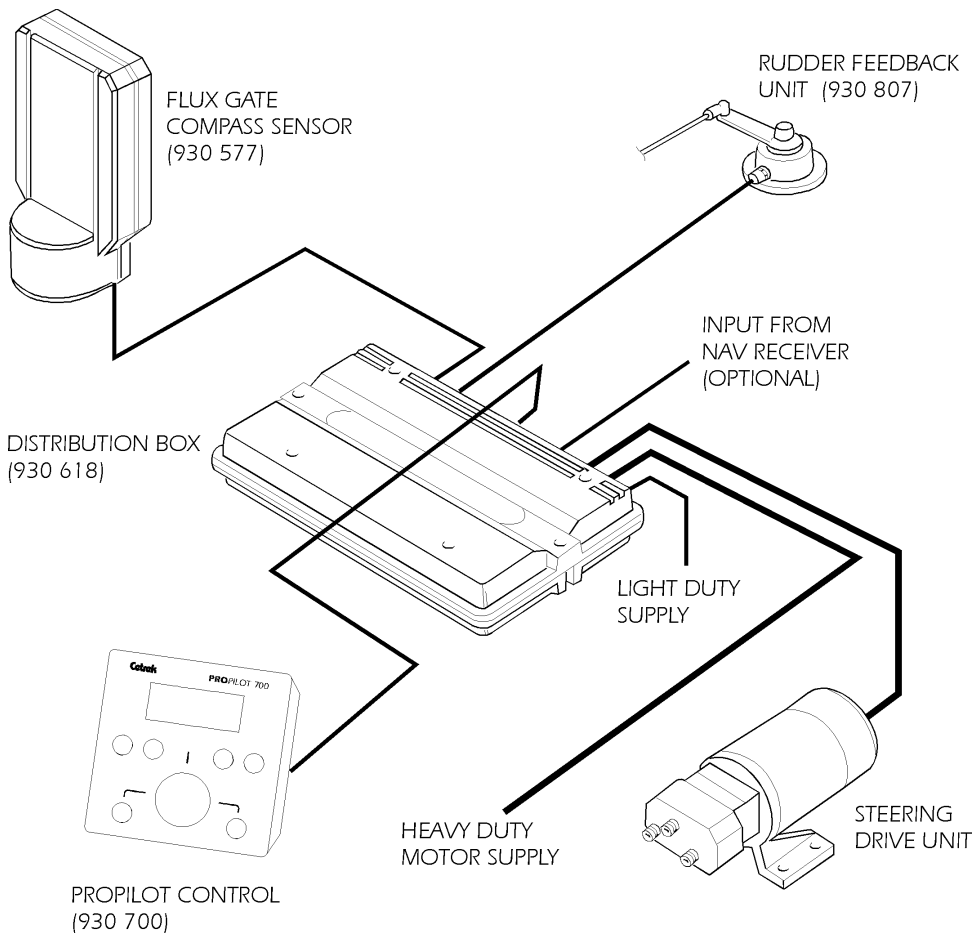
# CONTENTS

THE SYSTEM .....	6
System Accessories .....	6
A Brief Overview .....	6
INSTALLING YOUR PROPILOT 700 .....	7
Before you Start .....	7
Suggested Procedure .....	7
Distribution Box .....	8
Compass Sensor .....	8
Autopilot Control .....	9
Rudder Feedback Unit .....	9
Drive Units .....	10
Good Wiring Practice .....	11
Connecting the Autopilot .....	13
INSTALLATION SCHEMATIC .....	14
INSTALLING OPTIONAL EQUIPMENT .....	16
Cetrek Equipment .....	16
Navigators .....	16
NMEA 0183 .....	18
PROPILOT 700 FRONT PANEL FUNCTIONS .....	19
INSTALLATION SETTINGS .....	20
Compass Alignment .....	20
Rudder Phasing .....	20
Rudder Feedback Unit .....	20
Motor Phasing .....	20
CONFIGURING YOUR AUTOPILOT .....	21
Preset Configurations .....	21
Installing a Preset Configuration .....	22
Rudder Limit .....	22
Rudder Deadband .....	22
Counter Rudder .....	22
Trim .....	23
Navigator Interface Format .....	23
Navigator Gain .....	24
Power Steer Gain .....	24
Compass Damping .....	24
Auto-deviation .....	24
To Exit .....	24
SEA TRIALS .....	25
Checks at the Dockside .....	25
Checks at Sea .....	26
Automatic Deviation Correction .....	27
SYSTEM DESCRIPTION .....	29
Block Diagram of Distribution Box .....	29
Fuses and Maximum Ratings .....	29
Changing Software Eproms .....	30
Switches .....	30
TROUBLESHOOTING GUIDE .....	31
General Principles and Cautions .....	31
Faults .....	31
ERROR AND FAULT MESSAGES .....	34
INDEX .....	

# PROPILOT 700 INSTALLATION & SERVICING MANUAL

The System

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## THE SYSTEM

A basic system consists of the following:

- a Distribution Box (930 618) to collect, process and output information.
- a Compass Sensor (930 577) to provide heading information.
- an Autopilot Control (930 700) for the helmsman to control the autopilot.
- a Rudder Feedback Unit (930 807) to provide rudder position information.
- a Connection Cable (930 276) between the Propilot 700 cable and the Distribution box.

The system also requires a Drive Motor (hydraulic or mechanical) to activate the vessel's steering system.

### SYSTEM ACCESSORIES

Your system may have some of these accessories as well:

- Power steer remote controls.
- Rudder Position Indicators and Repeaters.
- Compass Repeaters.
- A Navigator.
- A second station Propilot 700 Control.

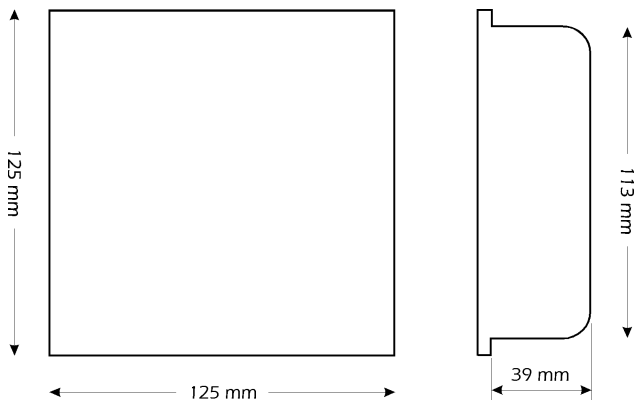
### A Brief Overview

The Distribution Box is the heart of the system and every thing connects to this. It contains the computer section that reads the data from the sensors, i.e. the rudder position from the Rudder Feedback Unit, the vessel's heading from the Compass. It reads the helmsman's orders from the Autopilot Control or a Navigator, then calculates, using the sea state and configuration settings and moves the rudder, via the Drive Motor to maintain a course.

The Distribution Box contains customised software (618700 V1.0) for connecting a Propilot 700 system.

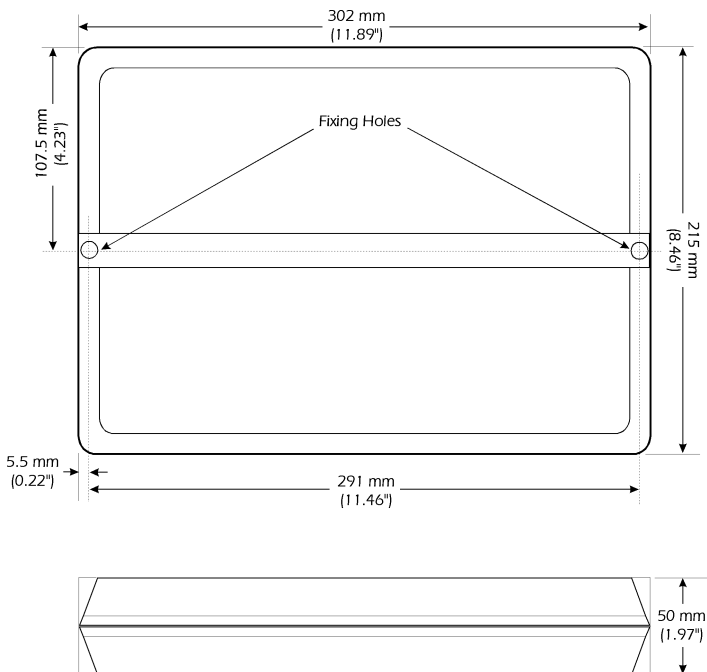
A link is fitted between Port B and power on the Windvane Port. The switch on the Light Duty Supply must be located near the Propilot 700 control.

