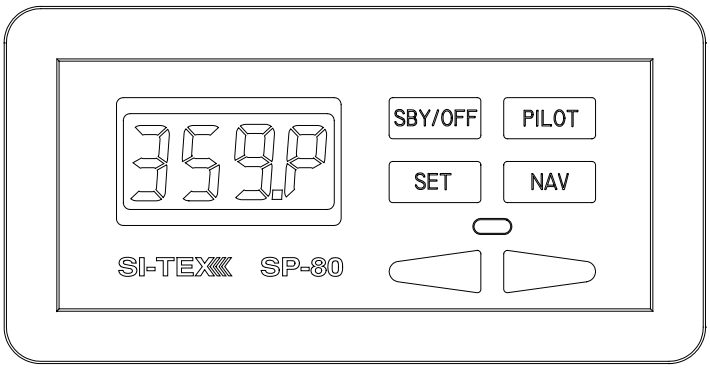
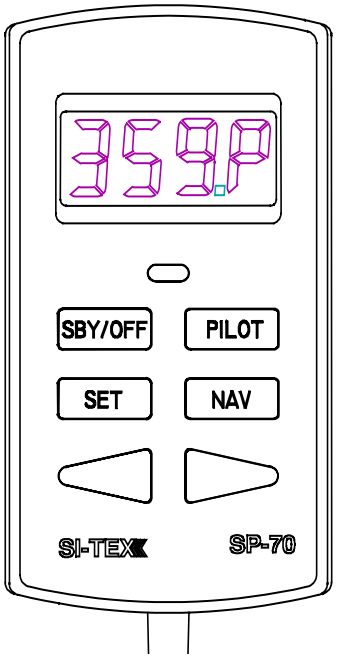
SI-TEX MARINE ELECTRONICS INC

INSTALLATION and OPERATION MANUAL
SI-TEX SP-70 AND SP-80 AUTOPILOTS



SI-TEX SP-80 AUTOPILOT

SI-TEX SP-70 AUTOPILOT



WARNING

This Autopilot will automatically steer your vessel, however, it is only an aid to navigation. Its performance can be affected by many factors including equipment failure, environmental conditions and improper handling or use. This system does not reduce your responsibility for the control of the vessel when underway. You must always be in a position to monitor the course, supervise the Autopilot, and resume manual control if the need to do so arises.

Whenever underway, your vessel must be under the control of a qualified and alert person.

PRODUCT DESCRIPTION

SI-TEX SP-70 or SP-80 Autopilots are reliable, accurate and easy to use aids to navigation. They feature four operating modes, watertight design, and built-in navigation interface.

The 4 operating modes are:

- STANDBY MODE allows manual steering while displaying compass information.
- POWER STEERING MODE features push button steering control, and displays compass or rudder information.
- PILOT MODE steers to a constant heading.
- NAV MODE steers along a course line when the SP-70 or SP-80 is connected to an appropriate navigation device.

In both PILOT and NAV Mode, pressing the Red or Green Key allows use of the Dodge/Course-change feature.

To steer a constant heading, the SP-70 or SP-80 compares compass heading information with the course heading that is entered into memory. If the vessel is not on the correct heading, the Autopilot calculates the rudder position that will bring the vessel onto the correct heading. The Autopilot uses a drive unit to move the rudder. Information from the Rotary Feedback or Outboard Feedback is used to calculate new rudder positions and to verify that the steering system has followed the Autopilot commands.

When steering along a course line, both Autopilots use information from the compass to monitor the heading. They also use position information received in NMEA 0183 format from LORAN, GPS, or plotter. Using both of these inputs, the SP-70/SP-80 calculates a course to steer and keeps the vessel on the course line.

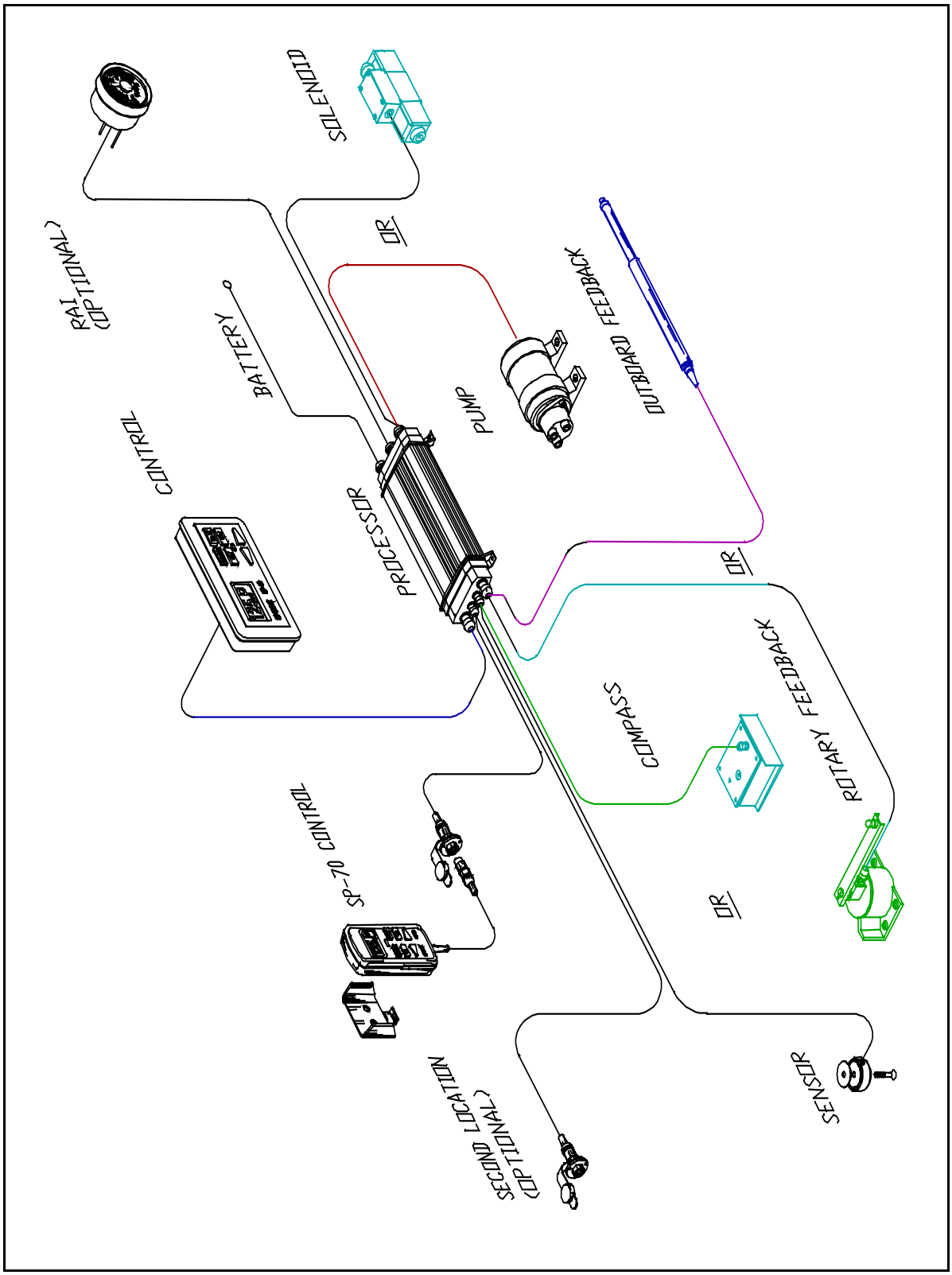
The SP-70/SP-80 contains a program called *Ghost Rudder.* Should the Rudder Feedback fail, the Autopilot will use its memory of the rudder movement to calculate new rudder positions. The *Ghost Rudder* program will not allow the Autopilot to steer as well as it can with the Rudder Feedback. It will allow the Autopilot to be used until repairs can be made to the Rudder Feedback.

The design of the SP-70/SP-80 includes many circuit protection devices such as; reverse power connection protection, output circuitry overload protection, protection against overheating, protection against computer failure or program error.

SPECIFICATIONS

Voltage: 10VDC - 40 VDC
Steering Outputs: 20 Amperes Maximum

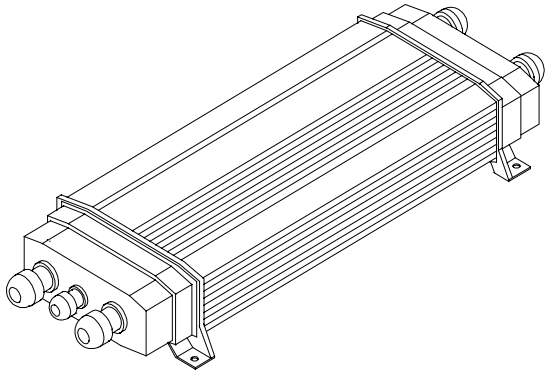
Sizes	**L X W X H**
SP-70 Control:	2.75 x 5.13 x 1.0 in. (7.0 x 13.3 x 2.5 cm.)
SP-80 Control:	6.0 x 3.1 x 1.0 in (15.4 x 7.9 x 2.5 cm)
Processor:	6.3 X 15 X 2.7 in. (16.0 x 38.1 x 6.9 cm.)
Compass:	5.6 x 4.2 x 3.4 in. (14.2 x 10.7 x 7.6 cm)
Pump:	4.8 x 7.5 x 4 in. (12.2 x 19.0 x 10.2 cm.)



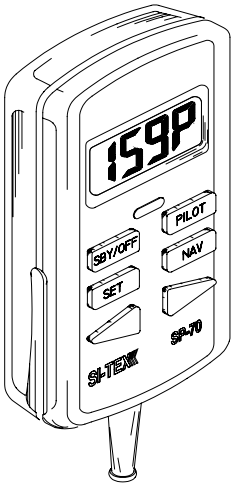
SP-70/SP-80 System layout

SI-TEX SP-70/SP-80 PARTS LIST

Parts are not drawn to any scale.

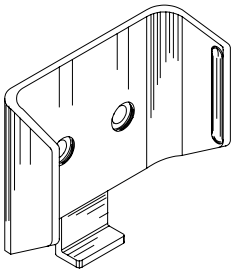


Si-Tex Processor: Part Number 30080003. Used on both SP-70 and SP-80 Autopilot packages.

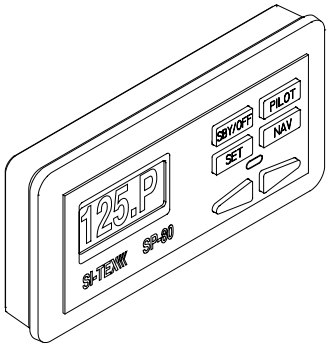


FOR SP-70 AUTOPILOT PACKAGES

SP-70 Control Unit. Part Number 20080009. This part includes a curly cord wired to the Control Unit.

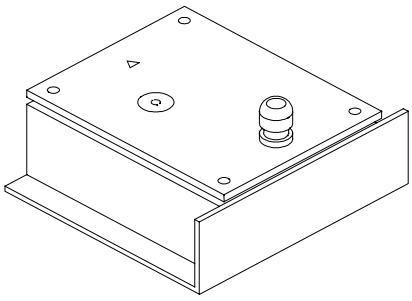


SP-70 Control Unit Clip and Spacer. Part Number 65610010.



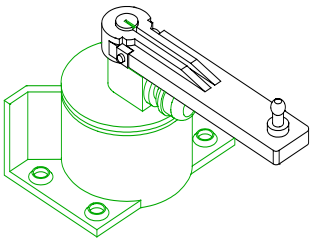
FOR SP-80 AUTOPILOT PACKAGES

SP-80 Control Unit and Mounting Bracket. Part Number 20080011. This part includes a 25 foot (7.7 meter) cable wired to the Control Unit.



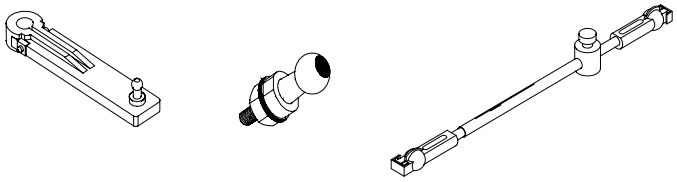
SP-70/SP-80 Fluxgate Compass. Part Number 20320003. This part includes 40 feet (12.2 m) of cable wired to the compass.

In this group, one part **OR** the other part will be included:

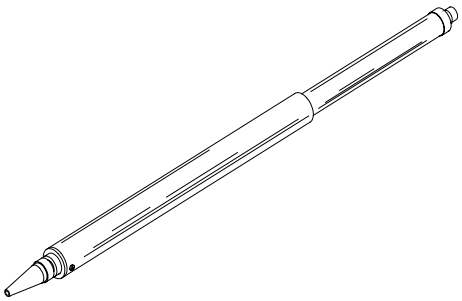


Rotary Rudder Feedback: Part Number 20330008. This part includes 50 feet (15.2 m) of cable wired to the Rudder Feedback. This part will always come with:

Rotary Rudder Feedback Linkage Kit.
Part Number 20330007



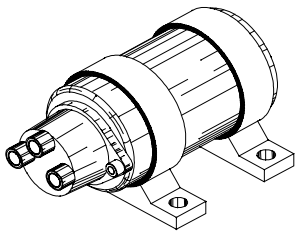
OR



Outboard Feedback: Part Number 20330002. This part includes 30 feet (9.1 m) of cable wired to the Rudder Feedback.

Also included but not drawn:

- Power Cable: Seven and a half feet (2.3 m) of cable provided for connection of Processor and breaker.
- Accessory Kit: Contains a small screwdriver, extra terminal sockets and gland.
- Control Unit Interconnection Cable (SP-70 systems only): 10 feet (3.05 m) of cable with a receptacle and cap on one end. Labelled as cable one.
- Si-Tex SP-70 and SP-80 Autopilot Manual. Part Number 29010049.



Adjustable Reversing Pump. Part Number 20810016 (12VDC/18CI), 20810031 (24VDC/18CI), 20810018 (12V/30CI) and 20810035 (24V/30CI). 18CI pumps are for installations where the steering ram size is from 7 in^3 (115 cm^3) up to 18 in^3 (295 cm^3). 30CI pumps are for installations where the steering ram size is from 15 in^3 (245cm^3) up to 30 in^3 (490 cm^3).

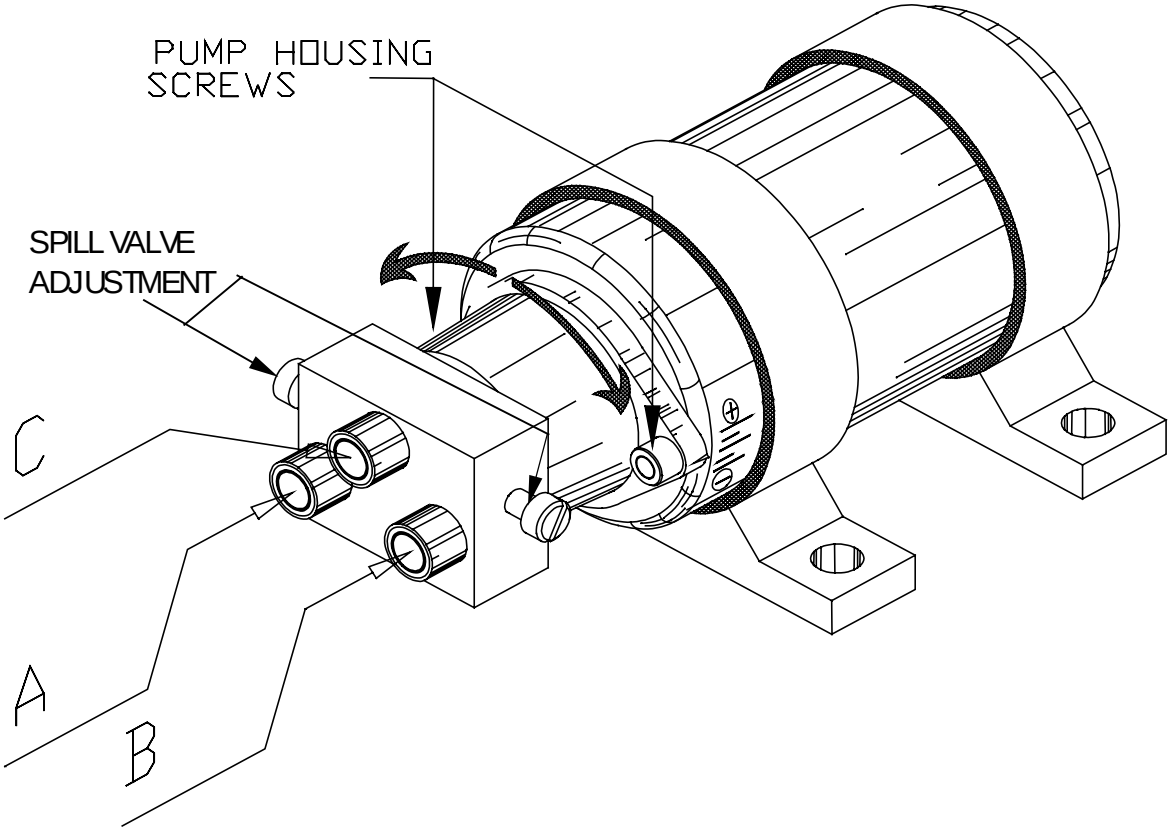
INSTALLATION INSTRUCTIONS

SI-TEX MARINE REVERSING PUMP

Part Nos. 20810016, 20810031, 20810018 & 20810035

GENERAL:

The reversing pump consists of a hydraulic pump and a motor. The pump is a piston type, driven by a reversing permanent magnet motor. The pump is designed in such a way that it will keep oil from returning through the pump when is not running or correcting. There is also a bleed-to tank to allow the use of unbalanced cylinders. The pump is compatible with all hydraulic steering systems including pressurized steering systems such as Hynautic.