**PROPILOT 700 DIMENSIONS**



Note: also allow adequate clearance for cable connections to ensure cables are not unduly stressed.

**930 618 DISTRIBUTION BOX DIMENSIONS**



## INSTALLING YOUR PROPILOT 725

### **Before you Start**

Before commencing the installation of your new pilot please carry out the following initial checks:

- that the correct items have been delivered ?
- that the units are undamaged ?
- that the correct voltage drive unit has been supplied ?
- if using a Mechanical Drive Unit, that the correct chain and sprocket is available ?
- if you are using a hydraulic pump, that you have the correct size fittings available to connect the pump ?
- that you have the correct type of hydraulic fluid to top up the steering system once the pump is installed ?
- that you have a power cable of a suitable gauge to supply power to the system?
- that you have a Circuit Breaker of suitable size for your system? A Light Duty Switch is required near the Propilot 700.

If you find an error please contact the supplier of the product immediately.

Before the drilling or cutting of any holes takes place, please consider the exact location and cable routing that is required for each unit. Please read this installation section and any installation information supplied with your units before you install the system.

### **Caution!**

All exposed moving parts must be sufficiently guarded to prevent accidental damage to persons or clothing.

### **Suggested Procedure**

We suggest that the following procedure will allow you to install the system encountering the least problems.

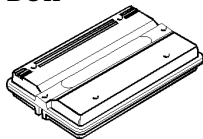
- Read this section then select the best positions for the units.
- Install the Distribution Box.
- Install the Autopilot Control and route the cable to the Distribution Box.
- Install the Compass Sensor and route the cable to the Distribution Box.
- Install the Rudder Feedback Unit and route the cable to the Distribution Box.
- Install the drive unit. Route the cable to the Distribution Box.
- Route the light and heavy duty power supplies to the Distribution Box.

- Then proceed to connect all the cables to the Distribution Box as per the Installation Schematic.

Finally:

- Connect the light duty supply fused at 5 amps, via the Light Duty Switch.
- Connect the heavy duty supply, see the Drive Unit information for fuse ratings.

### Distribution Box



This is the heart of the system and must be installed in a DRY, accessible position.

Ideally the box should be positioned so that the heavy duty power supply cables from the batteries to the distribution box and from the distribution box to the drive unit are kept to a minimum length. This is particularly important on sailing vessels where often you are operating on batteries which are not fully charged.

If the distribution box has to be installed in the engine room please ensure that the area is properly ventilated to avoid high ambient temperatures and abnormal condensation levels.

### Compass Sensor



The Compass Sensor needs to be carefully located. The optimum position is to mount it on a convenient (vertical) bulkhead, as low and as close to the centre line of the boat as possible. On fast vessels, it is advisable to fit the compass sensor at least half way back along the centre line.

On steel vessels it is necessary to mount the sensor 2 to 3 metres above the superstructure or to use a Gyro or Pick-off coil system working from the vessel's main steering compass.

The compass sensor must be installed away from sources of magnetic interference, such as:

Radios, RDF, Depth Recorders, etc:	at least 1 metre clearance
Power cables carrying more than 0.5 amp:	at least 1 metre clearance
Radar Magnetrons:	at least 3 metre clearance
Ship's engines, large mass steel (soft iron) etc:	at least 1 metre clearance

Also, do not install the compass in a position where magnetic material i.e. tool boxes, drink cans, chain etc. may be stowed at any time.



Check the proposed location with a hand bearing compass. This will indicate whether there is a large deviation that may cause problems. Switch on any electrical equipment that may cause deviation and check the hand-bearing compass to see if there has been any change on heading. If a change is observed the Sensor should not be installed in this position as the compass heading may not reflect the true heading of the craft, therefore making autopilot control inaccurate.

Once the Compass Sensor is installed the transit screw in the base of the unit should be shortened or removed.

The compass does not have to physically align with the bow of the vessel because it will be manually aligned later during the Installation Settings.

The Automatic Deviation Correction routine is explained later in the Sea Trials section.

Further instructions on the location of the compass sensor are included with each compass sensor despatched from Getrek's factory.

**Autopilot Control**

In the interest of safety there must be an autopilot control within reach of the helmsman AT ALL TIMES.

This should be installed in a position convenient for the helmsman to operate it.

**Rudder Feedback Unit**

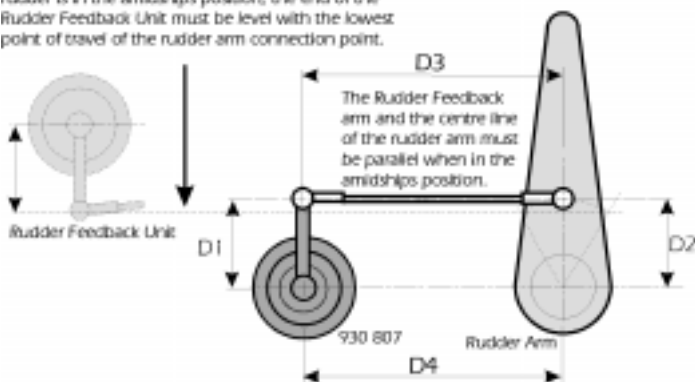


The Rudder Feedback Unit is connected directly to the Rudder Arm, which may be a tiller, quadrant or tie bar, of the steering system. It may be necessary to construct a mounting base for this unit.

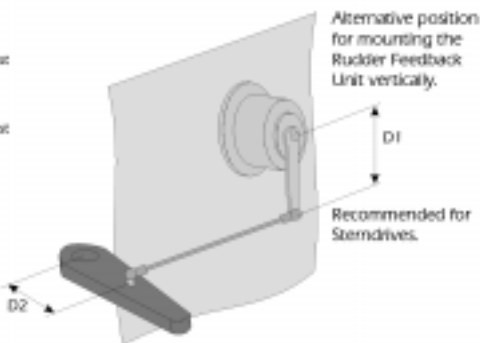
As the steering gear is often exposed and in an area which is used for stowage, ensure that the Rudder Feedback Unit cannot be jammed by ropes, buckets, fenders etc.

You can mount the Rudder Feedback Unit on either side of the Rudder Stock as changing the "Phasing" so that the Feedback Unit indicates Port and Starboard correctly is done manually in the Distribution Box. This procedure is described later, in the Installation Settings.

When fitted in this alternative position and the rudder is in the amidships position, the end of the Rudder Feedback Unit must be level with the lowest point of travel of the rudder arm connection point.



In all Positions:  
Distance D1 must be the same length as D2.  
In all Positions:  
Distance D3 must be the same length as D4.



The rudder amidships position of the Rudder Feedback Unit must be accurately centred.

### Drive Units

Mechanical Drive Units connect into existing mechanical steering systems.

The size and position of a Rotary Drive Unit should have been specified when originally ordering the Pilot System. The unit will have to be positioned to align with the sprocket which will be fitted to the existing mechanical steering system. It is essential to ensure that a strong mechanical mounting is provided for these units as considerable loads are developed when under use.

The heavy duty supply should be fused according to the drive unit fitted:

930 403, 404, 415	30A Antisurge
930 413, 414	20A Antisurge

Hydraulic Drive units connect into existing manually operated hydraulic steering systems. Hydraulic pumps should be mounted on a rigid base to avoid unnecessary vibration and noise.

The heavy duty supply should be fused according to the drive unit fitted:

930 100,101,130,132,135,160,161,162	30A Antisurge
930 110,111,155,170,171,172,180,182	20A Antisurge
930 146	10A Antisurge
930 102,112 (Continuous Running Pumps)	5A Antisurge

For other continuously running pumps use a fuse rating of a suitable size for the solenoids.

For either system it is acceptable to use a Fused switch or a Circuit breaker. Changing the Phasing to reverse the rotation of the motor is explained later in the Installation Settings.

**Good Wiring Practice**

Having decided on the location and position of each unit it is essential to check the cable runs to ensure that there are no problems.

All cable runs should be kept as clear as possible from other cables carrying RF (radio frequency), pulsed signals or heavy currents (such as winches etc.). At least 3 ft. clearance is advised. Take particular care to ensure the maximum clearance from radio transmitting aerials.

If it is necessary to extend any of the cables, the same type of cable must be used and the screens must be connected. Screened cables should be earthed at the Distribution Box using the clamping bars provided.

If it is necessary to extend the Drive Unit cables, they should be extended using a heavy duty cable, by the shortest possible route, to avoid unnecessary power loss.

If the vessel has a "clean" earthing system (ie using a dyna plate or similar system) then the case of the Distribution Box may be connected to it using a heavy duty cable or copper strip, this will usually improve RFI rejection.

Note:

The negative of the battery system is not normally a clean earth and the case of the Distribution Box should not under any circumstances be connected to it.

All DC supply cables should be kept as short as possible, and should be taken from the battery via a switch/fuse or circuit breaker of a suitable rating for the system being installed.

Two separately switched and fused power supplies must be connected to the Distribution Box. The first is for the light duty primary supply for the electronic control system. The second is for the heavy duty supply for the drive unit.

**IMPORTANT :**

The Light Duty Supply Switch must be located close to the Propilot 700, to turn the autopilot on and off.

Avoid running power and motor supply cables together or in the same conduit with control and compass cables to help reduce the risk of interference.

It is good practice to cleat all cables to fixed points at no less than 0.5 m (18") spacing and where cables pass through bulkheads, protect the cable with a suitable grommet or sleeve.

**Connecting  
the Autopilot**

All the connections for the system are made to the PCB in the Distribution Box which is clearly marked to make connections easy and straightforward.

Spare plugs are supplied for the connection of navigators etc. Additional ones are available from your Cetrek distributor.

**KEY TO THE COLOUR CODING OF CABLES**

R	Red	Rouge	Rot	Rojo
B	Blue	Bleu(e)	Blau	Azul
BK	Black	Nbir(e)	Schwarz	Negro
BN	Brown	Marron	Braun	Marron
V	Violet	Violet(te)	Violett	Violeta
G	Green	Vert(e)	Grün	Verde
W	White	Blanc(he)	Weiss	Blanco
GY	Grey	Gris(e)	Graua	Gris
Y	Yellow	Jaune	Gelb	Amarillo
O	Orange	Orange	Orange	Naranja
NC	No connection	Pas de lien	Kein anschluss	No conectar

The Installation Schematic on page 14 shows the location of the connectors on the PCB and the relevant cable connections.

**Caution!**

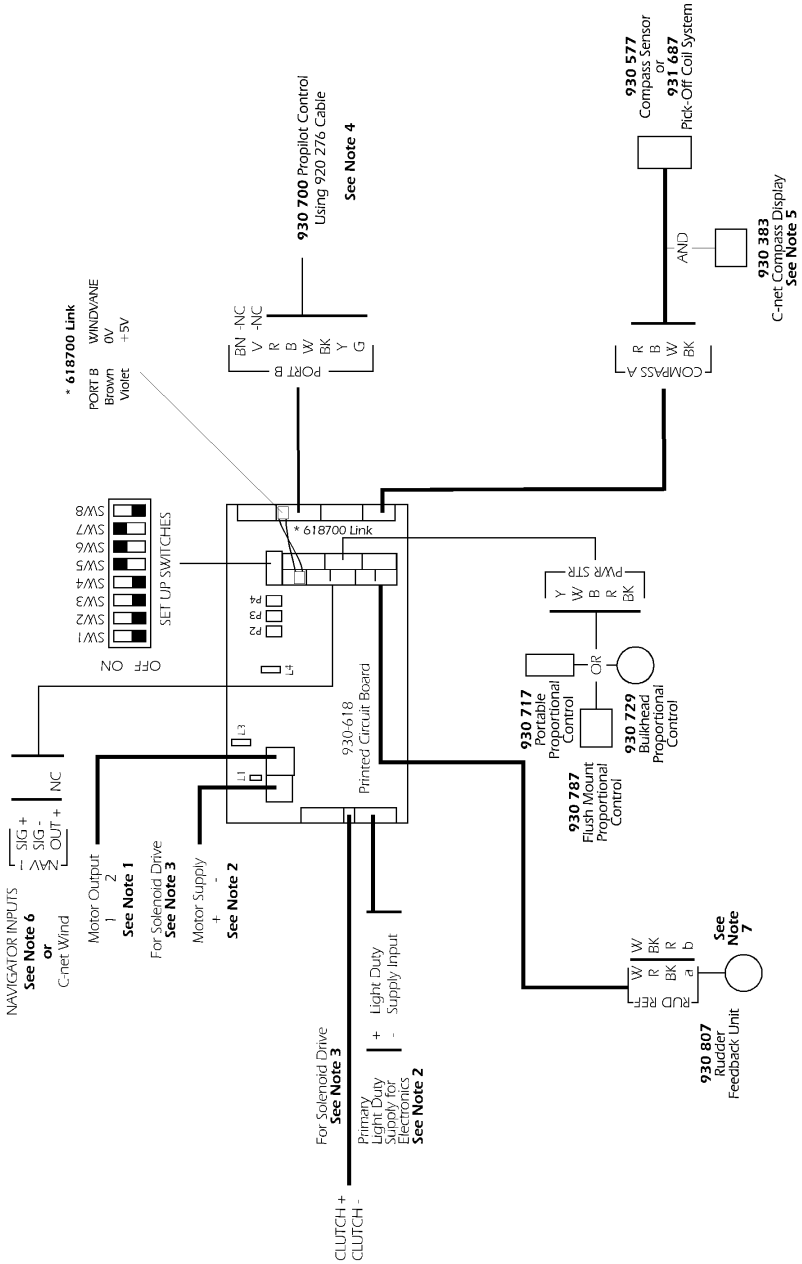
Incorrect wiring (e.g. reverse polarity) can cause irreparable damage to some equipment and is not covered by the Cetrek warranty agreement.

# PROPILOT 700 INSTALLATION & SERVICING MANUAL

## Installation Schematic

### Installation Schematic - 930 618 used with 930 700 (618700 Software)

[Issue 02 PCB Onwards]

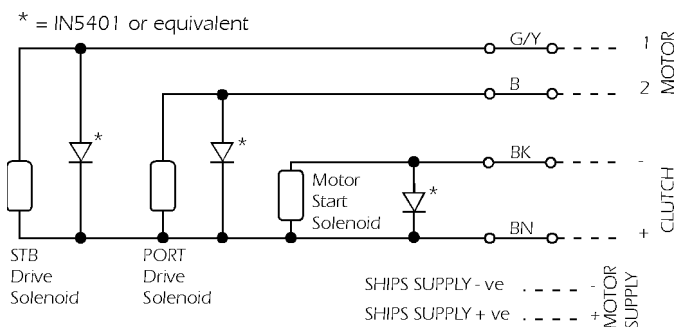


**WARNINGS**

- i) Do not connect or disconnect wiring with power applied.
- ii) Ensure cable screens are suitably connected.
- iii) Always check colour codes before applying power. Older units may have plugs incorrectly wired for use with the 930 618 unit.