To adjust flow rate, loosen pump housing screws and turn pump housing. Clockwise will decrease flow rate, anti-clockwise to increase flow rate.

Part Nos. 20810016(12V) & 20810031(24V) 18CI Pumps

The pumps above can be ordered with a 12VDC or 24VDC motor and have an adjustable flow rate that will deliver from 36 in^3 to 73 in^3 (600 cm^3 – 1200 cm^3) per minute of oil at 500 PSI (3,440 kPa) (34 Bar). It is suitable for rams with displacements ranging from 7 in^3 (115 cm^3) to 18 in^3 (295 cm^3) displacement.

Part No. 20810018(12V) and 20810035(24V) 30CI Pumps

The pumps above can be ordered with a 12VDC or 24VDC motor and have an adjustable flow rate that will deliver from 61 in^3 to 122 in^3 (1000 cm^3 – 2000 cm^3) per minute of oil at 500 PSI (3,440 kPa) (34 Bar). It is suitable for rams with displacements ranging from 15 in^3 (246 cm^3) to 30 in^3 (495 cm^3) displacement.

***** IMPORTANT *****

If the system you purchased includes a reversing motor pumpset, it is important that you apply and install this unit correctly. To ensure that you get the most from your purchase, read this installation and instruction manual carefully. By following the step-by-step procedure and using only basic tools and materials, you will find the installation easy to do.

Caution

This Pump is not waterproof and is therefore not warranted against water damage.
This Pump is not warranted against damage caused by improper installation.

If you are installing this pump on a Capilano or Syten steering system, you probably have a 3-line steering system. Read the 3-line steering installation instructions carefully.

Tools And Materials Required To Install Pump

1) Basic Tool Kit
2) Pipe Cutter
3) Funnel with Filter (a coffee filter will do)
4) 3/8" Electrical Drill
5) 2 gallon (9 L.) bucket (to catch excess oil).
6) Rags or Paper Towels
7) Pipe Fittings **(check with steering gear manufacturer for type & size)**[1]
8) Tubing **(check with steering gear manufacturer for type and size)**[1]
9) Hydraulic Oil **(check with steering gear manufacturer for type)**[1]
10) Teflon based thread sealer (such as LOCTITE™ P.S.T.)
11) Miscellaneous Hardware (for mounting pump and securing lines)

1. Consult with your steering system manufacturer to get detailed information about factory authorized materials. Failure to do so could void your warranty.

Planning

Installation of the pump consists of:

- Finding a mounting location for the pump
- Partially draining the steering system
- Mounting and connecting the pump to the existing steering lines
- Filling and bleeding the steering system.

A suitable mounting location for the pump MUST:

- Be dry
- Be lower than at least one of the helm pumps in the steering system
- Provide a solid mounting base
- Be at least 4 feet (3.1 m) from the vessel's compass.

A mounting location for the pump SHOULD:

- Provide easy access to the pump
- Provide an easy connection point to the steering system
- Minimize the length of the pump hoses
- Minimize the length of the wires to the motor.

A typical mounting location would be in the engine compartment or the steering console.

The pump can be mounted in any orientation except with Port C facing downward. If Port C is facing downward then air will not be able to rise out of the pump and the pump will not have a supply of oil.

There are two ways to connect the pump to the steering system. The first is to leave the system completely filled and be careful not to spill hydraulic fluid. The second is to drain the system of fluid completely before cutting or opening any lines.

If you follow the first method, remember that when you disconnect or cut the steering lines, there will be a constant slow discharge of oil due to gravity draining the system. Have a container ready to catch all excess oil. Do not reuse any oil reclaimed from your system.

Draining your System

If you wish to follow the second method and drain the system, use the following simple procedure.

1. Have a large container, about 2 gallons, ready.
2. Disconnect the delivery lines at a low point, usually where the lines connect to the steering cylinder.
3. Turn the wheel of the highest helm pump in both directions until no more fluid comes out of the lines.
4. Repeat the previous step on each lower helm pump in turn.

Types of Steering Systems

There are two general types of steering systems, two-line systems, and three-line systems. The pump connection to the steering system is different for each type. Separate instructions are supplied for both types of steering systems.

You have a *three-line system* if the helm pump is a Capilano Model 250 or 275 (Made by Teleflex), or if there is a Uniflow valve mounted close to the steering cylinder.

You have a *two-line system* if you do not have the above components in your system.

CAUTION

CLEANLINESS must be maintained while making hydraulic connections. Contamination introduced into the steering system fluid can cause steering components to malfunction, possibly resulting in a loss of steering.

Before beginning to connect the pump to the steering system, review the following installation hints:

- Cap or cover the ends of hoses with a clean rag before pushing them between bulkheads.
- Wipe copper filings off freshly cut and reamed copper tube. Do not blow the filings off.
- Teflon based thread sealer, such as 'LOCTITE™ P.S.T.' must be used on all male pipe threads. Do not place thread sealer on the first two threads. Do not use a tape-type thread sealer. These can shred and enter the steering system fluid.

Do not place thread sealer on female pipe threads.

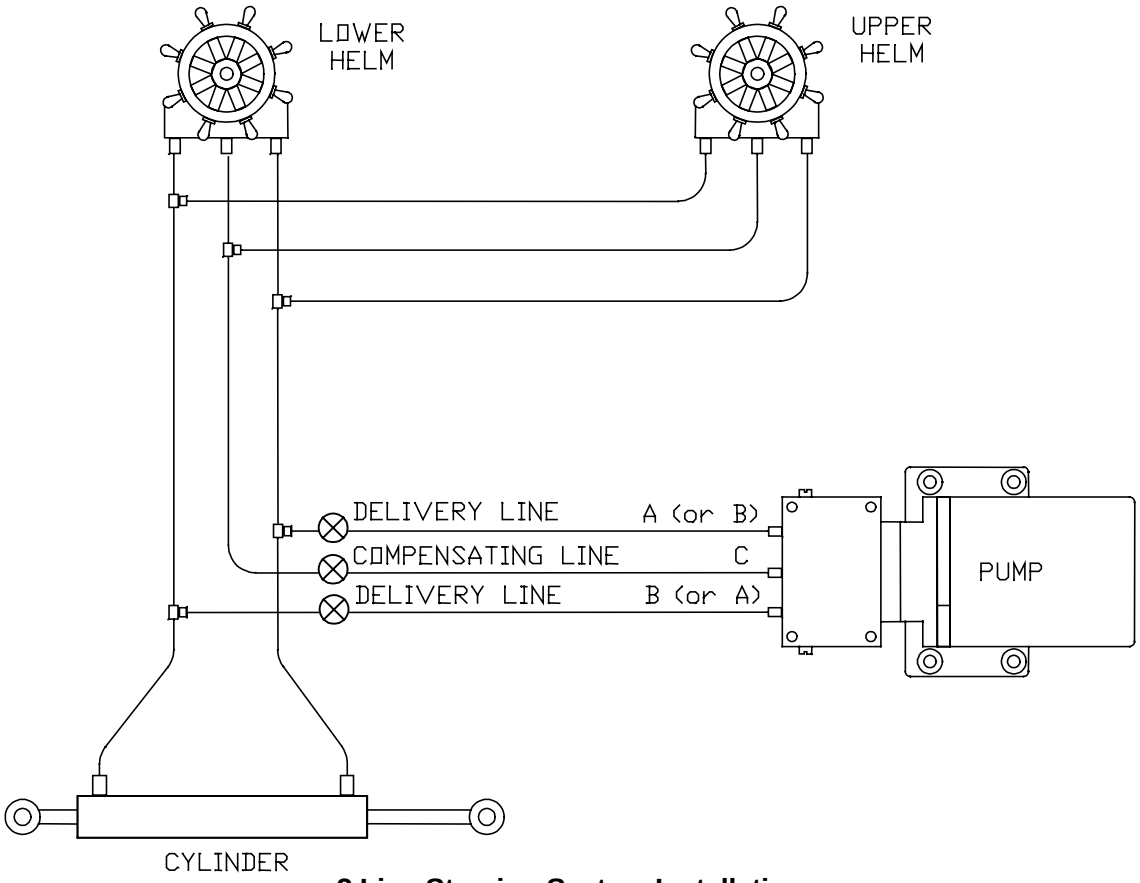
- When tightening fittings into the pump lockvalve, hold the lockvalve, not the motor. That way, the lockvalve will not twist out of alignment with the rest of the pump.
- Connection of the pump lines is most easily made at existing breaks in the steering system lines. For example: valves, t-joints and other fittings.

CAUTION

Opening your hydraulic steering system will introduce air into your steering system. This air will be expelled if the steering system is bled properly. After you refill your system and during the "Set-up Routine", your autopilot can be used for bleeding the air. Ensure that you follow the Compensating Line installation instructions very carefully as all air is expelled through this line when bleeding your system. If the Compensating Line does not prime properly and allow fluid to get to the autopilot pump, the pump will not perform properly. The Compensating Line does not have to be a high-pressure hose. In fact, even a clear hose can be used allowing for easy visual confirmation of proper Compensating Line operation.

Hydraulic Connections For Two-Line Steering Systems

A simple schematic of the pump installation is shown below.



2 Line Steering System Installation

Delivery Lines:

Ports A and B in the diagram above are the input/output ports of the pump and must be connected to the steering lines coming from the steering cylinder. It does not matter which pump port is connected to which steering line.

Compensating Line:

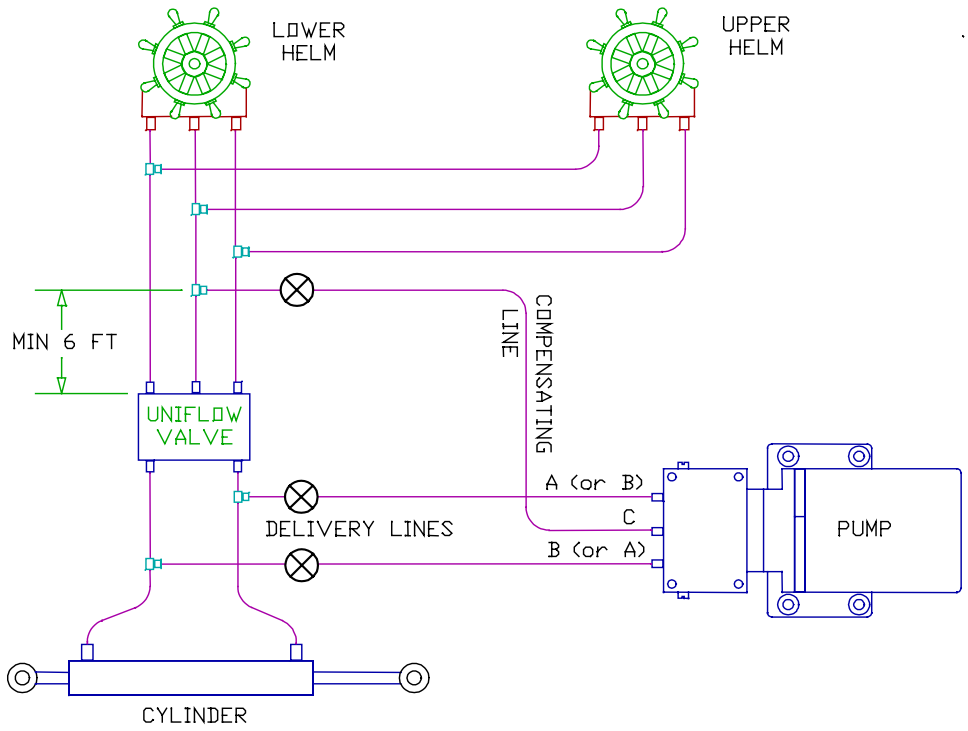
In the above diagram **Port C** is the compensating or bleed line, and must be connected to the steering system's reservoir. This connection can be made at: a helm pump; remote reservoir (if there is one); the compensating line connecting two helm pumps; or the compensating line connecting a helm pump to the remote reservoir. If the connection is being made directly to the helm pump, ensure that the bleed line is connected to the **LOWER** helm bleed port.

The compensating line *MUST* have a gradual rise from the pump, to the connection, to the steering system. This allows air to rise out of the pump, ensuring a constant supply of oil to the pump.

INSTALLATION OF SHUT-OFF VALVES RECOMMENDED

Hydraulic Connections For Three-Line Steering Systems

A simple schematic of the pump installation is shown below.



3 Line Steering System Installation

Delivery Lines:

In the above diagram, **Ports A and B** are the input/output ports of the pump and must be connected to the steering lines between the steering cylinder and the Uniflow valve. The simplest method of doing this is to install a tee in each of the cylinder ports of the Uniflow valve itself and connect to these tees. It does not matter which pump port is connected to which steering line.

Compensating Line:

Port C is the compensating or bleed line and must be connected to the steering systems' reservoir. This connection can be made at a helm pump; a remote reservoir (if there is one); the return line connecting two helm pumps; or the return line between a pump and the Uniflow valve. If the connection is being made directly to the helm pump, ensure that the bleed line is connected to the *LOWEST* bleed port of the pump.

The connection *MUST* be at least six feet (1.83 m) from the Uniflow valve as shown above. If the connection is too close to the Uniflow valve, the manual steering system may not work well.

The compensating line *MUST* have a gradual rise from the pump, to the connection, to the steering system. This allows air to rise out of the pump, ensuring a constant supply of oil to the pump.

⊗ **INSTALLATION OF SHUT-OFF VALVES RECOMMENDED**

Re-Fill And Bleed

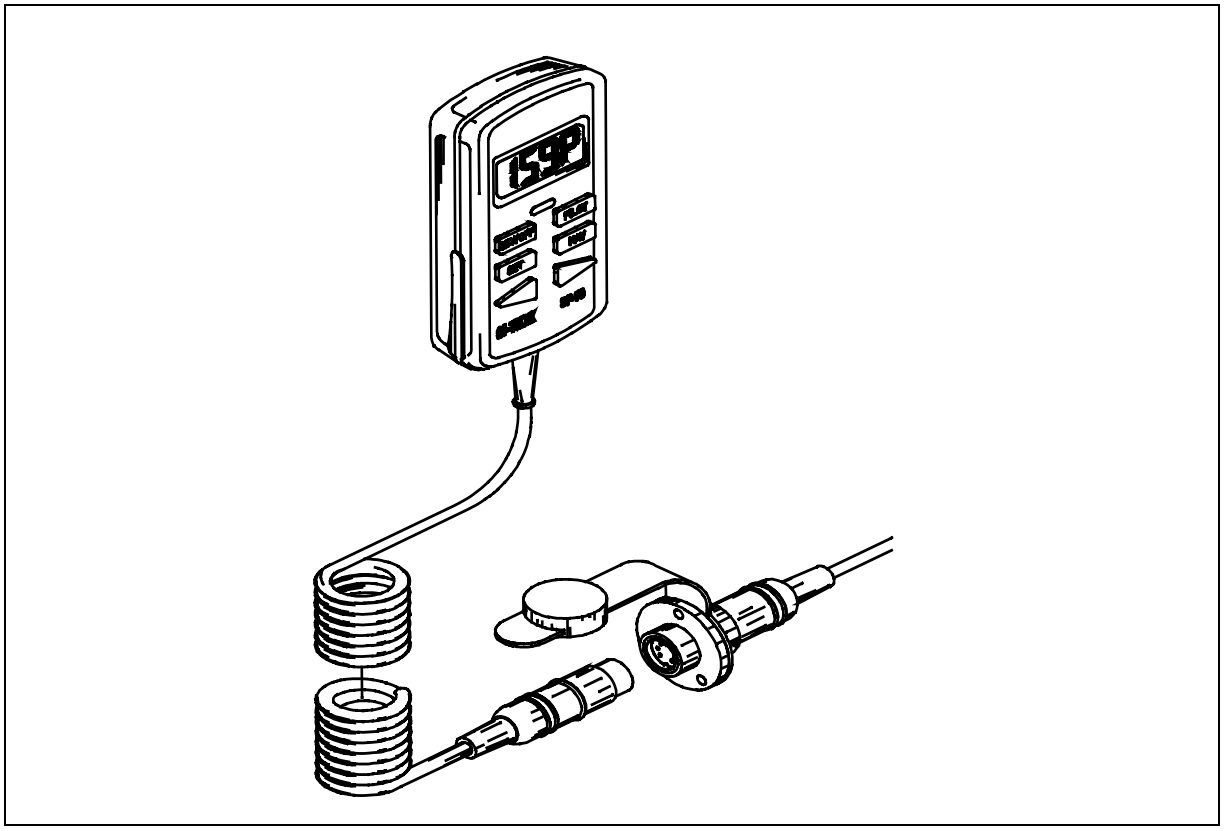
After you have installed your Pump, refill and bleed your manual steering system according to the manufacturer's directions. Any air, which is in the pump, will be expelled during the Set-up Routine.