**NOTES**

1. Motor Connections Ensure L4 is in the 'PWM' position. The 930 618 can be connected with any of the drives that Cetrek supplies. Phasing can be reversed manually in the Distribution Box once the system is installed. See "Installation Settings" for further details.
2. Motor Supply The Heavy Duty Motor Supply and Light Duty Supply must be run independently. Fuse the Light Duty at 5 amps, the switch must be located close the Propilot 700. See "Drive Units" in the Installing Section for the Heavy Duty fuse rating.
3. Solenoid Drives Should be connected as shown in the diagram below. Links L1 & L3 must be cut, L4 must be moved to the 'Spool' position. Also ensure that adequate diode protection is fitted to the Spool Valves to prevent reverse spikes damaging the FET's in the 930 618. A suitable diode is IN5401 or equivalent. Cetrek units 930 102, 930 112 have this protection built in.



4. Set SW1, 2 and 3 to OFF for 930 700. Ensure the 618700 Links between Port B and power on the Windvane Port are fitted.
5. If the C-net Compass (930 383) is used as a Compass Repeater DO NOT connect the white wire to this unit.  
It is advisable to check your C-net Compass Manual for details of the connections into the Compass unit.
6. Navigator Input: Set SW7, for NAV1, ON for single wire output, OFF for two wire output.
7. Set SW5 & SW6 to ON for 930 807 and to OFF for 930 801. There is no connection for the brown wire on the 930 801. If connecting a 930 319 Rudder Indicator, follow instructions supplied with the unit for phasing, regardless of the Rudder Feedback phasing.

## INSTALLING OPTIONAL EQUIPMENT

### **Cetrek Equipment**

Your Cetrek equipment will have Installation and Operation Instructions with each individual unit as is appropriate for the equipment. The Installation Schematic in this manual covers the wiring connections of optional equipment.

Non Cetrek equipment will usually interface with your Autopilot if you follow these instructions.

### **Navigators**

The autopilot can be controlled with data received from a radio navigator (Sat Nav, Loran, Decca or GPS) which has a compatible output format.

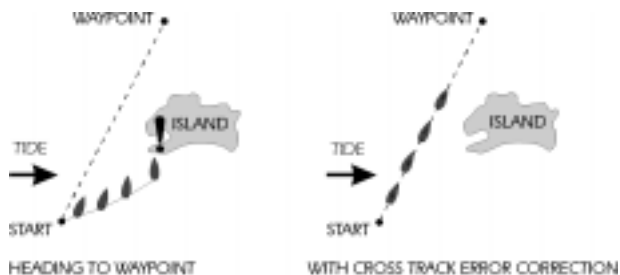
The marine industry has generally adopted the data output formats as specified by the National Marine Electronics Association of North America (NMEA). Your autopilot will only accept NMEA 0183 for autopilot control:-

In order for the navigator to output the required information, it first has to be programmed with your required destination or waypoints. The basic information used for autopilot control is:-

- Cross track error. This is expressed in units of one hundredth of a nautical mile (60ft.) and whether the error is to port or starboard of track.
- Alarm condition. This indicates if information received from the navigator is valid.
- Heading to the next waypoint.
- Next waypoint Number.

In order to get full use of the interface facility from your equipment, it is important to understand the principles of control used. It would of course be very simple to use the heading to the next waypoint calculated by the navigator. However, this would be a dangerous method to use when in the proximity of land as a stray tidal offset could put the vessel in a position when it will run aground.





The use of Cross Track Error to control the autopilot heading enables the vessel to be held on track to the next waypoint. The autopilot is actually controlled by its own compass output and the Cross Track Error information is used to calculate the Trim required to keep your craft on track.

When the waypoint is reached (provided the navigator is programmed for the next waypoint) Cross Track Error would not be sufficient information to turn the vessel on to the next track. To do this it is necessary for the navigator to output the heading to the next waypoint and indicate that a new waypoint has been selected. Because of this, the operation when waypoints are reached will depend on the type of data received from your navigator.

**NMEA 0183**

The Autopilot is capable of processing the following NMEA 0183 messages. To obtain full use of the interface at least one message containing Cross Track Error, Heading to Waypoint and Waypoint number must be present in the data received from the Navigator.

MESSAGE	CROSS TRACK ERROR	HEADING TO WAYPOINT	TOWAYPOINT NUMBER	WIND ANGLE
APA	✓	✓	✓	-
APB	✓	✓	✓	-
BOD	-	✓	✓	-
BWC	-	✓	✓	-
XTE	✓	-	-	-
RMB	✓	✓	✓	-
VWR	-	-	-	✓

✓ Indicates that the data should be present in the given message according to the NMEA 0183 specification.

However, please note that not all navigator manufacturers provide all the data required by a given message.

A navigator can be connected to the Distribution Box using the NAV1 port.

If the Navigator has a single wire output then connect it to the terminal marked 'SIG+'. Switch SW7 to ON.

If the navigator has a two wire output then connect the positive signal to the 'SIG+' terminal and the negative signal to the 'SIG-' terminal. Switch SW7 to OFF.

The Installation Settings explain how to select the gain values.

**PROPILOT 700 FRONT PANEL FUNCTIONS**

<b>KEY</b>	<b>PRIMARY FUNCTION</b>	<b>SECONDARY FUNCTION</b>
>	Dodge to Starboard	Increases Configuration Menu Settings
<	Dodge to Port	Decreases Configuration Menu Settings
< >	Changes function of Dodge keys between Dodge and Course Change	
<b>KNOB</b>	1 Pre-Selecting A Course (in Standby Mode) 2 Course Change (in Autopilot Mode)	
<b>AUTO</b>	1 A 226 Select Autopilot Mode 2 P 226 Power Steer Selected	Course Change - in conjunction with Course Selector Knob.
<b>OFF</b>	1 Return to Standby from Drive Mode 2 Return from Background Menu	None
<b>NAV</b>	1 } 14 Cross Track Error display 2 N 226 Selects Nav Control & shows heading being followed	
<b>ADJ</b>	Selects Sea State Settings: r u Rudder r e Response  Shows Rudder Position, eg: Pr : 02 Port Rudder, or Sr : 00 Starboard Rudder, or Stop Rudder Limit	Press and hold ADJ Key on Power up to select Configuration Settings: (Use < or > to change values)
		1 CONF < or > to give: DISP SdIS PLAN 2 rL Rudder Limit 3 rd Rudder Deadband 4 Cr Counter Rudder 5 tr Trim 6 nG Navigator Gain 7 PG Power Steer Gain 8 Cd Compass Damping 9 CLr Deviation Correction

## INSTALLATION SETTINGS

There are four installation settings which are as follows:

- Rudder phasing of the Rudder Feedback Unit.
- Motor phasing.
- Rudder Feedback Unit offset.
- Magnetic Compass Alignment and Damping.

After Powering up, see Sea Trails, Checks at the Dockside.

### **Compass Alignment**

Check the heading agrees with an accurate magnetic compass or transits. If an adjustment is required a manual adjustment can be carried out. Make a note of the amount of adjustment needed.

Remove the Compass Sensor front cover, then loosen the clamp holding the coil base. The Coil Base has a printed scale. Move the coil base clockwise to increase the heading display, or anti-clockwise to decrease the heading display.

Check that the heading display now agrees with an accurate magnetic compass or transits. Tighten the clamp and refit the front cover.

### **Rudder Phasing**

Rudder Phasing is carried out to ensure the rudder indication corresponds with the direction steered.