Technical Specifications

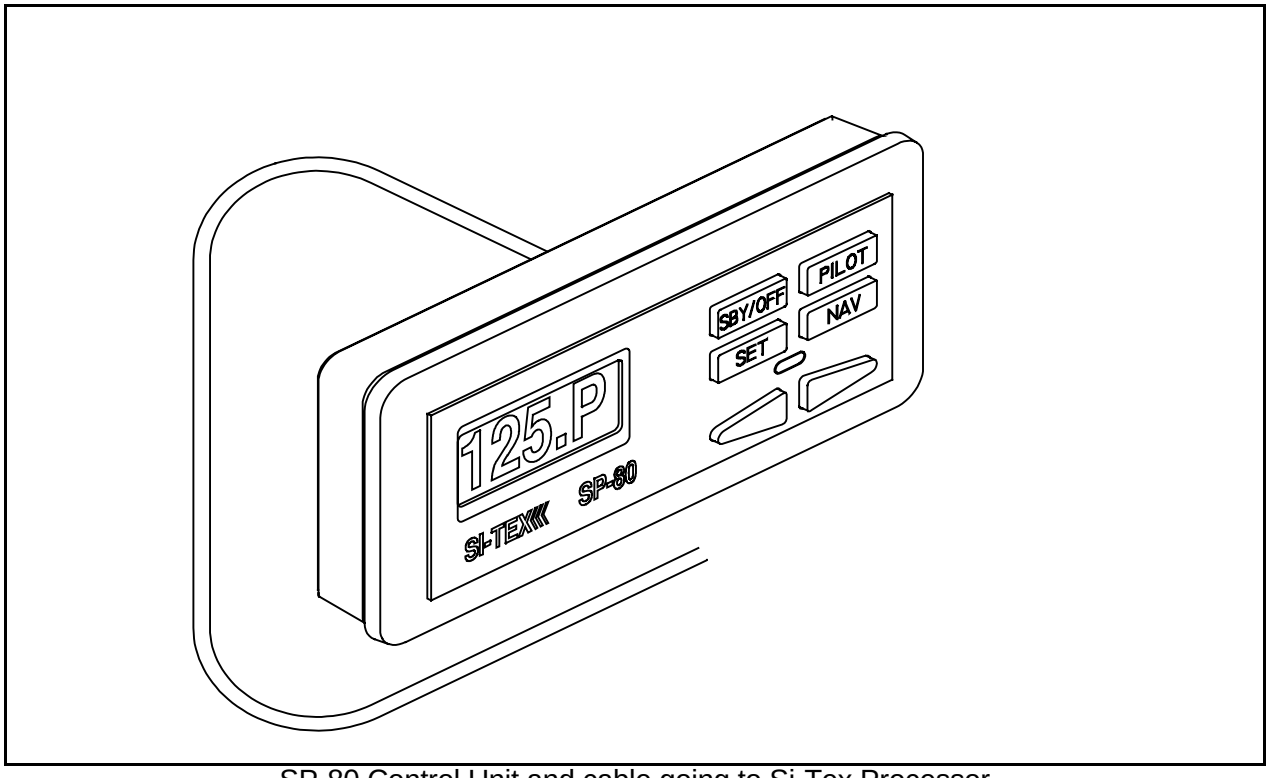
Part Number:	20810016	20810031	20810018	20810035
Model Number:	18CI	18CI	30CI	30CI
Operating Voltage:	12VDC	24VDC	12VDC	24VDC
Max Displacement @ 200PSI:	73 in^3	73 in^3	122 in^3	122 in^3
Current @ 200 PSI:	4.5 Amps	3.0 Amps	6.0 Amps	3.0 Amps
Max Pressure:	800 PSI	800 PSI	500PSI	500PSI

Specifications Common To Both Pumps

Port Sizes:	- 3/8 inch compression fittings supplied
Displacement (18CI):	- Adjustable, from 26in^3 (600cm^3) to 73in^3 (1200cm^3)
Displacement (30CI):	- Adjustable, from 61in^3 (1000cm^3) to 122in^3 (2000cm^3)
Min Stall Pressure:	- 1200 PSI (84.0 Bar) (8,268 kPa)
Oil Type:	- Any approved hydraulic steering fluid
Operating Temperature:	- 0 to 50 Degrees Celsius (32 to 122 Fahrenheit)
Lockvalve:	- Yes
Lockvalve Leakage:	- Negligible
Unbalanced Cylinder:	- Yes, up to 3/4 (1.9cm) diameter rod
Weight:	- 5.0 lbs (2.27 kg) including wire
Size:	- 10 inches x 3.75 inches x 4.75 inches
Size (metric):	- 254mm x 95mm x 121mm
Shaft Seal:	- 100 PSI (6.89 Bar) (689 kPa) minimum



Connection between SP-70 Control Unit and Receptacle on Cable Number 1



SP-80 Control Unit and cable going to Si-Tex Processor

INSTALLATION INSTRUCTIONS

SP-70 and SP-80 AUTOPILOTS

Planning

Caution

Using ordinary electric tools near water is very dangerous. To minimize the dangers of electric shock and personal injury, we recommend using cordless rechargeable tools or hand tools.

Processor Location

Allow at least a foot or 30 cm of clearance on either end of the Processor in the space where it is to be located.

In choosing a location for your SI-TEX SP-70/SP-80, remember that the Control Unit Interconnection Cable or Number 1 Cable, and the cable from the Compass to the Processor should not be cut or lengthened. Excess cable may be loosely coiled behind a panel.

Number 1 Cable from the SP-70 Control Unit Receptacle to the Processor is **10 feet long (3.05 metres)**. Number 1 cable from the SP-80 Control Unit to Processor is **25 feet long (7.7 metres)**.

The cable from the Compass to the Processor is **40 feet long (12.2 metres).**

You will want to have the Control unit near the steering station you use the most. On SP-70's try to position the Receptacle so that the curly cord will also reach other convenient locations such as the place that you use when docking your vessel.

If you are going to use a sealant when flush mounting the SP-80 Control Head, be careful to not cover the small square hole in the middle of the bottom side. This hole must vent to atmosphere.

Do not mount the Processor near heat sources, such as heat radiators, or over engines. If you can, mount the Processor so that the cooling fins are vertical.

Power Connection

There is a **7.5 foot (2.3 metre) power cable** included with your SI-TEX SP-70/SP-80. We recommend that you do not lengthen this cable.

If you must extend the cable:

- Use the smallest extension length possible.
- Use no less than 10 A.W.G. ($6mm^2$) conductor. Splice and solder the joints.
- The extension must be less than 10 feet (3 metres).
- Make the joints watertight by using heat-shrink tubing and silicon, or some other watertight covering.

Grounding

The Power Cable also contains a grounding wire. Connecting this wire to a proper ground (*see below) may reduce static on radios and improve LORAN reception.

Many different grounding connections could be used:

1. If you have a small vessel, the negative battery post can be used.
2. If you have several electronic instruments, each could be individually attached to the battery post. Do not connect one instrument to another instrument and then to the post.
3. If you have a ground plane for a radio on your boat, connect the ground wire to that ground plane.

**A proper ground connection point must be at the same voltage potential as battery negative. Any voltage difference between battery negative and the ground point may indicate a problem and the ground wire should not be used. Ensure that connection wires are as short as possible and that connections are clean.*

Compass Location

When choosing a location for the Compass, try to locate it as close as possible to the most stable spot on your boat. Usually this spot will be close to the water line level, in the middle of the boat and two-thirds towards the stern from the bow.

Do not install your Compass near wires or devices carrying large electric currents such as battery chargers, electric pumps, motors or televisions.

Do not mount your Compass near any iron or steel objects.

Tools

You will need the following tools to install your SI-TEX Autopilot:

SCREWDRIVER: One Phillips and one medium slot screwdriver

WIRE CUTTERS: A pair of ordinary wire cutters suitable for general work around your house.

DRILL and a selection of DRILL BITS

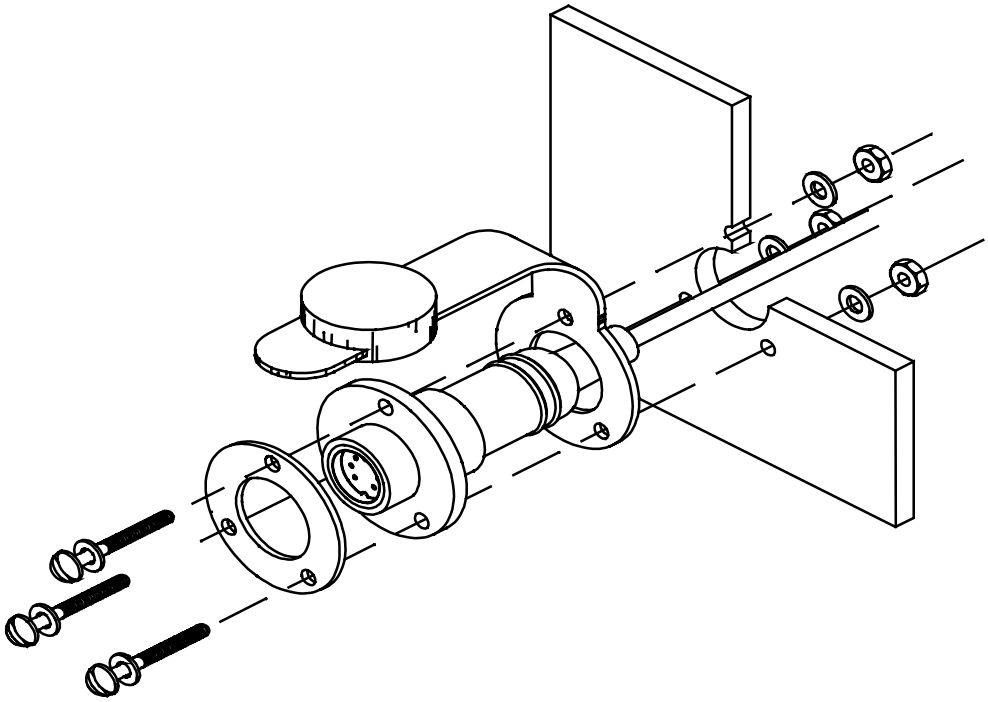
SMALL ADJUSTABLE WRENCH

If you purchased a SP-70 or SP-80 with a Rotary Rudder Feedback you may need **one stainless steel band clamp** which is more than large enough to fit around your rudder post.

You may also wish to have a supply of tie wraps for securing cable lengths and tools specific to your own boat.

SP-70 Receptacle Installation

The Receptacle is attached to the Number 1 cable. The diagram to the right shows the Receptacle mounted in a panel.



Cable 1 Receptacle Installation

Mount the receptacle near your normal steering position. The curly cord on the Control Unit lets you move about 5 feet away from the Receptacle.

A stainless steel ring is placed between the bolt heads and the receptacle flange. Do not attempt to seal the receptacle by over-tightening the bolts as the ring will deform the receptacle and interfere with plug insertion. A proper caulking compound or sealant should be used instead. The three bolts should only be tightened enough to compress the lock-washers, no more. As the plug has a tight seal, and insertion into the receptacle may be stiff, a lubricant has been included in your package.

Hole sizes:
Hole for receptacle: 0.825 inches or 21 mm in diameter.

Use the barrel of the Receptacle to mark holes for the flange.

Holes in the flange are for a number 6 (3mm) screw. You may wish to vary this size depending upon the panel material.

Clip Installation

The Clip is used for mounting the Control Unit. The Clip is mounted with two number 10 (5mm) screws or bolts.

The usual mounting location is on the dashboard within easy reach when you are steering your vessel.

Power Cable Installation

The Power Cable is labelled with a "5". Connect the Power Cable to a breaker capable of supplying twenty Amperes.

CAUTION

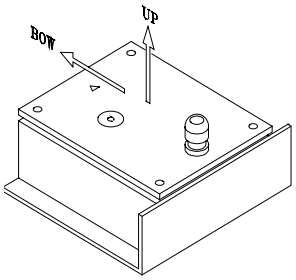
Keep the breaker turned off or do not connect the cable to the breaker.

Use the white wire for battery positive from the breaker. Use the black wire for battery negative. The green wire is a grounding wire.

Extending the cable is not recommended. If you must extend it, see page 23 for guidelines on proper extension techniques.

Route the supplied Cable to the Processor location.

Fluxgate Compass Installation



Fluxgate Compass

The fluxgate compass must be correctly positioned or it will not work.

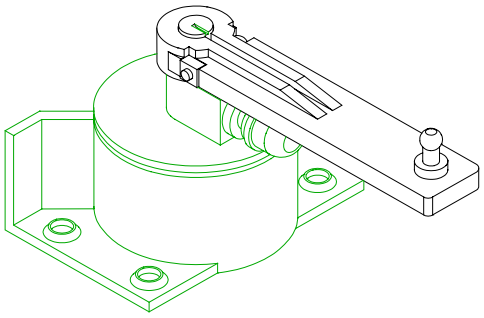
To correctly position the Fluxgate Compass, mount it so that the surface with the cable gland is up. On the top surface there is an arrow labelled "bow". The arrow must point in the same direction as the bow of your boat. In cases where the compass is mounted on a side wall, the bow line arrow may be ± 90 degrees out of alignment. Remove the four top housing screws and rotate the housing ± 90 degrees. **Warning: This unit comes from the factory watertight. Be careful with seals and "O" rings if you remove the housing.**

Initially, mount your Fluxgate Compass using strong adhesive tape or some other temporary, non-marking fastener. Coil any excess cable at the Compass location rather than at the Processor. It may be necessary to relocate your compass after you have done the "Set-up Procedure".

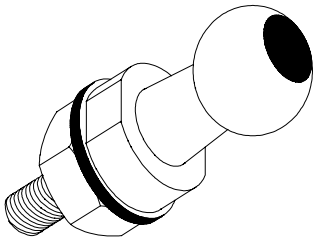
Rotary Rudder Feedback Installation

If you have purchased a SP-70 or SP-80 with an Outboard Feedback, please see the instructions titled, "Outboard Feedback".

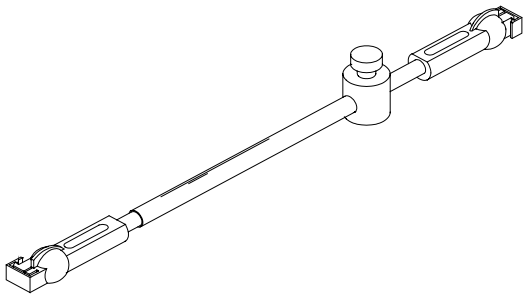
Select the following parts from your SP-70 or SP-80 package:



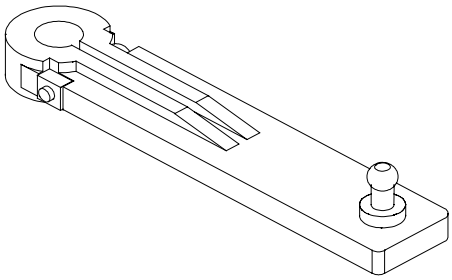
RUDDER FEEDBACK



BRASS BALL JOINT
(INCLUDED WITH LINKAGE)



LINKAGE



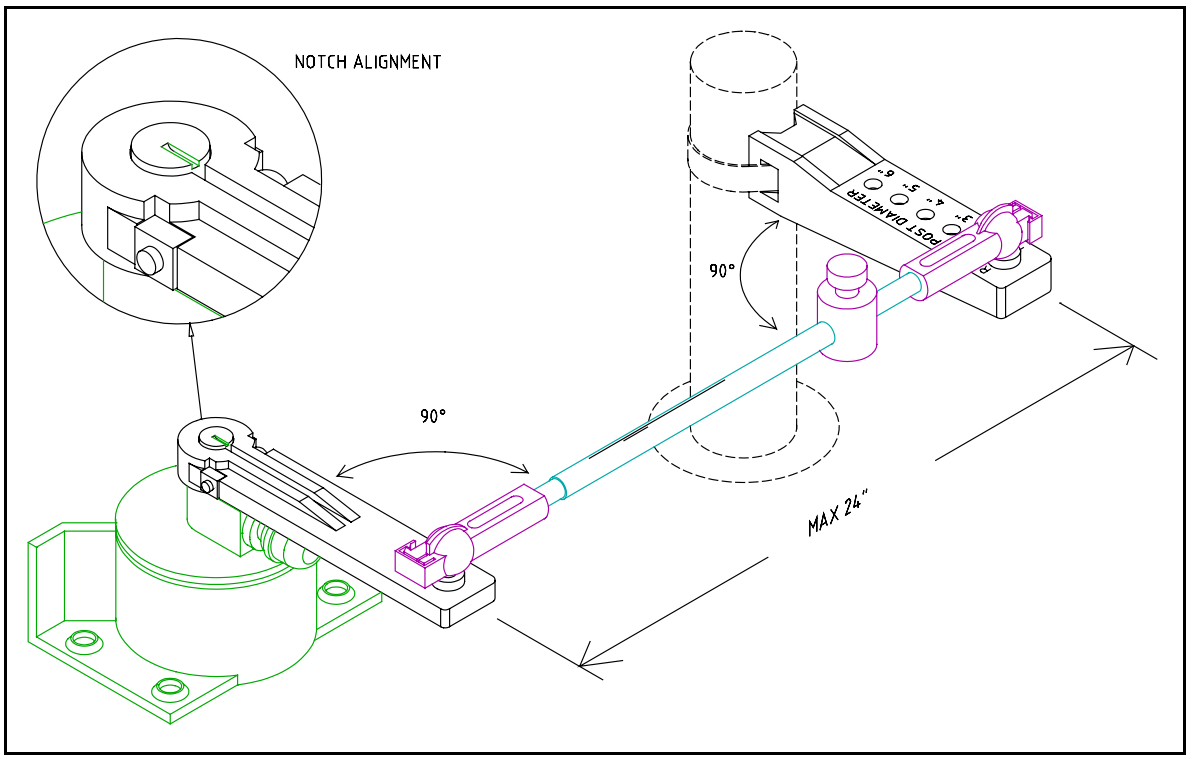
RUDDER ARM

You may also need:

- One **stainless steel band clamp** to hold the Rudder Arm to the rudder post.
- **Four screws:** #10 size (5 mm), suitable length.