Connect the wires from the Rudder Feedback Unit inside the Distribution Box. When Dockside Checks are performed, in Standby, if the rudder indicator displays the opposite direction to the rudder movement, reverse the 930 807 Red and Black wires.

### **Rudder Feedback Unit**

The Rudder Feedback Unit must be centred accurately using the midship markings and Rudder Angle Template to ensure the rudder is amidships when travelling in a straight line.

### **Motor Phasing**

Motor Phasing is carried out after Rudder Phasing to ensure the polarity of the motor moves the rudder to Port and Starboard correctly.

Connect the wires from the Motor Drive inside the Distribution Box. When Dockside Checks are performed, in Autopilot Mode, if the rudder moves continuously in one direction, switch off immediately, then reverse the Motor OUTPUT 1 and 2 wires.

## CONFIGURING YOUR AUTOPILOT

Because no two vessels are quite the same, your autopilot will need to be configured for the characteristics of your boat. This is done initially when the system is installed but you may be able to fine tune it later.

The Propilot 700 has default settings for three types of boat, Planing, Semi-displacement and Displacement. For each of these boat types there is a standard configuration preprogrammed into the autopilot's memory.

Select the configuration (boat type) most suited to your vessel, then fine tune the settings as you become familiar with the autopilot.

### PRESET CONFIGURATIONS

The following is a list of the values that the Preset Configurations will set the Autopilot to, including those for equipment that you may not have connected. Notice that the Rudder Ratio and Response settings also change. These settings are only intended as a general guide.

If adjustments are made to the preset values for a boat type, make a note of the settings. If further adjustments are tried, to see if they improve performance, there is not a restore function to return to the previously adjusted setting.

The preset values are as follows:-

	Displacement	Semi-Disp	Planing
Rudder Ratio - rU	5	4	3
Response - rE	0	0	0
Rudder Limit - rL	7	7	7
Rudder Deadband - rd	1	1	1
Counter Rudder - Cr	2	1	0
Trim - tr	2	2	2
Nav Gain - NG	5	5	5
Compass Damping - Cd	1	1	1

The configuration settings enable the Propilot 700 to be adjusted according to sea state, speed, the vessel's load, etc.

**Installing a  
Preset  
Configuration**

Press and hold the ADJ key, on power up, until the LCD displays the Configuration message (approximately 3 seconds).

**CONF**

Press either the < or > key to display the current setting in the selection window (without changing the setting). Only one Preset can be switched ON. When you select one, the other two are automatically turned OFF. Press the ADJ key to re-enter the settings menu or repeatedly press either the < or > key to select the required preset. Press the ADJ key to re-enter the settings menu or press the AUTO or OFF key to exit this routine and store the new setting.

**DISP**

**DIS**

**PLAN**

**THE SETTINGS EXPLAINED**

**Rudder Limit**

This sets the maximum rudder movement, either side of amidships, obtainable under autopilot control. The Propilot will display 'StOP' when these limits are reached. The range is from 0 (=3°) to 9 (=30°). Set the limit so that the rudder does not quite touch its end stops.

**r L**

**Rudder  
Deadband**

Some steering systems have slack in them due to wear or system design which gives a few uncontrolled degrees of rudder movement. To stop the autopilot trying to correct these small movements, which it can never successfully do, the rudder deadband setting allows a small rudder displacement from the required position without the autopilot trying to correct the error.

**r d**

Set this to the minimum value that avoids hunting of the rudder. The range is from 0, (0°) to 9, (2°).

**Counter Rudder**

At the end of a large course change the amount of rudder is reduced as the vessel approaches the new heading to prevent the vessel from overshooting. This may even result in opposite helm being applied for a short time. The rate at which the reduction in the amount of rudder occurs is known as Counter Rudder.

**Cr**

If this is set too high the vessel will not settle on to the new heading quickly enough. If the Counter Rudder is set too low the vessel will overshoot and the pilot will have to correct accordingly, possibly causing the vessel to oscillate from side to side, before settling to the new heading.

This setting will have a greater effect on heavier displacement vessels but must obviously be customised according to the characteristics of individual craft. Adjust to give approximately 10° of overshoot for a 90° change of course.

The range is from 0 (No Counter Rudder) to 9 (Maximum Counter Rudder).

## **Trim**

## **T R**

Theoretically if the rudder is amidships the vessel will travel in a straight line. Often something will cause the vessel to drag to one side, for example the wind, towing something or current. To counteract this a few degrees of rudder will be applied, this is termed Trim or Standing Helm. This setting adjusts the rate at which that standing helm is applied.

The higher the setting, the faster the standing helm is applied. This should be set so that the autopilot will trim the vessel to the correct course within 60 seconds.

On single screwed vessels or sailing yachts it is only possible to check the Trim setting while using the craft when, for example, the prevailing conditions cause the vessel to steer with offset rudder. The correct Trim adjustment setting for these types of vessel is therefore best found by experience.

To check the Trim adjustment with twin engine vessels, run the boat under Auto command with both engines running, then close down one engine. The vessel will initially go off course but should return to course in less than 60 seconds. If the vessel takes a longer period of time to return to course then increase the value set for Trim.

The range is from 0 (No Trim) to 9 (Maximum Trim).

## **Navigator Interface Format**

The Navigator is connected to Nav Port 1 only, the Interface format is factory set to NMEA 0183 - 4800 Baud Rate.

**Navigator Gain** This is the window to set the signal Gain for the navigator. Its value can be between 0 and 9. Initially set it to 05 then fine tune it during Sea Trials.

**NG** To enter the settings window press and hold the ADJ key, on power up, until 'CONF' is displayed. Then press the ADJ key until 'NG' is displayed, the value can then be altered using the < and > keys.

If the navigator gain control is set too high the vessel, when under navigator control, will make large step corrections to return the vessel to track. The gain of the navigator should be set as high as possible without this effect being induced.

**Power Steer Gain** This adjusts the sensitivity of the steering when it is controlled by a remote device such as a 930 729 Proportional Control. The range is from 0 (least sensitive) to 9 (most sensitive).

**Compass Damping** This sets the amount of damping applied to the readings from the heading sensor to avoid rapid changes of the heading display. The range is from 0 minimum damping to 9, maximum damping. Generally, the higher the sensor is above the waterline, the more damping is required.

**Cd** Compass Damping is one element of the standard configurations preprogrammed into the autopilot's memory. As with the other configurations the damping can be fine tuned as you become more familiar with the Autopilot.

To access the settings window press and hold the ADJ key, on power up, until 'CONF' is displayed, then press the ADJ key until 'Cd' is displayed, the value can then be altered using the < and > keys.

**Auto-deviation CLR or CORR** This allows access to the automatic deviation correction procedure for the heading sensor and is explained in the following section, Sea Trials.

**To Exit** To exit from the installation settings routine at any stage, press the AUTO key then the OFF key. This ensures that the autopilot remembers the settings you have just programmed in.



## SEA TRIALS

With the installation completed, it is strongly advised that the following Sea Trials are carried out.

### Checks at the Dockside

Ensure that the steering moves freely from lock to lock without undue stiffness and that it can move to its full travel without the Rudder Feedback arms fouling the steering.

Return the rudder(s) back to the amidships position.

Switch the autopilot ON, if the steering operates, *switch off at once* and re-check the connections. Continue when the fault has been corrected.

Check that no system faults appear after the self test routine has been completed.

Check that the autopilot has been configured for the vessel, e.g. displacement, semi-displacement or planing.

Check that the Rudder Position display indicates the rudder moving to the left when the helm is turned to Port and to the right when it is turned to Starboard. If not, reverse the Rudder Feedback Unit phasing (see the Installation Settings earlier).

Check that the rudder position indicator displays '**PR00**' or '**SR00**' when the rudder is in the position normally required to steer the vessel in a straight line. Also check that it displays '**STOP**', indicating that it has reached the Rudder Limit, *before* it reaches the end of rudder movement (in both directions). If not adjust the Rudder Limit in the Installation Setting menu.

Switch the autopilot from Standby mode into Autopilot mode. Very little or no rudder movement should occur. If the rudder drives continuously to one side, *switch off at once* and reverse the motor phasing. If the rudder continuously 'hunts' about amidships, increase the rudder Response setting.

Check that when you rotate the Course Control Knob clockwise, the motor drives the rudder to Starboard and when you rotate the Course Control Knob anticlockwise, the rudder drives to Port. If the Rudder moves in the wrong direction, switch off and reverse the motor phasing (see the Installation Settings earlier).

Ensure that the transit screw in the base of the compass sensor has been removed or shortened (or replaced if it is exposed to the elements) and check that the compass heading agrees with the ship's heading. If not remove cover and align compass manually.

Finally check that the OFF and AUTO keys of any additional Control Unit's function correctly.

Sea trials can now be carried out to set the compass deviation corrections and to determine the best settings for optimum autopilot performance.

### Checks at Sea

It is dangerous to carry out these trials in restricted or busy waters.

Calm sea conditions are required to carry out the Automatic Deviation Correction procedure, average sea conditions are preferable for the rest of the sea trials.

The following order is recommended for carrying out the Sea Trials.

Carry out the Automatic Deviation Correction routine.

Check that the selected Configuration settings give the best performance for the vessel in this order:-

- a. Rudder adjustments.
- b. Counter rudder.

After carrying out this adjustment, check the steering characteristics and adjust the Rudder and Response as required.

- c. Trim adjustment. If conditions allow.
- d. Compass Damping.

Set the Navigator Gain if a navigator is fitted (see Installation Settings earlier).

**WARNING**

Changed values are not automatically stored until you press the AUTO key then OFF key. Therefore store the settings as soon as it is practical and safe to do so.

It is also advised that the optimised settings are recorded, in case they are accidentally changed at any time.

**AUTOMATIC DEVIATION CORRECTION**

The compass has a facility to automatically measure and compensate for the majority of hard and soft iron deviation found on board a vessel.

The compass sensor requires the vessel to turn approximately  $\frac{3}{4}$  times clockwise to complete the deviation correction. The first turn corrects for hard iron errors, the second for soft iron errors.

It is not necessary to turn the boat at a constant rate nor will momentarily stopping the rotation affect the deviation correction procedure. Turning the vessel in an anticlockwise direction during the correction procedure should be avoided as this can lead to erroneous correction values.

The deviation correction facility is not accessible until 10 seconds after power up of the compass sensor.

**Procedure**

Find an area of calm water where it is safe to perform slow CLOCKWISE turns.

Press and hold down the ADJ key, on power up, for approximately 3 seconds until the configuration message appears.

**CONF**

Press the ADJ key repeatedly until the LCD displays Auto deviation message either '**CLr**' or '**COrr**'.

**CLr**

If '**COrr**' is displayed it means that the autopilot already has correction values stored. Press the < and > keys simultaneously to reset the correction or ADJ key to re-enter the settings menu without resetting.

**C O R R**

Once the LCD displays '**CLR**' set the vessel on a slow clockwise turn and press the < and > keys simultaneously.

**C L R**

The display will inform you that the auto deviation correction routine has been initialised.

**i N i T**

After 60° of turn the LCD will change to display '**run**'. Continue the slow clockwise turn until the LCD changes to display '**CORR**', usually 2¼ turns.

If the display still indicates '**run**' then the vessel has been turned too quickly and requires an additional turn at a slower rate.

**R u n**

This completes the Auto deviation correction routine. Press the OFF or ADJ key to return to the mode you require.

**C O R R**

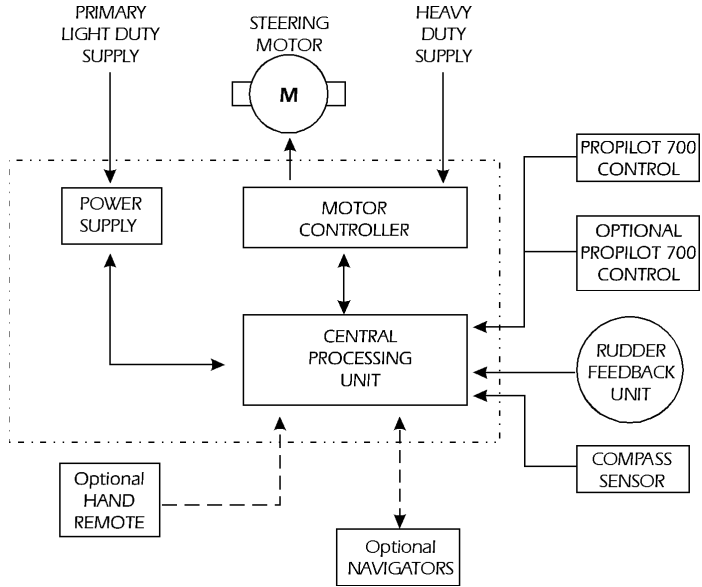
You should now check that the compass heading agrees with the vessel's true heading and does not need manually realigning. The compass should also be checked against known headings to check the accuracy of the compass (known headings could be obtained either from an accurate magnetic compass or from transits).

**WARNING**

Changed values are not automatically stored until you press the AUTO key then OFF key. Therefore store the settings as soon as it is practical and safe to do so.

## SYSTEM DESCRIPTION

**Block Diagram  
of Distribution  
Box Showing  
Primary Data  
Paths**



An Installation Schematic showing all possible connection options is shown on page 14.

### Fuses

FS1-3 amp, QB, Ø5mm x 20mm cartridge, (Light Duty Ships Supply Input).  
 FS2-5 amp, QB, Ø5mm x 20mm cartridge, (Clutch output).  
 FS3-1,25 amp, QB, Ø5mm x 20mm cartridge, (Motor Supply logic).

### Absolute Maximum Ratings over Operating Temperature Range

(Operation at or above the Absolute Maximum ratings may cause permanent damage to the equipment.)

Maximum Supply Voltage: 32 volts DC  
 All input voltages (except NAV Port): -0.7 to +5.5 volts DC  
 NAV Port: -15 to +15 volts DC  
 (Nominal 0 to 5v)  
 Maximum motor drive current: Factory preset to 26Amp limit  
 Storage Temperature: -30 to +75°C  
 Operating Temperature (Ambient): 0 to 55°C

**Changing  
Software  
Eproms**

The software is stored in the EPROM, IC 11. To change the eprom, first disconnect any power to the Distribution Box. Remove the cover and internal RFI shield. IC11 is located in the centre of the PCB, replace the existing eprom with the new one, being certain that pin 1 is in the correct position (away from the motor connection block) and that no pins are bent or miss their socket. Refit the RFI shield and cover.

Restore the power supplies and turn the autopilot on. The display may show system fault '**F002**' to start with. If it does, switch the autopilot Off then On again and this should clear the condition. If it does not then almost certainly the eprom has not been fitted correctly.

**Switches**

There is an eight way DIL switch on the PCB which is used to change the way the Distribution Box functions. It is situated in the top right quadrant of the PCB with switch one (SW1) being nearest the centre of the board. The ON position is defined as when the switch is pushed up towards the FET's.

The functions of the switches are as follows:

**SW5**

Switch to the ON position when using a Rudder Feedback Unit that has no integral limit switches, i.e. 930 807.

Switch to the OFF position when using a Rudder Feedback Unit that has integral limit switches, i.e. 930 801.

**SW6**

Switch to the ON position when using a Rudder Feedback Unit that has no integral limit switches, i.e. 930 807.

Switch to the OFF position when using a Rudder Feedback Unit that has integral limit switches, i.e. 930 801.

**SW7**

Switch to the ON position when a Navigator with a single wire output is connected to the NAV1 port.

Switch to the OFF position when a Navigator with a two wire output is connected to the NAV1 port.