Install the Rudder Feedback Assembly in the stern of the vessel, close to the rudder post. Place the Rudder Feedback so that it will be protected from objects which may shift position when your boat is moving.

Mounting the Rudder Feedback



Rudder Feedback correctly installed to rudder post

In the diagram above notice that:

- the Rudder Feedback Arm is above the cable entry gland;
- the Linkage sockets are on the top of the ball joints. *Do not hang the Linkage from the ball joints.*

Mount the Rudder Feedback so that the Rudder Feedback Arm and the Rudder Arm:

- are at the same height and
- separated by less than 24 in. (60.9 cm) center to center, and
- each makes an angle of 90 degrees with the Linkage.

To correctly align the Rudder Feedback and the Rudder Arm, you may need to make a mounting base for the Rudder Feedback. Such a base must be firm. It should not flex when the vessel is moving.

Use the Rudder Feedback as a template to drill holes in the mounting surface. If you must drill new holes in the flange at the back of the Rudder Feedback, drill the Rudder Feedback flange first, and then use it as a template to drill holes in the surface.

Mount the Rudder Feedback using # 10 (5 mm) screws or bolts of suitable length.

To Assemble the Rudder Feedback Arm

Measure the approximate diameter of your rudder post in inches.

The Rudder Arm has several holes drilled through it. The holes are marked by numbers on the top surface of the arm.

Select the hole on the Rudder Arm marked by a number equal to the diameter of your rudder post measured in inches. (1 cm = 0.394 in.)

Bolt the Brass Ball Joint onto the Rudder Arm using the selected hole. The ball of the Brass Ball Joint must be on the same side of the Rudder Arm as the numbers. Tighten the nut and lock washer securely.

Attach the Rudder Post Arm to the rudder post using a stainless steel band clamp. The Brass Ball Joint must be on top. The Rudder Post Arm must be at the same height as the Rudder Follower.
The Rudder Post Arm must point straight ahead when the rudder is in the straight ahead steering position.

Attaching the Rudder Feedback Linkage.

Move the rudder so it is in the straight ahead position.

Move the Rudder Feedback Arm so that the Arm is directly above the point where the cable enters the Rudder Feedback.

Loosen the adjustment block that keeps the two pieces of the Rudder Feedback Linkage from sliding.

Snap the Rudder Feedback Linkage onto the two Brass Balls. Make sure to close the small release clamps on each Plastic Socket.

With the Rudder Feedback Arm directly above the cable gland and the Rudder Arm pointing straight ahead, tighten the adjusting block.

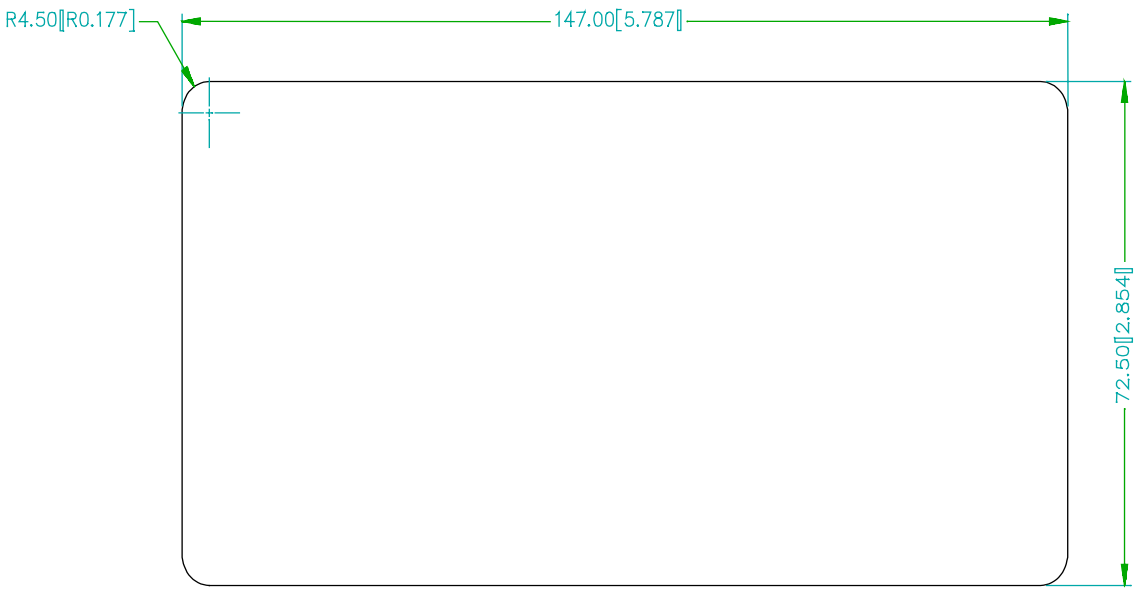
Caution

Carefully watch the Linkage while you move the rudder through its full range of motion. The Rudder Feedback and the Rudder Feedback Linkage should move easily without binding. The moving parts must not contact any other objects. If there are any problems, fix them now.

Run the Rudder Feedback Cable from the Rudder Feedback to the space where the Processor will be located. Place the Cable so that it is protected from abrasion, stretching and cutting.

Turn to the section titled: "Wiring the Processor".

Flush Mounting the SP-80 Control Head



Cut-out And Radius Dimensions for the SP-80

NOT TO SCALE

Outboard Feedback Installation

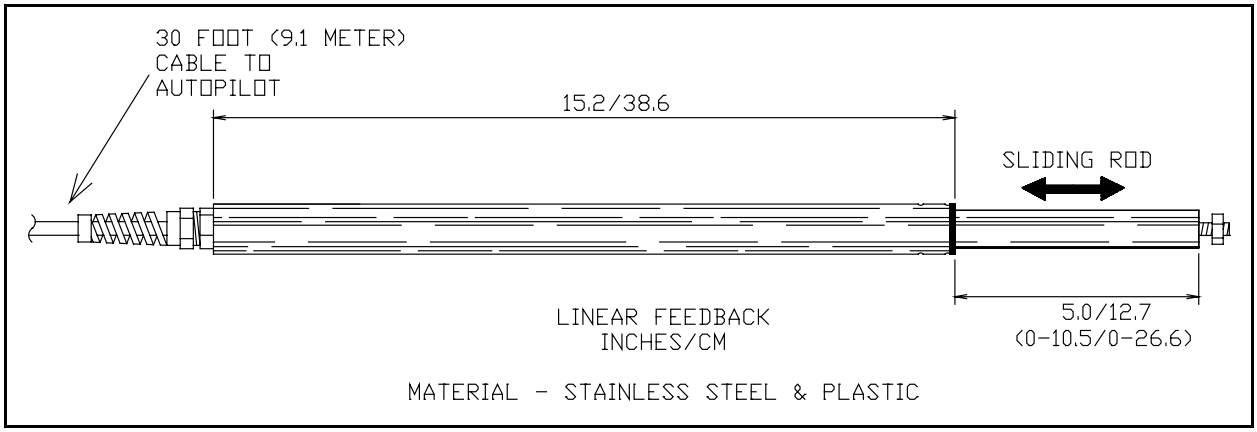
If you have a Rotary Rudder Feedback, see the section titled, "Rotary Rudder Feedback".
Introduction:

The Outboard Feedback sends information about the rudder or propeller position to the SP-70 or SP-80.

The Outboard Feedback can be attached to the hydraulic steering cylinder by using a stainless steel band clamp. A stainless steel bracket attaches one end of the Outboard Feedback to the steering cylinder rod.

The Outboard Feedback is provided with 30 feet (9.1 metres) of cable.

The Outboard Feedback can be used with hydraulic cylinders from 1.25 to 2.25 inches. (31.8 to 57.1 mm) in diameter. The cylinder stroke cannot exceed 10.5 inches (266 mm).

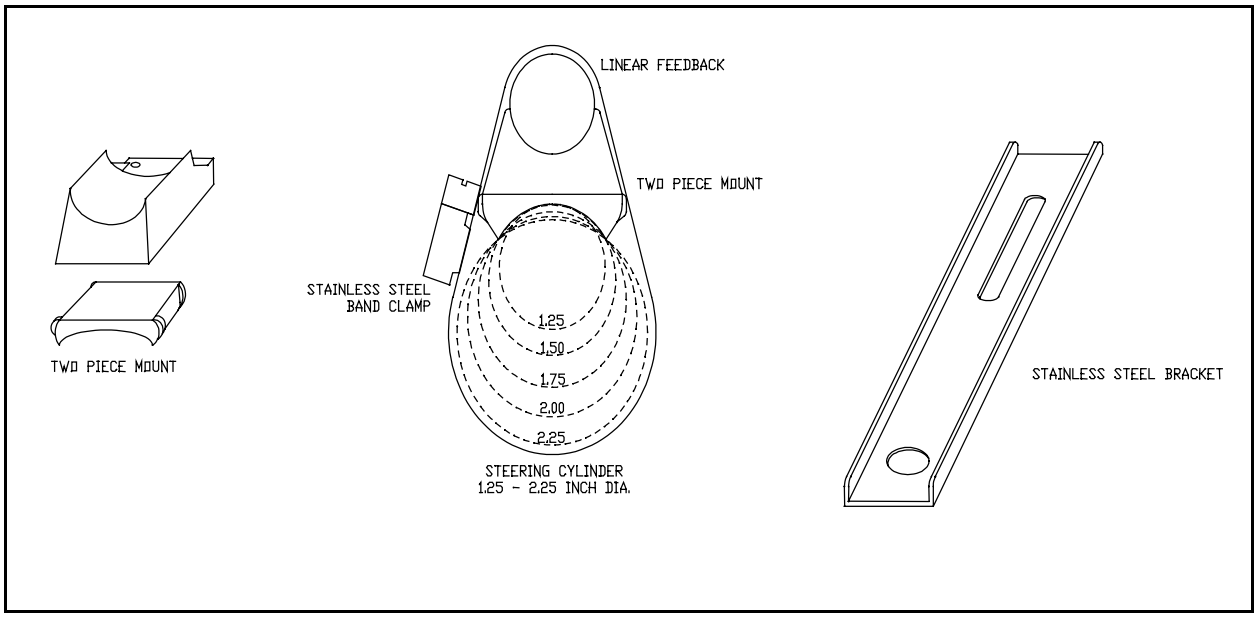


Outboard Feedback

Caution

The Outboard Feedback will be damaged if it is extended more than 10.5 inches. This damage will not be covered by warranty.

If necessary, the extended length of the steering cylinder can be limited using corrosion-resistant spacers as shown on page 36.



Mounting Hardware

Mount the Outboard Feedback so that it will not be damaged when the motor is tilted for trailering.

Installation

The Outboard Feedback may be mounted with the sliding rod facing either left or right.

Before you install the Feedback, move the steering gear through its full range of motion from one side to the other. Measure the change in length, of the hydraulic steering cylinder rod. If the rod extends or retracts more than 10 in. (254 mm), make spacers to limit the motion of the steering system as shown on page 35.

Turn the motor so that it is centered between the left and right limits of travel.

Use a tape measure or ruler to position the Outboard Feedback rod so that it projects 5.25 in. (133 mm) from the body of the Outboard Feedback.

Loosely clamp the Outboard Feedback to the tube of the hydraulic cylinder using both pieces of the two piece mount and the stainless steel band clamp. The clamp should be positioned as close as possible to the tube end where the cable exits.

Remove the nut from the end of the rod on the hydraulic cylinder. Place the stainless steel bracket over the threaded end of the rod and replace the nut. Do not completely tighten at this time.

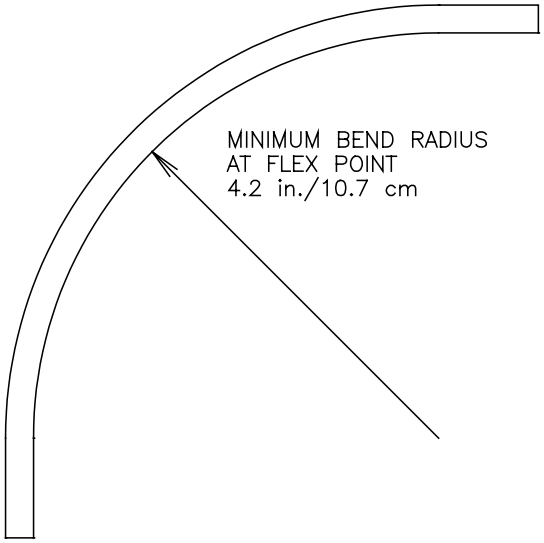
Adjust the position of the Outboard Feedback so that the end of the sliding rod is flush with the Stainless Bracket. Screw the nut onto the threaded rod at the end of the Outboard Feedback.

The Outboard Feedback should now be at half its full extension and attached to the outboard motor which is at the center position.

Adjust the position of the Outboard Feedback so that as nearly as possible it is parallel with the hydraulic cylinder both horizontally and vertically. Tighten the nuts and the stainless steel band clamp securely.

Run the cable forward to the Processor location. Choose a route for the cable so that the *minimum bend radius in the cable is at least 4.2 in. (10.7 cm)*. This is especially important in the motor well and other areas where vibration is present.

Complete the autopilot installation and perform the Set-up Routine as described.

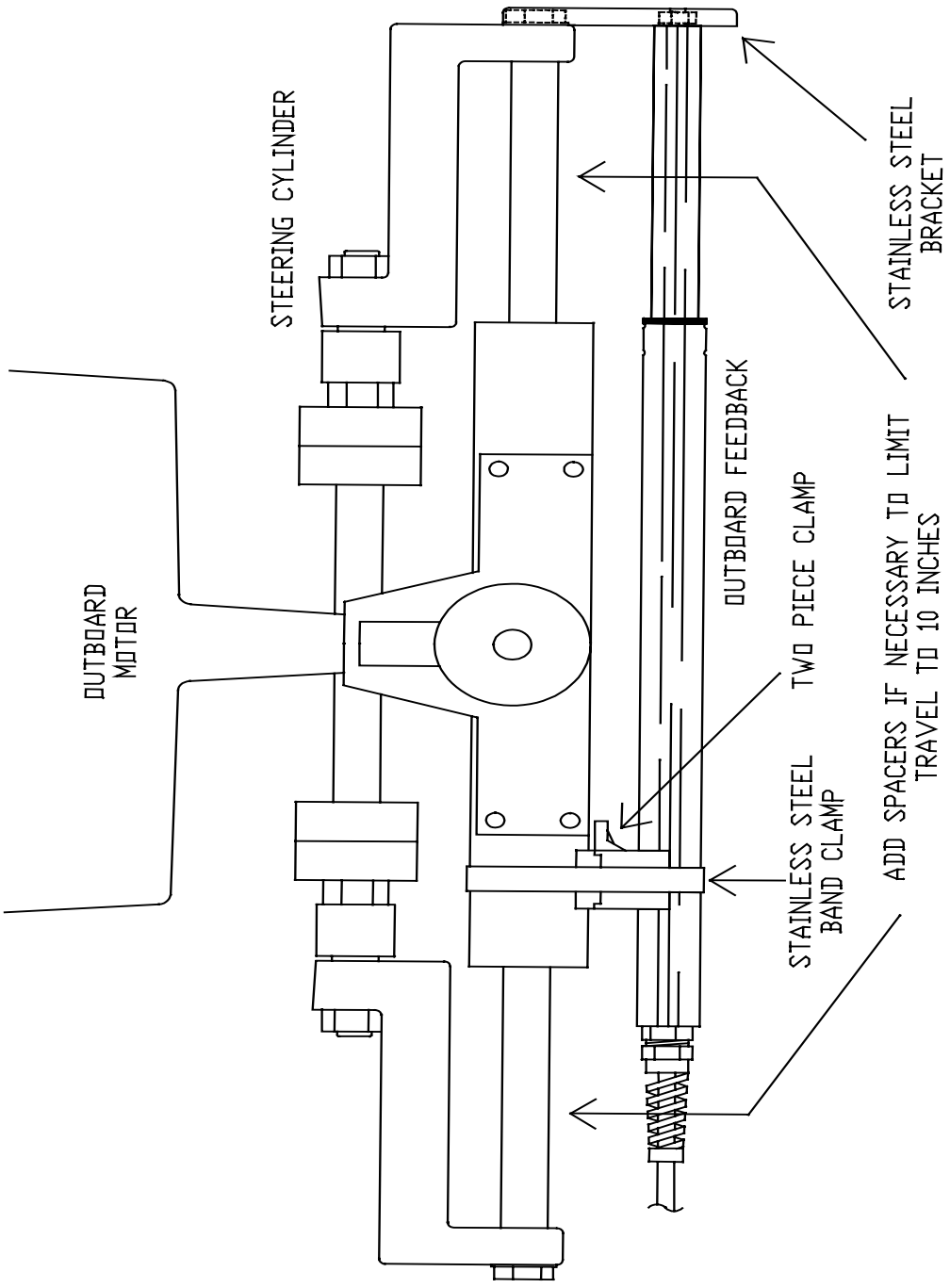


Minimum Bend Radius

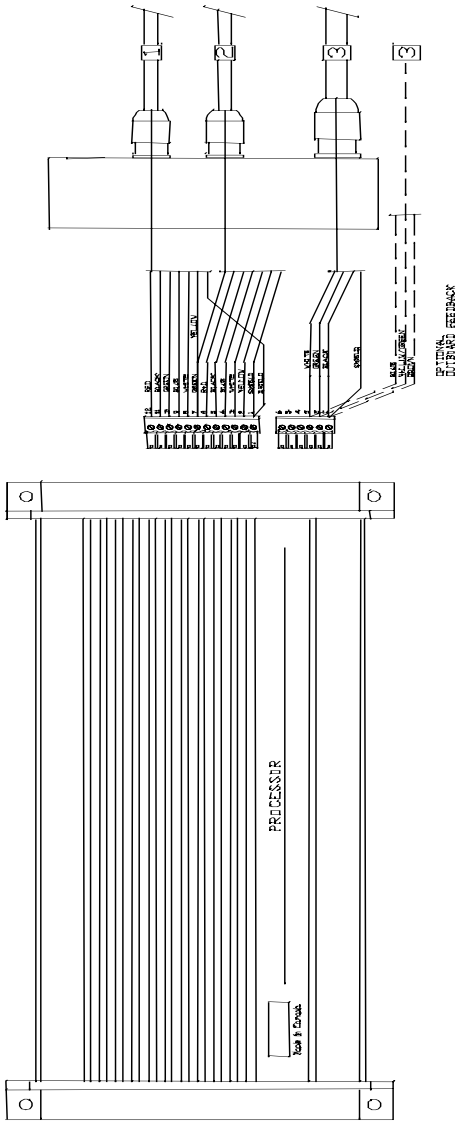
Maintenance

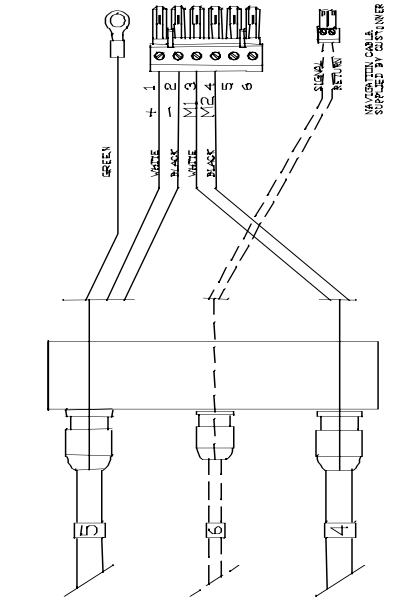
Keep the sliding rod clean. Wipe it occasionally so that dirt cannot enter the Linear Feedback. Use a clean, soft rag.

After trailering your boat, it is very important to clean the sliding rod.

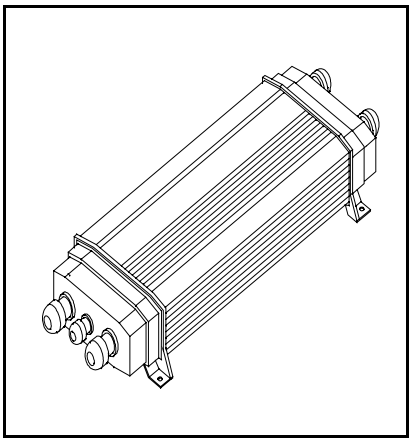


Outboard Feedback Mounting to Front Mount Cylinder





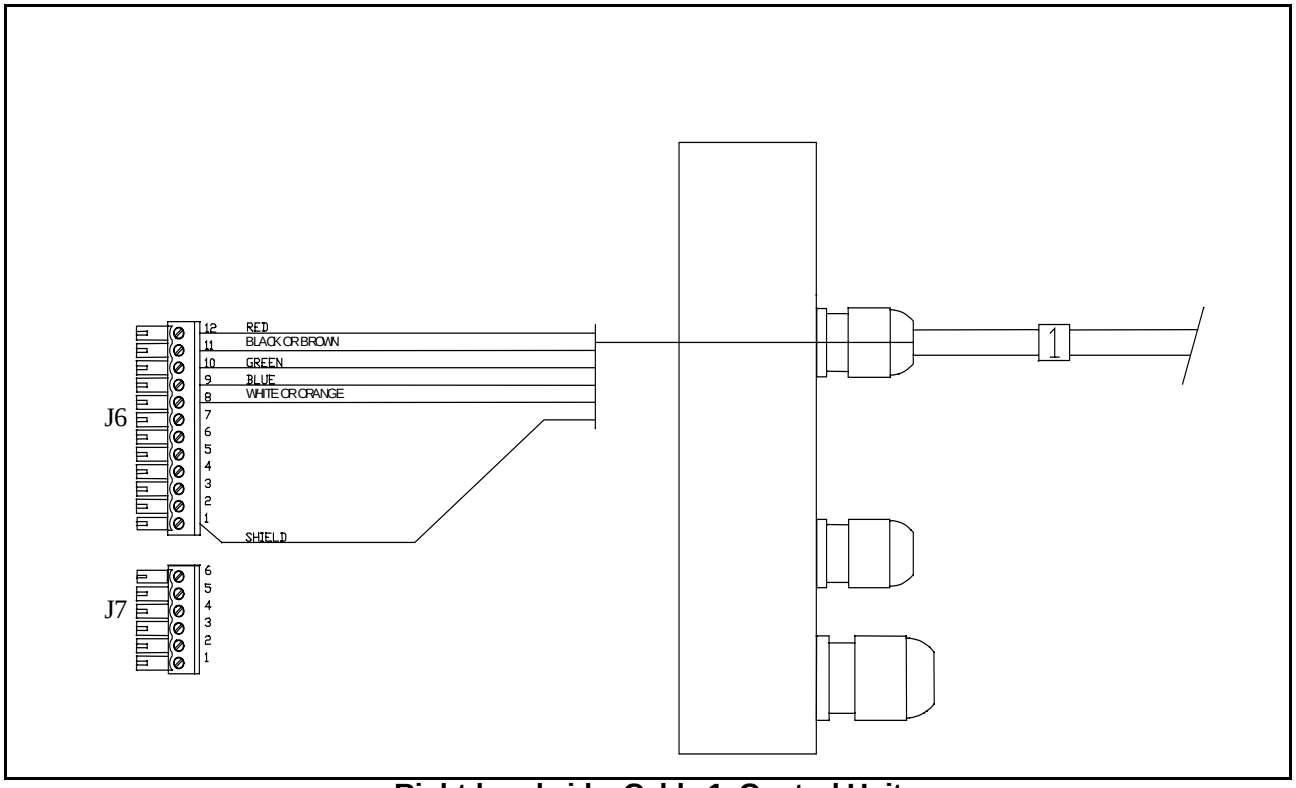
Wiring the Processor



Place the Processor in front of you with the lettering right side up. Remove the four Phillips screws from each end. Remove the end pieces of the Processor enclosure.

Looking into the open ends of the Processor you will see several green terminal strips. These terminal strips are mounted into sockets. You can remove the terminal strips from the processor by gently pulling them away from the end of the Processor.

The terminal strips are labelled with numbers corresponding to the wiring diagrams on the following pages.



Right-hand side. Cable 1, Control Unit
Note: There is an extra yellow wire in the cable that is <u>not</u> used.

Pull all of the terminal strips from the right-hand end of the Processor.

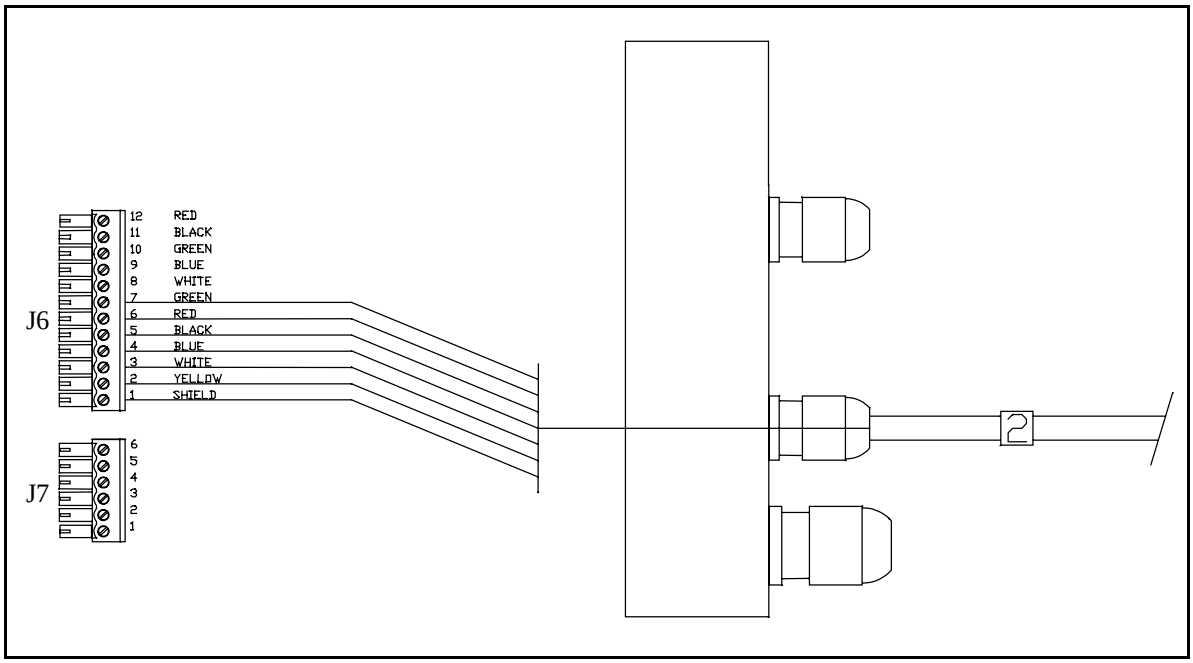
Note that there is an empty socket which does not have a terminal strip. When you replace the terminal strips, do not accidentally place one into the empty socket.

Pass the wires numbered "1", "2" and "3" through the watertight glands on the right end cap as shown in the diagrams labelled:

- Right-Hand Side. Cable 1, Controller
- Right-Hand Side. Cable 2, Compass
- Right-Hand Side. Cable 3, Rudder Feedback

Use the same diagrams to wire the individual wires to the terminal strips.

Insert the bared end of the wire into the terminal strip and fasten it there by tightening the screw on the terminal strip. Start from one end of the terminal strip and work to the other in sequence. Check your work.



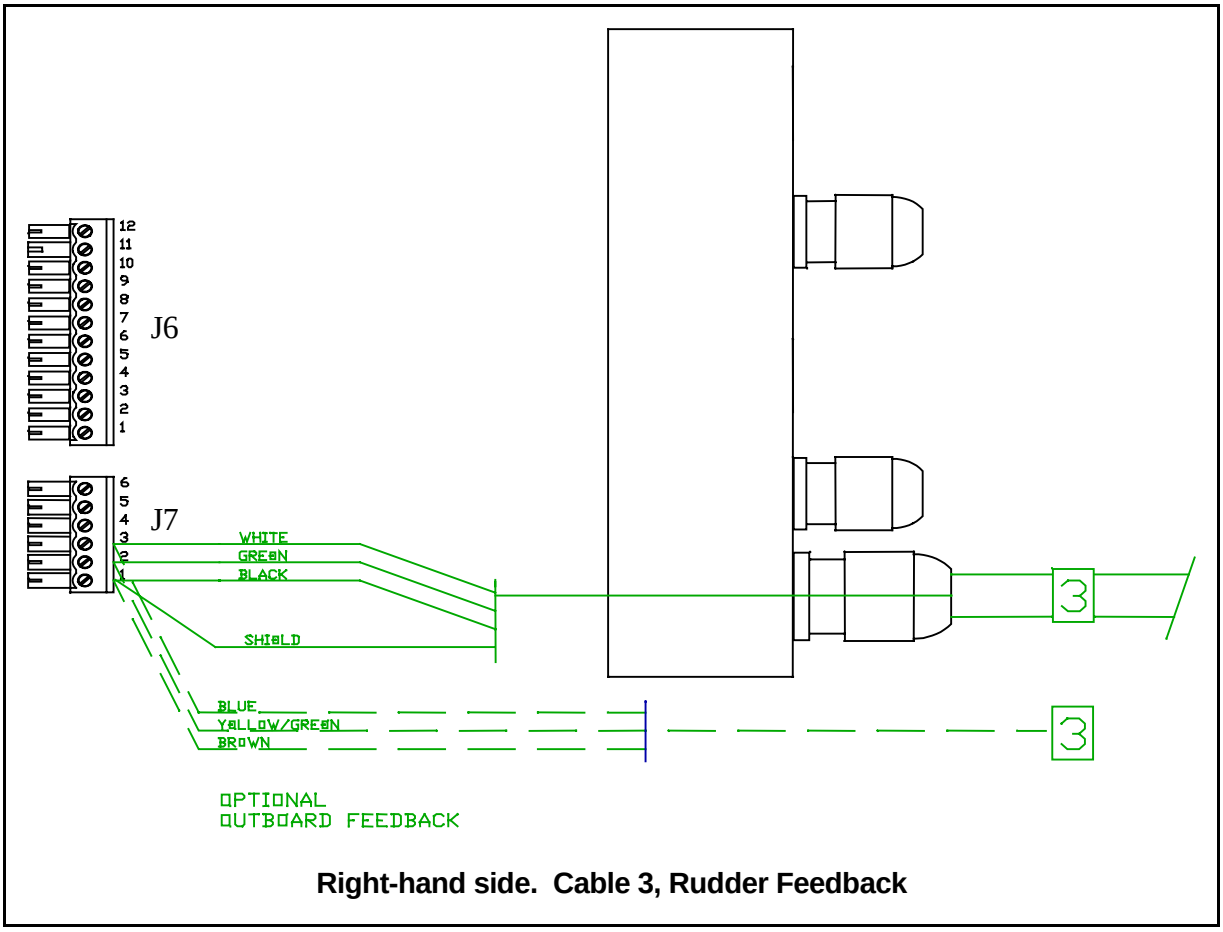
Right-hand side. Cable 2: Compass.
Note: Yellow wire on terminal #2 may be substituted with a brown wire.

Connections for Non SP-70/80 Fluxgate Compasses

Be careful:
The entire stripped end of the wire must be completely inside the terminal strip. Stripped sections of wire must not be able to touch each other.
Every wire must be connected to the correct terminal.