## TROUBLESHOOTING GUIDE

### IN AN EMERGENCY

Press the OFF key or switch the Light Duty Supply off to regain manual control.

1. Do not connect or disconnect wiring to the terminal blocks without first ensuring that the supply is turned off. Certain components will be seriously damaged if shorted out inadvertently.
2. When first installing or when changing the wiring always double check the colour coding before switching on the power.
3. Do not use a simple voltmeter to attempt to check powered up Digital logic lines or signal lines unless specifically described in the following discussion.
4. Ensure that all cable screens are properly earthed.
5. Check the fuses and replace blown ones with direct equivalents. Most units have one internal fuse, the Distribution Box has 3.
6. Take suitable precautions when handling PCB's with Static Sensitive Devices.
7. Read the 'Good Wiring Practice' advice in the 'Installing Your Autopilot' section earlier.

### Faults

1. The system will not power up.

### Possible cause and remedy

Check the power supplies to the Distribution Box.

In the Distribution Box PCB:

Check Fuse 1. Check the supplies from the Distribution Box (Brown and Violet wires at PORT B). Check that the link to the Brown wire, (is at 0V) when you turn the autopilot on, if not, then suspect fault in the wiring.

Check that the Violet wire is at +5V when you turn the autopilot on. If this is not so then a fault with the wiring or Distribution Box PCB is likely.

If new software has just been fitted, check the IC legs. Damaged legs will probably mean a damaged eeprom.

2. The display works momentarily then blanks or the keys stop working.

The Fail Safe Watchdog is causing system software to stop working. A fatal fault has been detected on the Distribution Box PCB. Remove the top cover and internal RFI shield from the Distribution Box. Visually check that the socketed IC's (IC13 MPU, IC11 Eeprom, and IC9 PGA) are installed

securely. Check for any loose material that may cause shorts.

3. System stops working for no apparent reason and cannot be restarted

See 1 and 2 above.

4. System stops working when radio transmitter or other RF device is keyed; or when a device needing current is operated (electric windlass, etc)

This could occur if RF energy is being injected into the power cables or by radiation injection into the pilot system components at very high levels. The autopilot has been exhaustively tested to withstand RF injection and radiation at levels far above those considered safe to personnel. Antenna mismatch yielding high SWR can cause dangerous conditions and in the interest of operator safety the radio installation should be inspected immediately.

A more normal problem to occur is that a Radio transmitter, or other high current unit, is being supplied from the same battery as the autopilot. When the device is operated, it may be causing the battery voltage to drop below that required to maintain the autopilot operation. Once power loss has occurred, the fail-safe watchdog has been designed to stop the system automatically. This would be particularly noticeable if the battery had a bad cell or corroded connections. It is recommended to supply the autopilot with power from a different battery to the other auxiliary requirements.

5. The autopilot powers up but displays System Faults which can be reset and do not immediately recur

This may happen very occasionally due to a momentary loss of synchronization during power up. The self test software reports all errors of this type to help anticipate potential problems. Unless this happens repeatedly it is of little concern.

6. The autopilot powers up but displays a System Fault which cannot be reset.

Normally this can be traced to a wiring error. System fault messages are explained and action to be taken is given, in "Error and Fault Messages" after this.



7. Autopilot engages but motor does not drive
- Check the heavy duty supply to the Distribution Box.  
In the Distribution Box:  
Check fuse FS3.  
Check that the relay (left rear of PCB) switches when going from STANDBY to PILOT (it can be heard). If it does not, suspect a relay fault or Regulator (REG2) fault. If it does, suspect a drive FET or logic failure on the Distribution Box PCB.  
If you suspect a faulty motor, test it by powering the motor directly from a suitable battery.
8. Motor drives one way only
- Centre the helm and retry to ensure you are inside the electronic limits.  
If using a Rudder Feedback Unit without integral limit switches, check that the DIL switches 5 & 6 in the Distribution Box are switched ON. If using a Rudder Feedback Unit with integral limit switches, check that the switches are working.  
Otherwise suspect a drive FET or logic failure on the Distribution Box PCB.
9. Motor drives both ways but lacks power.
- Low battery voltage.  
Motor cable or supply cable too small.  
Motor faulty. Check brushes etc.  
On hydraulic systems check hydraulic fluid level. On mechanical systems check that the Clutch output and Motor Clutch are working.
10. Motor drives hard over when autopilot is engaged
- Indicates a wiring error on either the Rudder Feedback Unit or the motor drive connections, probably in the Distribution Box and possibly the Phasing of them.  
Also check that the Rudder Feedback Unit arm has not become disconnected.

## ERROR AND FAULT MESSAGES

If your autopilot detects a problem with the system it will display a warning on the LCD.

### L O b A

- LOW BATTERY VOLTAGE

To clear the alarm, press any key.

Check the ship's battery and charging system.

### H d b A

- STEERING MOTOR SUPPLY FAILURE

To clear the alarm, press any key.

Check the supply to the motor.

Alarms 'EE10' and above are used by the optional Navigator Interface and are explained in the Navigator Control section.

### F 0 0 2

- BACK-UP MEMORY FAULT

To clear the alarm, press any key.

If this fails to clear the alarm refer to the Troubleshooting Guide.

### F 1 2 8

- RAM MEMORY ERROR

Autopilot will automatically switch to Standby Mode.

Press the AUTO or OFF key. If this fails to clear the alarm refer to the Troubleshooting Guide.

### F 1 2 9

- EPROM ERROR

Autopilot will automatically switch to Standby Mode.

Press the AUTO or OFF key. If this fails to clear the alarm refer to the Troubleshooting Guide.

### F 1 9 8

- RUDDER FEEDBACK FAULT

Autopilot will automatically switch to Standby Mode.

Press the AUTO or OFF key. If this fails to clear the alarm refer to the Troubleshooting Guide.

### F 2 2 4

- NO RUDDER MOVEMENT INDICATED

Autopilot will automatically switch to Standby Mode.

Press the AUTO or OFF key. If this fails to clear the alarm refer to the Troubleshooting Guide.

### F 2 2 5

- RUDDER FEEDBACK AMPLIFIER FAULT

Autopilot will automatically switch to Standby Mode.

Press the AUTO or OFF key. If this fails to clear the alarm refer to the Troubleshooting Guide.

**Navigator  
Alarms**

In the event of the Navigator indicating an alarm condition, the LCD on the Autopilot will show an error message.

To clear the error message, press the AUTO or OFF key. If the alarm clears, the autopilot will accept data. If the alarm condition still exists, turn the Navigator Control off and resumes autopilot control from the compass or manually steer the vessel.

**Note:**

The autopilot will hold the vessel on its present heading and will not accept any further changes from the Navigator until this error is cleared.

**EE10**

This indicates a Navigator alarm (loss of lock etc.) usually due to operation in weak signal areas. This message will reset automatically when the alarm situation clears.

**EE11**

This results from an internal message buffer overflow. This condition indicates that data is being received by the interface however the format or timing is incorrect. Check the Navigator set-up and wiring.

**EE12**

Indicates a loss of Navigator signal or an incorrect format. Check the Data output from the Navigator, check the connections between the Navigator and the main autopilot. The red LED Nav 1 in the Distribution Box flashes if data is received. If this message occurs repeatedly then suspect a bad wiring connection, noise on the data line or a fault in the Navigator.

This fault will reset automatically if the signal input is resumed. It should be noted that not all Navigator manufacturers adhere to the NMEA standard recommendations. If you suspect this may be causing a problem consult your Cetrek Dealer.

**EE13**

Indicates that no signals have been received by the Distribution Box at the NAV port. Check that the Navigator is sending data. An LED is provided on the PCB inside the Distribution Box (positioned in the top right quarter of the board, see the Installation Schematic) which flashes to indicate that data is being received on NAV input. If the LED is not flashing then no data is being transmitted from the Navigator.