J6 (12 POS)	SP-70/80 Fluxgate	SP-70/80 Function	Non-SP-70/80 Connections
1	Shield	Ground	Gnd
2	Yellow	Cosine	Cosine *
3	White	Ref	Ref
4	Blue	Sine	Sine *
5	Black	Drive P2	N/C
6	Red	Drive P1	N/C
7	Green	+12V	+12V

*** If the reading is reversed, swap these two wires.**



Right-hand side. Cable 3, Rudder Feedback

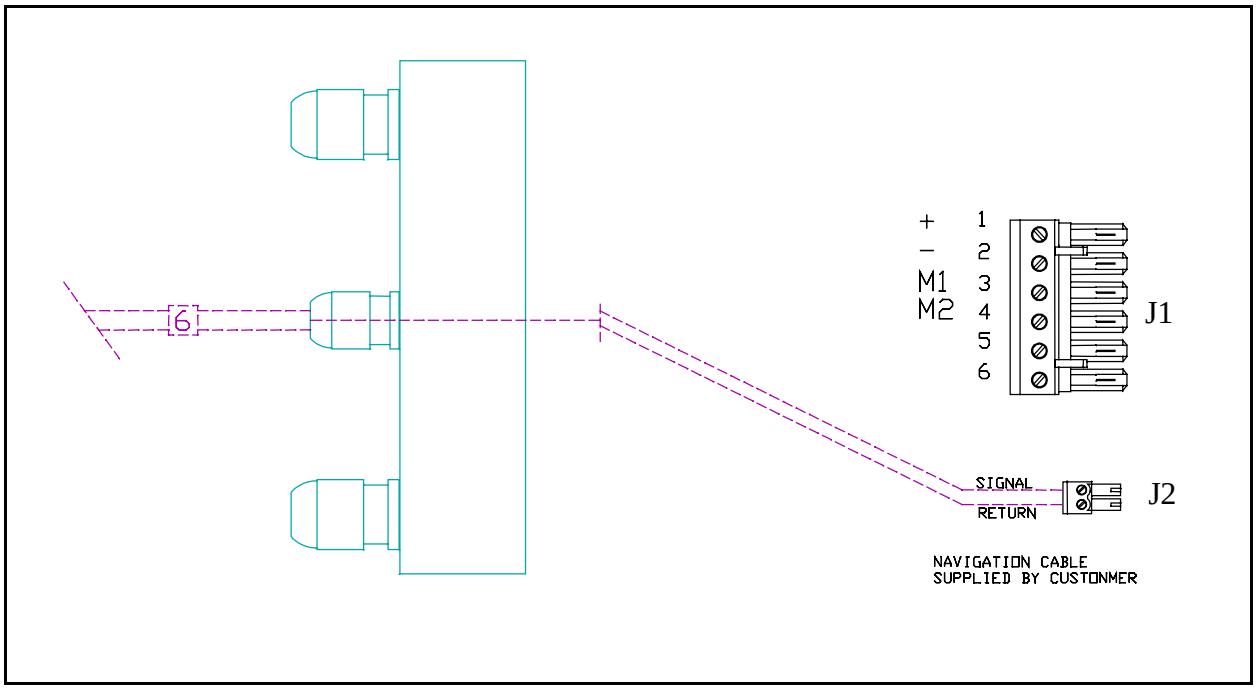
When you have completed the right-hand wiring, remove the terminal strips from the left hand end piece.

The optional navigation input may be connected at this time. Parts for this are in your Accessory Bag. We do not supply the cable for this connection. This input is diagrammed on the next page.

The gland for this input must be mounted on the end cap. To locate the hole for the gland, look on the inside of the end cap. You will see several places where the plastic has been formed so that a hole may be easily drilled. Drill the hole using a 9/32 (7 mm) drill.

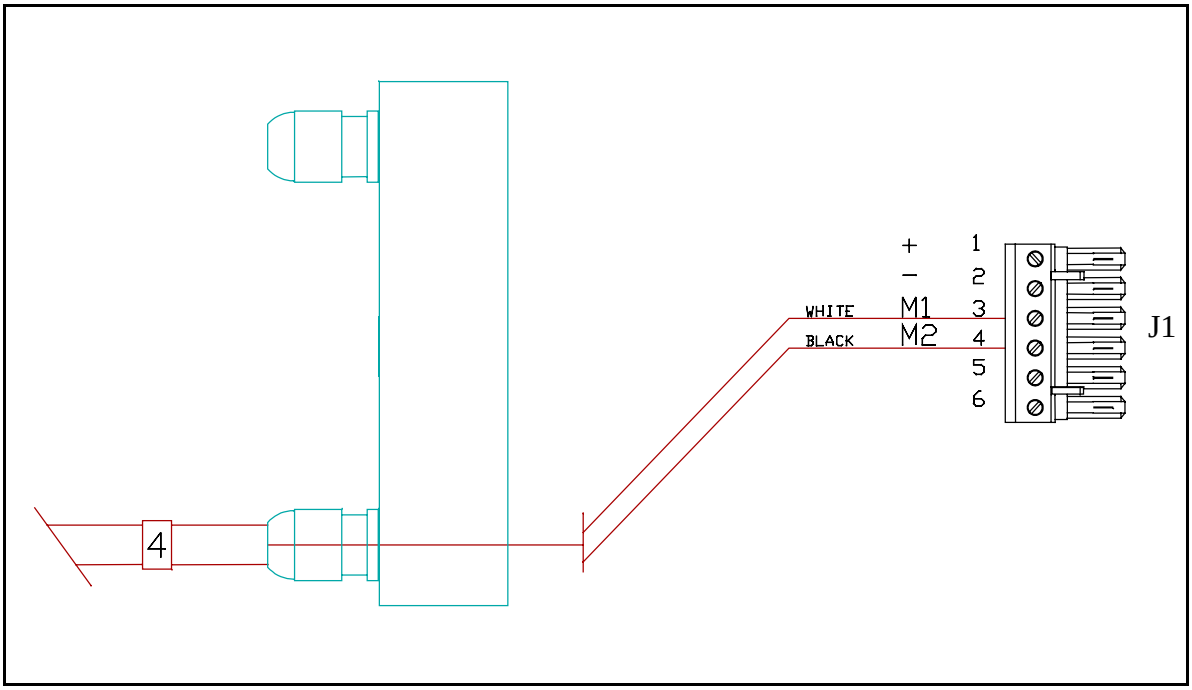
Place the gland from the accessory kit in the hole. Fasten it with the supplied plastic nut and tighten securely.

Pass the wires numbered "4" and "5" through the glands in the left hand end cap as shown in the diagrams labelled," Cable 4, Pump Motor", and " Cable 5, Power". Using the same diagrams, wire the left hand terminal strips. These drawings do not show the gland for the optional navigation input.



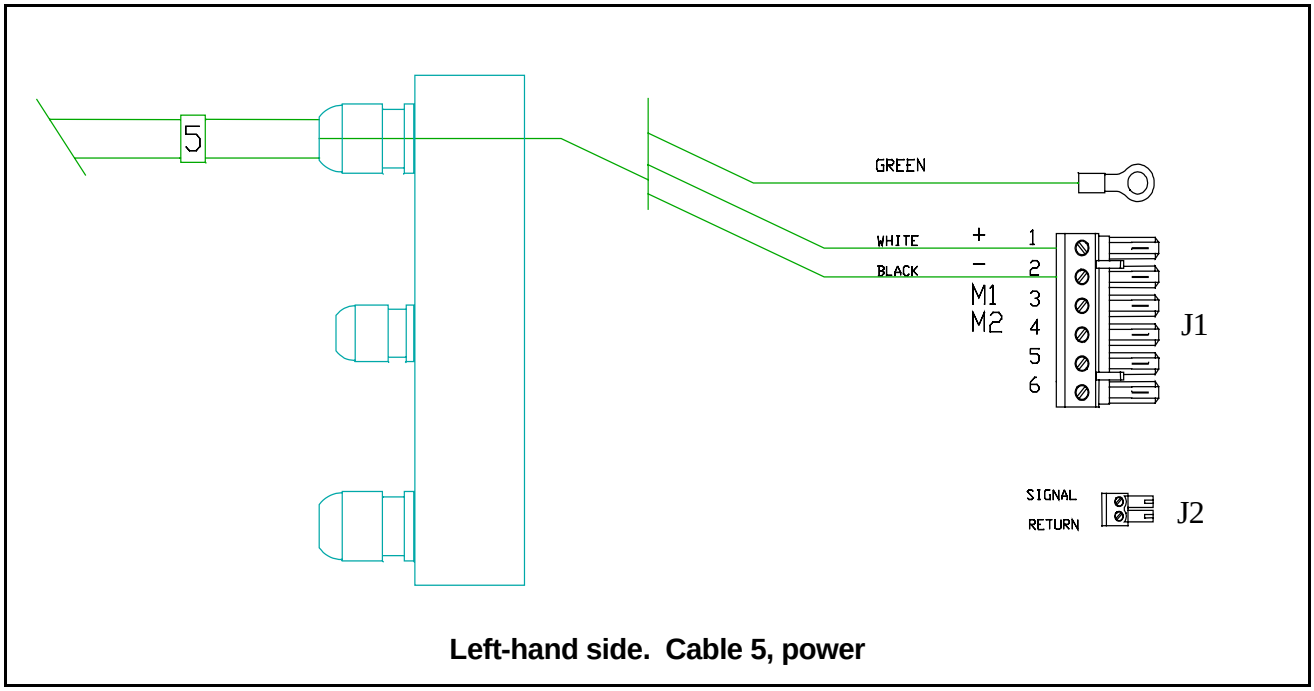
Left hand side showing optional navigation input connection

Use the diagram above to wire the navigation input. The terminal strip for this is in your Accessory Bag. See your LORAN, GPS, or plotter manual for information about wiring connections from that unit. The cable shield should be connected only to the Nav device.



Left hand side. Cable 4, Pump Motor.

Please see appendixes for wiring to other motors or solenoids.



Left-hand side. Cable 5, power

Connecting the ground

In the picture above, the ground wire is the green wire. It is connected to the bolt beside the terminal sockets for the power connection.

The green wire is connected by removing one of the nuts and the lock-washer from the bolt. Place the connector on the end of the green wire over the bolt. Replace the lock washer. Replace the nut and tighten it securely.

The other end of this wire should be connected to the grounding point you have chosen aboard your boat. See page 24 for examples of possible grounding points.

If you are assembling your Autopilot for the first time, please go to the section titled, "Mounting the Processor" on the next page.

FUSE REPLACEMENT

The Si-Tex Processor is protected against reversed power connection by a fuse. The fuse will probably not blow otherwise. If you need to replace this fuse, check your power supply for correct polarity.

To replace the fuse:

1. Turn off the power to the Processor.

2. Loosen the right side watertight glands. Remove the end cap. Disconnect the plugs.

3. Remove the 4 Phillips screws holding the inner end cap. Remove the inner end cap.

4. Bend up the copper ground tabs so that they are parallel to the body of the Processor.

5. Loosen the left hand side watertight glands. Remove the outer end cap.

Disconnect the plugs.

6. Remove the four Phillips screws holding the inner end cap.

7. Hold the left hand inner end cap. Slide the Processor case to the right. This will expose the circuit board.

8. The fuse is located on the top left hand corner of the board. If it is damaged, replace it with a 20 Ampere AGC fuse.

9. Reassemble the Processor by working through the above steps in reverse order. **Recheck your power polarity before you insert the power connector.**

10. **Before leaving the dock**, turn on the Autopilot. Press the Red and Green Keys to move the rudder or outboard motor. If the new fuse fails at this time, you still have an electrical problem on your boat, or the Autopilot needs repair.

Mounting the Processor

Once you have completed and checked the wiring, you are ready to mount the Processor.

There are two ways this can be done, depending on the amount of space you have. The first method will usually be easier.

For ease of wiring, it is recommended that the Processor be mounted horizontally rather than vertically.

The first method is:

Plug the terminal strips into their correct positions on the processor.

Attach the end pieces. Do not cut or crimp any wires while tightening the screws. Tighten the nuts on the watertight glands. Tighten these nuts firmly with your hand. If you must use a tool, be very careful. It is very easy to damage the glands by using too much force.

Mount the Processor in its location.

The second method is:

Mount the processor in its location.

Plug the terminal strips and wires into the correct locations.

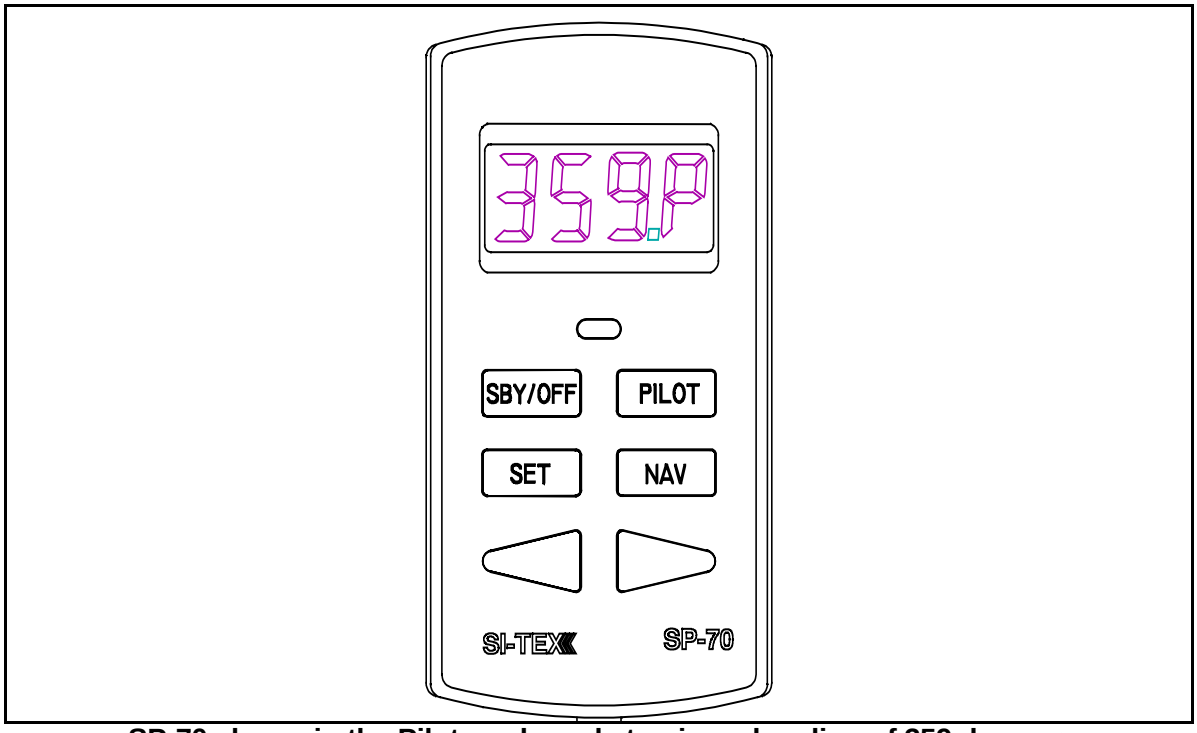
Attach the end pieces. Do not damage any wires while tightening the screws. Tighten the nuts on the watertight glands firmly with your hands. If you must use a tool, be very careful. It is very easy to damage the glands by using too much force.

Turn on the breaker for the Autopilot or connect the Power cable to the breaker.

The black wire connects to the negative terminal. The white wire connects to the positive terminal. The green wire is ground. See page 24 if you have not already decided on a ground.

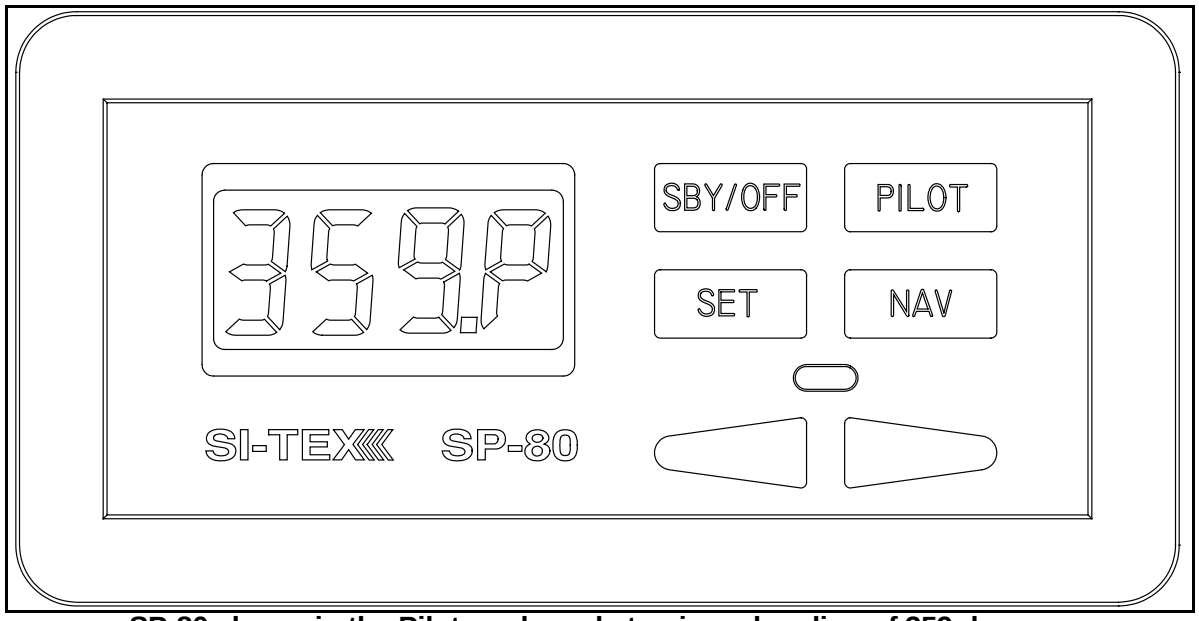
The Installation of the SP-70 or SP-80 is complete. You are now ready to begin the "Set-up Routine".

LOCATING THE “FLUSH KEY”



SP-70 shown in the Pilot mode and steering a heading of 359 degrees

On an **SP-70** Control Head, the **Flush Key** is located immediately below the digital display and is flush with Control surface to prevent accidental button pushes.



SP-80 shown in the Pilot mode and steering a heading of 359 degrees

On an **SP-80** Control Head, the **Flush Key** is located immediately below the **SET** and **NAV** keys and is flush with Control surface to prevent accidental button pushes.

SP-70 SET-UP ROUTINE (see page 50 for SP-80 set-up routine)

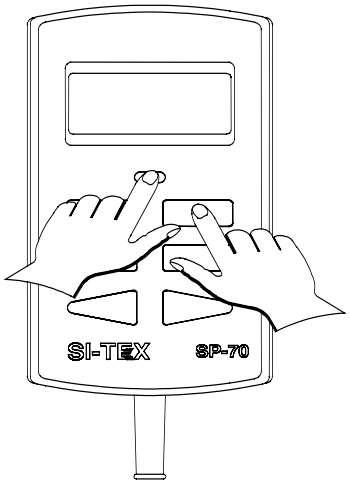
The SP-70 must be OFF before you begin the Set-up Routine. The first part of this routine can be done at the dock. If you have a Fluxgate Compass, you will later repeat the first part away from the dock.

The SP-70 Autopilot will guide you through the steps of the Set-up Routine. You cannot leave the routine without completing it. Turning off the Autopilot will not cause it to exit from the Routine.

Error Messages will appear if the SP-70 finds a fault. Correct the fault before proceeding to the next step.

An explanation of common Error Messages that may appear is placed inside a box like the one below. A full list of Error messages is at the end of this manual.

1. Press and hold the Flush Key (see page 44). Press and hold the Pilot Key until the display shows [FrST] and then [HO S] (Hard over to Starboard) Release both keys.



The error message for steps 2 to 4 is [rEdO] (redo). Press the Pilot Key to cancel the alarm. Then repeat the step.

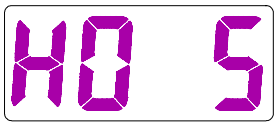
If you cannot perform these steps without the alarm sounding, check your Rudder Follower Installation and your steering system. Ensure that:

- The steering system can move through its full range of motion.
- The steering system has been bled properly.
- The Rudder Follower Linkage is assembled according to instructions.
- The wire connections going from the Rudder Feedback to the Processor are connected to the correct Processor terminal and terminal numbers.
- The wire connections are mechanically strong and are not becoming intermittent due to loose connections.

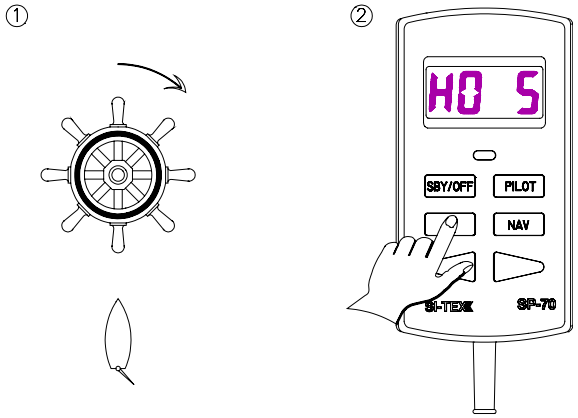
If you have an Outboard Feedback, ensure that:

- The Outboard Feedback travels an equal distance in each direction.

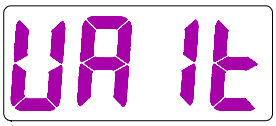
The display will show [HO S] (Hard Over to Starboard).



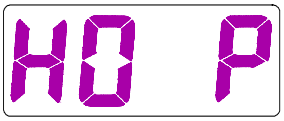
2. Turn the steering wheel fully to the right. Press the Set Key.



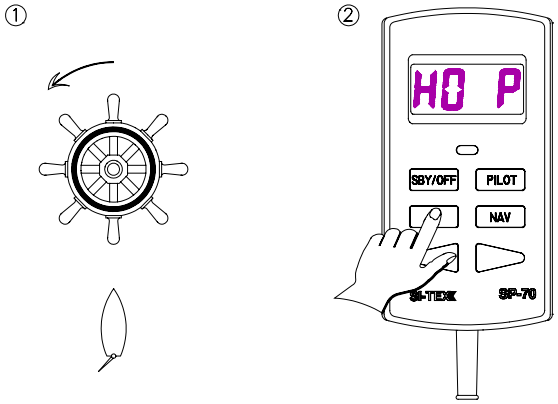
The display will show [UAIt] (Wait) for a few seconds.



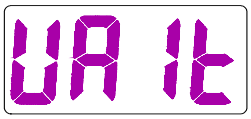
The display will next show [HO P] (Hard Over to Port).



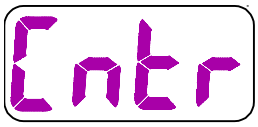
3. Turn the steering wheel fully to the left. Press the Set Key.



The display will show [UAIt] (Wait) for a few seconds.

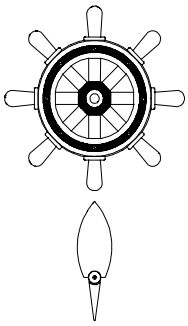


The display will then show [Cntr] (center).



IMPORTANT

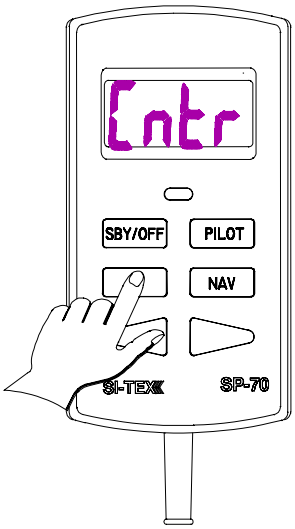
4. Move the steering wheel to the center position.



CAUTION

In the next step, the SP-70 will move the steering system through its full range of motion. Pressing and holding the SBY/OFF KEY will stop the steering movement immediately.

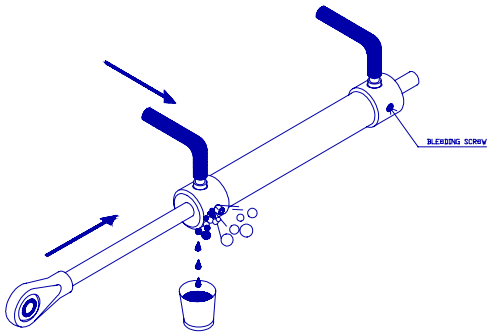
5. Press the Set Key.



The steering gear will move from side to side. As the Autopilot tests the drive system the display will show [d'tSt]. As the Autopilot checks the rudder the display will show [r'tSt]. The Output marks at the top of the display will show the direction of rudder movement. The display may also show timing marks.

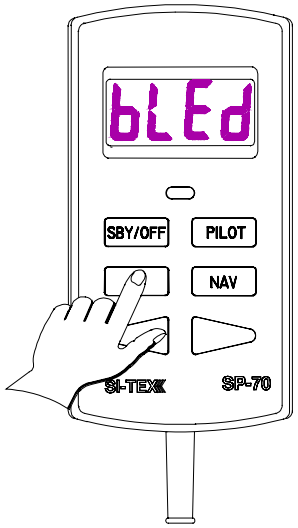
6. The display will now show [bLEd] (Bleed). **You are now in the bleed mode.**

If you have installed a pump or retrofitted to an existing mechanical or hydraulic drive unit, you must now bleed and/or time your pump. Please see the section titled *Pump Bleeding Instructions*.



NOTE:
IF YOU DO NOT NEED TO BLEED OR TIME YOUR SYSTEM, GO TO STEP 7.

7. Press the Set Key.



The Autopilot will next display a message about the compass type.

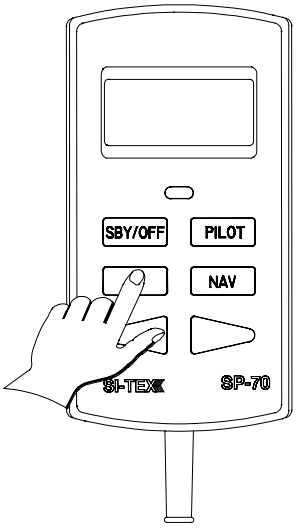
If you have a magnetic compass the display will show **[nAG]** (magnetic).

Go to Step twelve.

If the compass is a Fluxgate Compass the display will show [FLUH].

The Autopilot will next display [turn] (Turn). You must now adjust your compass.

8. Press the Set Key. The Autopilot will turn off.



The error message for this step is **[nC:Er]** (No compass Error). Ensure that:

- The compass cable is connected to the correct Processor terminals.
- There are no poor or loose connections on the Compass cable.
- When using a Magnetic Compass Sensor, the sensor reads the Compass card position properly. Some Magnetic Compasses have magnets so weak that the Sensor will not function properly.

Press the Pilot Key to clear the alarm, correct the problem, try the step again.

For Fluxgate Compasses

To fully adjust the Fluxgate Compass, it is necessary to take a short trip with your boat.

Put your tools and other magnetic objects in storage places away from the Fluxgate Compass.

Check your hydraulic installation for any leaks or loose components.

Do not attempt to adjust the compass near a steel bridge, a submarine cable, or a steel ship.

Move your vessel to a location that is:
- Free from other water traffic.
- Far away from large magnetic objects.

9. RE-START SET-UP procedure at Step 1 and follow until display shows [FLUH]. Go to step 10.

10. Slowly turn the boat in as small a circle as possible.

It must take at least one minute to complete the turn. If the Compass adjustment is satisfactory, the Autopilot will show [nort]. Go to Step Thirteen.

If the Autopilot will not stop displaying [tUrN], you may have such a strong magnetic field aboard your vessel that the compass is not able to sense any motion. If this occurs, try moving the compass far away from it's present location and repeat the turn.

11. Use four #10 (5mm) screws to mount your Fluxgate Compass.

These screws should be a non-magnetic material such as high quality stainless steel or brass.

If the Compass adjustment is not satisfactory the Autopilot will display
[MovE] (Move).
The Autopilot has been unable to adjust the Compass for the strong magnetic fields in that location. You must select another location which is further from magnetic materials or power cables. On small vessels the compass location often is a compromise between the most stable position and the position which has the least magnetic interference.

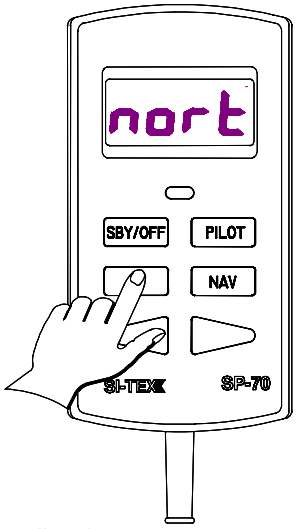
Press the Pilot Key to continue the Set-up Routine.

For Magnetic Compasses

12. If you have a magnetic compass the Autopilot will display [nort] (North).

Point your vessel, or simply turn the compass, until the compass is pointing North. Press the Set Key.

The Autopilot will then turn OFF.



The Autopilot has not compensated for any differences between North as shown by your compass and the real direction of magnetic North. You alone are responsible for the accuracy of your compass in its location.

Mount your compass in its location using fasteners made of non-magnetic materials such as high quality stainless steel or brass.

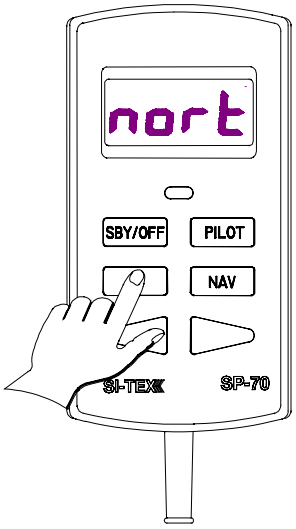
The Set-up Routine is now complete.

For Fluxgate Compasses

13. Autopilot will display [nort] (north) after successful calibration of the fluxgate compass (#10 in Set-up Routine).

As accurately as possible, point your vessel to magnetic North and press the Set Key.

The Autopilot will then turn off. This procedure will calibrate your Autopilot heading display with the actual magnetic



heading.

The Autopilot has not compensated for any differences between North as shown by your compass and the real direction of magnetic North. You alone are responsible for the accuracy of your compass in its location.

Mount your fluxgate compass in its location using fasteners made of non-magnetic materials such as high quality stainless steel or brass.

The Set-up Routine is now complete.

SP-80 SET-UP ROUTINE

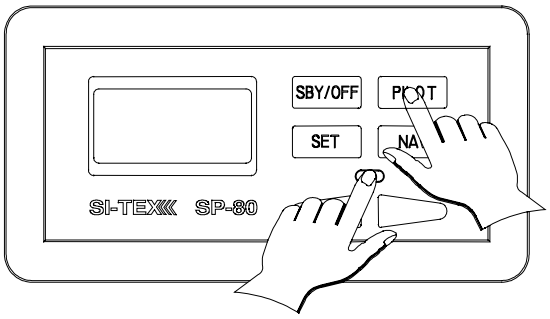
SP-80 MUST BE OFF BEFORE YOU BEGIN THE Set-up Routine. The first part of this Routine can be done at the dock. If you have a Fluxgate Compass, you will later repeat the first part away from the dock.

The SP-80 Autopilot will guide you through the steps of the Set-up Routine. You cannot leave the Routine without completing it. Turning off the Autopilot will not cause it to exit from the Routine.

Error messages will appear if the SP-80 finds a fault. Correct the fault before proceeding to the next step.

An explanation of common Error messages that may appear is placed inside a box like the one below. A full list of Error messages is at the end of this manual.

1, Press and hold the Flush Key (see page 32). Press and hold the Pilot Key until the display shows [FrST] and then [Ho S] (Hard over to Starboard). Release both keys.



The error message for steps 2 to 4 is [rEdO] (redo). Press the Pilot Key to cancel the alarm. Then repeat the step.

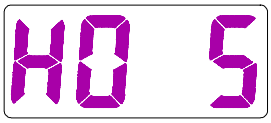
If you cannot perform these steps without the alarm sounding, check your Rudder Follower Installation and your steering system. Ensure that:

- The steering system can move through its full range of motion.
- The steering system has been bled properly.
- The Rudder Follower Linkage is assembled according to instructions.
- The wire connections going from the Rudder Feedback to the Processor are connected to the correct Processor terminal and terminal numbers.
- The wire connections are mechanically strong and are not becoming intermittent due to loose connections.

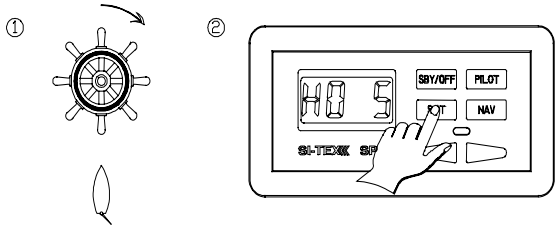
If you have an Outboard Feedback, ensure that:

- The Outboard Feedback travels an equal distance in each direction.

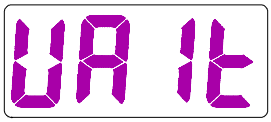
The display will show [HO S]
(Hard Over to Starboard).



2. Turn the steering wheel fully to the right. Press the Set Key.



The display will show **[WAIt]** (Wait) for a few seconds.

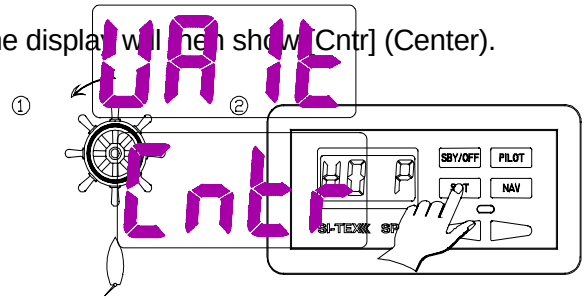


The display will next show [HO P}
(Hard Over to Port).

3. Turn the steering wheel fully to the left. Press the Set Key.

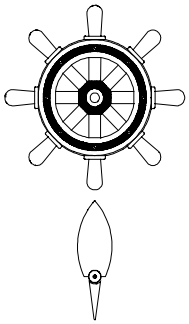
The display will show [WAIt] (Wait) for a few seconds.

The display will then show [Cntr] (Center).



IMPORTANT

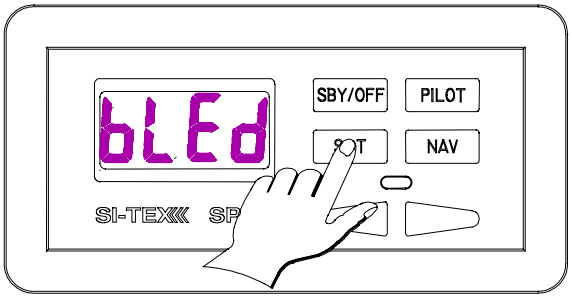
4. Move the steering wheel to the center position.



CAUTION

In the next step, the SP-80 will move the steering system through its full range of motion. Pressing and holding the SBY/OFF KEY will stop the steering movement immediately.

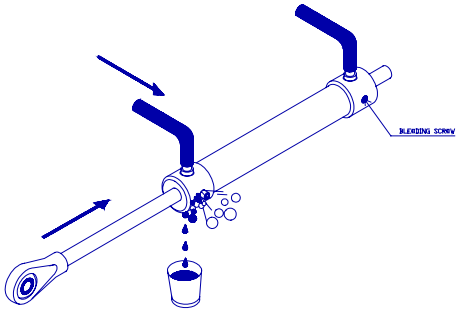
5. Press the Set Key.