Check the wiring. A two wire cable should be connected to the terminals SIG+ or SIG-. If you are in doubt about the signal polarity then reverse the connections. Normally a coax cable would be connected with the centre conductor to SIG+ and the outer conductor to SIG-.

**If You Need Assistance**

If you do ever need to contact your Cetrek Dealer or Distributor, it would save time if you could make a note of the following details for them:

Model Number :

Serial Number :

Software Version Number :

A description of the failure.

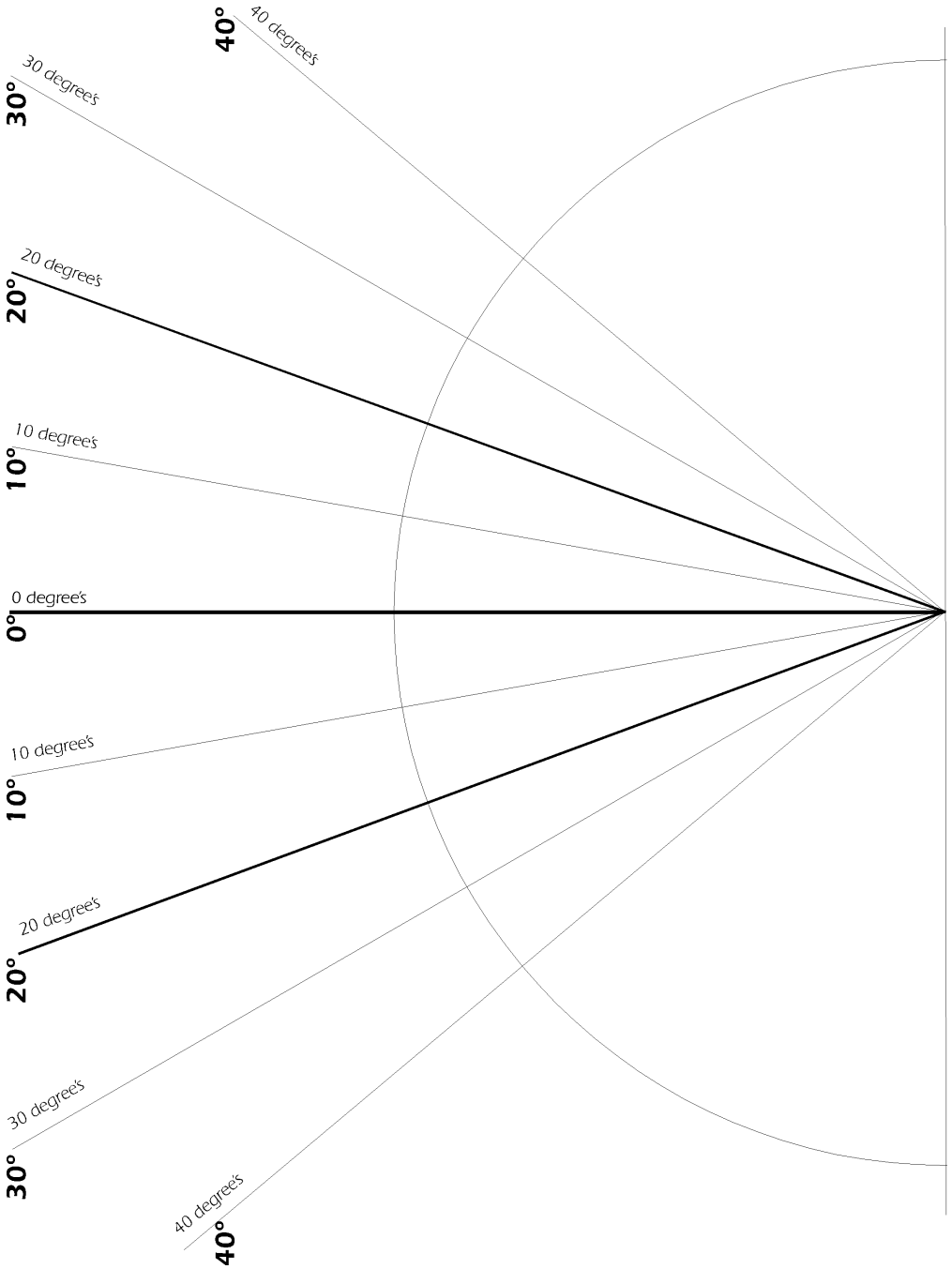


**Installation**

**Code of Practice**

In addition to the installation information contained within this manual, the "Code of Practice for Electrical and Electronic Installations in Boats", produced by the BMEA, is recommended as a useful guide.

BMEA - British Marine Electronics Association  
(A member of the British Marine Industries Federation)  
Meadlake Place, Thorpe Lea Road, Egham, Surrey, TW20 8HE





# INDEX

## A

Absolute Maximum Ratings ..... 29  
Alignment, of Compass ..... 20  
Automatic Deviation Correction .. 24, 27  
Autopilot Control ..... 5, 9

## B

Block Diagram ..... 29  
Boat Type ..... 20, 22

## C

Changing Software Eproms ..... 30  
Circuit Breaker ..... 7, 11, 13, 29  
Colour Coding of Cables ..... 13  
Compass  
    Alignment ..... 20  
    Damping ..... 21, 24  
    Sensor ..... 5, 8, 27  
Configuration Settings ..... 21  
Connections ..... 12  
Correction, Deviation ..... 27  
Counter Rudder ..... 21, 22  
Cross Track Error ..... 16, 17

## D

Damping ..... 21, 24  
DC supply ..... 12  
Deviation Correction ..... 27  
DIL switch ..... 15, 30, 33  
Dimensions ..... 6  
Displacement Vessel/Presets .... 22, 24  
Distribution Box ..... 5, 7, 8, 11, 12, 29  
Drive Units ..... 5, 7

## E

Error Messages ..... 34

## F

Fail Safe Watchdog ..... 31  
Fault Messages ..... 34  
Field Effect Transistor (FET) ..... 30, 33  
Front Panel Functions ..... 19  
Fuse ..... 7, 11, 12, 29

## H

Heavy Duty Supply ..... 7, 11, 12  
Hydraulic steering ..... 11

## I

Installation Schematic ..... 14  
Installation Settings ..... 20

## K

Key Functions ..... 19

## L

Light Duty Supply ..... 7, 12  
Light Duty Supply Switch ..... 12

## M

Magnetic Interference ..... 8  
Motor Phasing ..... 20, 25

## N

Navigator ..... 16  
    Gain ..... 21, 24  
    Interface ..... 23  
NMEA 0183 ..... 16, 18, 23

## O

Operating Temperature ..... 29  
Optional Equipment ..... 16  
Overshooting ..... 22

## **P**

### Phasing

Motor .....	11, 20, 25
Rudder .....	9, 20, 25
Planing Vessel/Presets .....	22, 24
Power Steer Gain .....	24
Preset Configurations .....	24

## **R**

Response .....	21, 25, 26
RFI (Radio Frequency Interference) .....	11, 30
Rudder	
Angle Template .....	37
Deadband .....	21, 22
Limit .....	21, 22
Phasing .....	9, 20, 25
Rudder Feedback Unit .....	5, 7, 9, 20

## **S**

Sea Trials .....	25
Semi-displacement Vessel/Presets .....	22, 24
Software, changing .....	30
Solenoid Drives .....	15
Standing Helm .....	23
Steel Vessels .....	8
Storage Temperature .....	29
Supply .....	7, 8, 11, 12, 15, 29
Switches .....	30
System Faults .....	21, 31, 32

## **T**

Temperature .....	29
Transmitting aerials .....	11
Trim .....	17, 21, 23, 26
Troubleshooting .....	31

## **W**

Waypoint(s) .....	16, 17, 18
Wiring .....	11, 13, 15