The steering gear will move from side to side. As the Autopilot tests the drive system the display will show [d'tSt]. As the Autopilot checks the rudder the display will show [r'tSt]. The Output marks at the top of the display will show the direction of rudder movement. The display may also show [O'Cur] and other timing marks.

6. The display will now show **[bLEd}** (Bleed). **You are now in the bleed mode.**

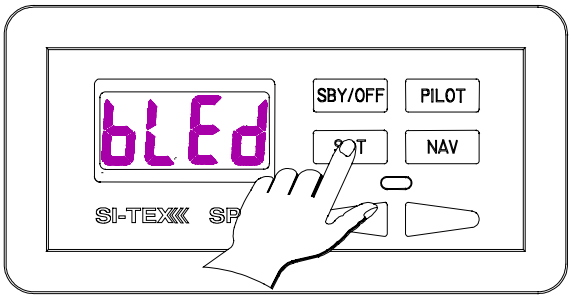
If you have a hydraulic system and if you opened the hydraulic lines during the Autopilot installation, then you must now bleed and/or time your pump. Please see the section titled *Pump Bleeding Instructions*.



NOTE:

IF YOU DO NOT NEED TO BLEED YOUR SYSTEM, GO TO STEP SEVEN.

7. Press the Set Key.

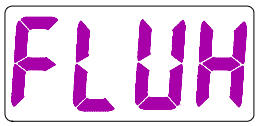


The Autopilot will next display a message about the compass type.

If you have a magnetic compass the display will show **[nAG]** (magnetic).

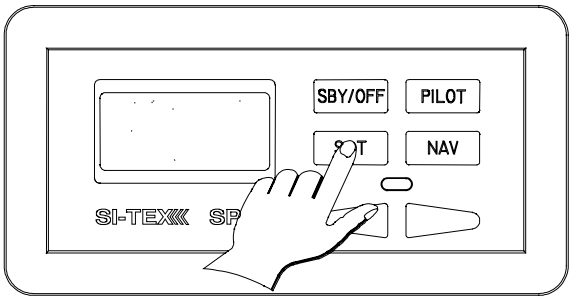
Go to Step twelve.

If the compass is a Fluxgate Compass the display will show **[FLUH]**.



The Autopilot will next display [tUrN] (Turn). You must now adjust your compass.

8. Press the Set Key. The Autopilot will turn off.



The error message for this step is **[nC:Er]** (No Compass Error). Ensure that:

- The Compass cable is connected to the correct Processor terminals.
- There are no poor or loose connections on the Compass cable.
- When using a Magnetic Compass Sensor, the sensor reads the Compass card position properly. Some Magnetic Compasses have magnets so weak that the Sensor will not function properly.

Press the Pilot Key to clear the alarm. Correct the problem. Try the step again.

For Fluxgate Compasses

To fully adjust the Fluxgate Compass, it is necessary to take a short trip with your boat.

Put your tools and other magnetic objects in storage places away from the Fluxgate Compass.

Check your hydraulic installation for any leaks or loose components.

Do not attempt to adjust the compass near a steel bridge, a submarine cable, or a steel ship.

Move your vessel to a location that is:

- Free from other water traffic.
- Far away from large magnetic objects.

9. **RE-START SET-UP** procedure at Step 1 and follow until display shows [FLUH]. Go to step 10.

10. Slowly turn the boat in as small a circle as possible.

It must take at least one minute to complete the turn. If the Compass adjustment is satisfactory, the Autopilot will show [nort]. Go to Step Thirteen.

If the Autopilot will not stop displaying [tURN], you may have such a strong magnetic field aboard your vessel that the compass is not able to sense any motion. If this occurs, try moving the compass far away from it's present location and repeat the turn.

11. Use four #10 (5mm) screws to mount your Fluxgate Compass.

These screws should be a non-magnetic material such as high quality stainless steel or brass.

This completes the Set-up Routine.

If the Compass adjustment is not satisfactory the Autopilot will display
[MovE] (Move).
The Autopilot has been unable to adjust the Compass for the strong magnetic fields in that location. You must select another location which is further from magnetic materials or power cables. On small vessels the compass location often is a compromise between the most stable position and the position which has the least magnetic interference.

Press the Pilot Key to continue the Set-up Routine.

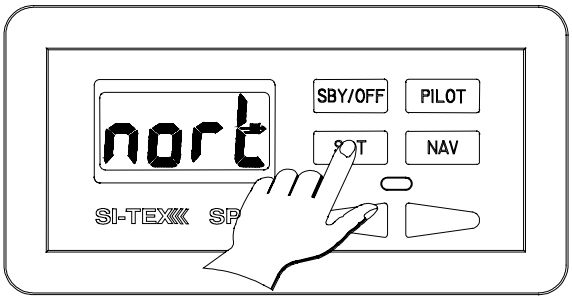
For Magnetic Compasses

12. If you have a magnetic compass the Autopilot will display [nort] (North).

Point your vessel, or simply turn the compass, until the compass is pointing North. Press the Set Key.

The Autopilot will then turn OFF.

The Autopilot has not compensated for any differences between North as shown by your



compass and the real direction of magnetic North. You alone are responsible for the accuracy of your compass in its location.

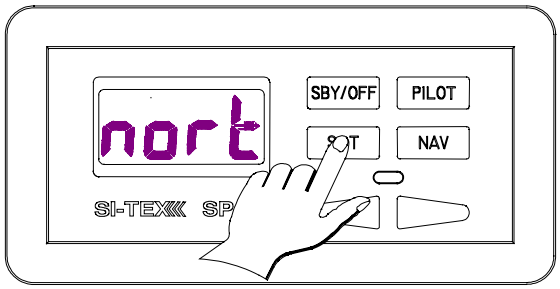
Mount your compass in its location using fasteners made of non-magnetic materials such as high quality stainless steel or brass.

The Set-up Routine is now complete.

For Fluxgate Compass

13. If you have a fluxgate compass, the Autopilot will display [nort] (North) after successful calibration of the fluxgate compass (#10 in Set-up Routine).

As accurately as possible, point your vessel to magnetic North and press the Set Key.



The Autopilot will then turn OFF. This procedure will calibrate your Autopilot heading display with the actual magnetic heading.

The Autopilot has not compensated for any differences between North as shown by your compass and the real direction of magnetic North. You alone are responsible for the accuracy of your compass in its location.

Mount your compass in its location using fasteners made of non-magnetic materials such as high quality stainless steel or brass.

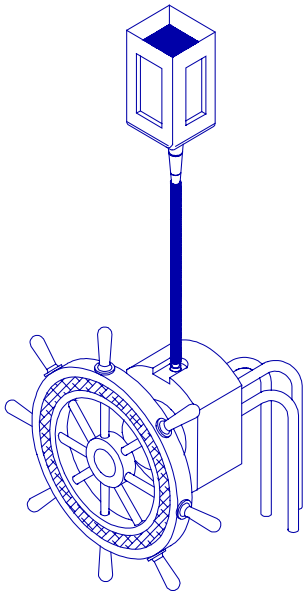
The Set-up Routine is now complete.

Pump Bleeding Instructions

1. Bleed your manual steering system according to the manufacturer's instructions. When you have completed the bleeding, leave the equipment for the bleeding procedure attached to your hydraulic steering system.

2. Fill your highest reservoir completely. Turn the steering wheel just past the stop to press as much oil as is possible into the system.

3. If you can, use a bottle of recommended hydraulic oil and a piece of plastic tubing to add extra capacity to your highest reservoir.



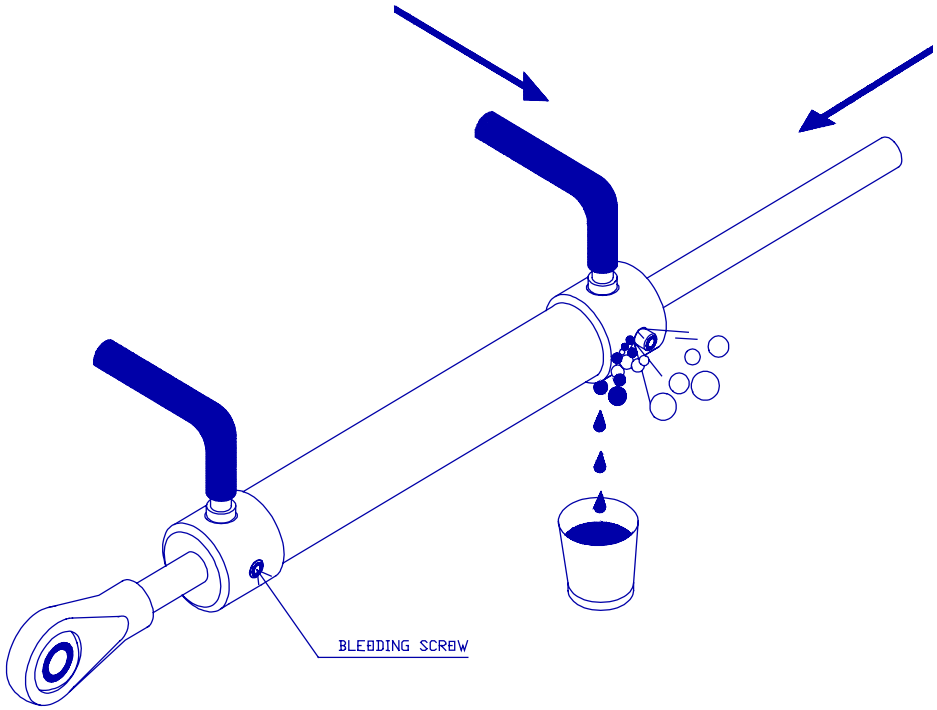
Adding Capacity

The manufacturer of your system may provide these items when you purchase a bleeding kit for your system. If you have a helper, have them watch the oil level in the highest reservoir and refill it when necessary.

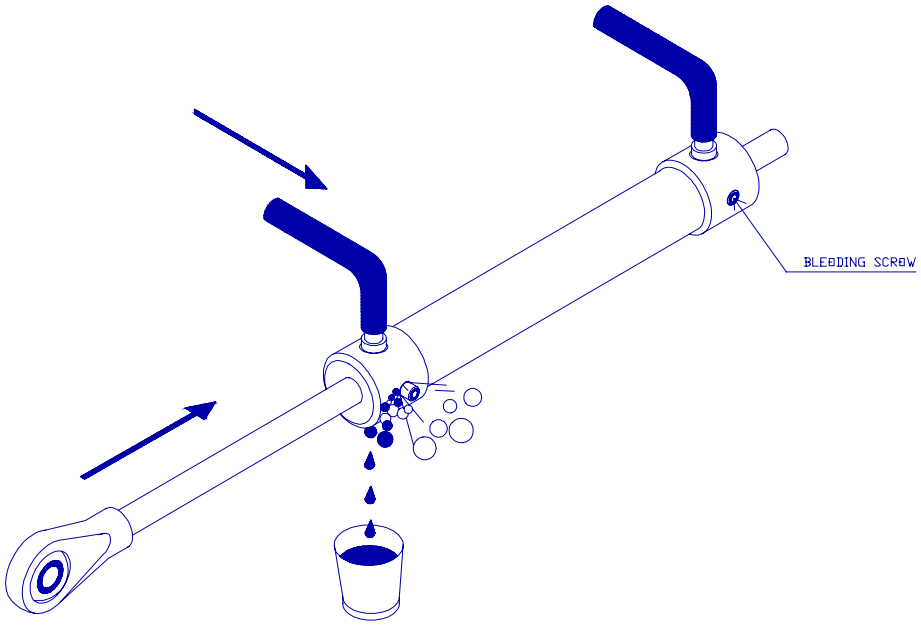
4. Your hydraulic cylinder rod is now fully extended in one direction. To bleed the Reversing Pump you will be extending the cylinder rod in the other direction. Open one and close the other bleeding screw just as you did when bleeding the manual part of your system and you were extending the cylinder arm in this direction. Generally, you close the bleeding screw or nipple closest to the rod which is now retracted. Open the bleeding screw closest to the now extended rod. See diagram on following page.

5. Position yourself so that you can see your hydraulic steering cylinder while operating the Controller.

6. You will be able to move the steering cylinder rod by pressing the Red Key or the Green Key on the Controller. When you press the key, the lights will stop blinking and the red or green light will turn on. Extend the rod as far as it will travel in the other direction.



Bleeding cylinder, rod moving left



Bleeding cylinder, rod moving right.

7. If you are using a Reversing Pump, let the Autopilot drive the Reversing Pump until it nearly stops after the rod reaches the end of it's travel. This will press as much oil as possible into the system. It will not damage the pump.

The SP-70 or SP-80 will drive the pump past the electronic rudder limit only when

the display shows ***[bLEd].***

8. Refill your steering system from the highest reservoir.

9. Adjust the bleeding screws so that the cylinder will be bled when the rod is extended in the original direction. Generally, you close the bleeding screw or nipple closest to the now retracted rod. Open the bleeding screw closest to the rod that is now extended.

10. Use the Controller to fully extend the cylinder rod to the other side.

11. Refill the highest reservoir.

12. Repeat steps 6 to 10 at least 10 times.

13. Close all bleeding screws or nipples. Clean up any oil spills and wipe fittings clean. Remove any buckets or equipment a short distance from the cylinders and fittings.

14. Use the Control Unit to extend the rod fully in one direction and then the other.

15. Check for leaks by looking for spilled hydraulic fluid on or near fittings and cylinders.

16. Check that a hardover to hardover time of 10 - 15 seconds can be attained with your drive unit.

17. Return to Step 7 of the Set-up Routine.

**** IMPORTANT ****

If you have installed a ComNav Marine reversing motor pump, a constant running pump or an engine driven pump, there are several checks that must be done during the first several weeks of usage in order to prevent poor or dangerous steering performance. During this period you must check for air or leaks in your hydraulic system.

Residual air in your steering system

Following the initial installation and bleeding of your ComNav pump, some residual air may remain suspended in the hydraulic fluid. During the first few weeks, this air will gradually bleed out through the header tank or the highest helm pump and the oil level may go down. Check several times and add more oil as required.

Leaking fittings or equipment

Following the initial installation and bleeding of your ComNav pump, continuously monitor the oil level of the reservoir, or the highest helm pump in your steering system and add oil as required. If this condition persists, it may be an indication of leakage in your steering system. Check all hydraulic steering fittings and equipment for leakage.

PILOTING WITH THE SP-70 or SP-80 AUTOPILOT

This section will introduce you to your SI-TEX Autopilot: Learn your Autopilot's operations step by step, you will find it's one of the simplest things on your boat.

Steering Control Settings

The SI-TEX Autopilot has a very wide range of steering control settings. There are:

- Four: Rudder Response settings.

- Ten: Sensitivity steps for each Rudder Response setting.

Each Rudder Response setting controls the steering in a very different way. The four Rudder Response settings are:

- Slow Rudder Response
- Slow Counter-Rudder Response
- Fast Rudder Response
- Fast Counter-Rudder Response

The 10 sensitivity steps are numbered zero to nine. Zero is an active setting and does not mean OFF.

In this section, you will learn how to:

- Use your Autopilot to steer a compass course.
- Select between the “fast” and the “slow” boat speed Rudder & Counter-Rudder Response.
- Select the correct sensitivity in each Rudder & Counter-Rudder Response.
- Use the features of your Autopilot.

After you have learned how to do this, experiment with your boat to find the combination of Rudder & Counter-Rudder Response settings that work the best for you.

Some vessels may not use all of the Rudder & Counter-Rudder Response settings.

Turn on the SI-TEX Autopilot by holding down the Pilot Key for two seconds. The autopilot will display “SP” first, then software versions and last, vessel heading followed by a “P”. You are now piloting with the SP-70 or SP-80. To get manual command back, press the Sby/Off Key momentarily.

PILOT MODE
Fast Boat Speed Setting

Some vessels always respond quickly to a small movement of the steering wheel regardless of the boat speed. These boats might get the best steering control by always using the "fast" boat speed setting. When the boat speed varies, change the sensitivity of the "fast" Rudder Response by a few steps. This might give you better steering performance than using the "slow" boat speed Rudder Response setting.

PILOT MODE
Slow Boat Speed Setting

Some vessels always require large amounts of steering wheel movement to start and stop a turn. These might get the best steering performance by using only the "slow" boat speed Rudder Response setting for all speeds. When the boat speed varies, change the Sensitivity of the "slow" Rudder Response by a few steps. This may be all that is required.

What is Good Steering Control?

When your SI-TEX Autopilot is working properly, it will steer your vessel in a straight line. The boat will not wander back and forth across the course line nor make any sudden turns unless you command it (refer to page 67).

Setting Slow Speed Rudder Response

It is best to set the slow speed Rudder Response first. These adjustments are much easier to do if the water is calm and there is little wind.

At this point, you will have finished adjusting your compass and exited the Set-up Routine. Move your boat to an open area of water away from docks and other boats.

Your vessel may make several turns while you are setting the Rudder Response. Make sure that you and your passengers are braced for unexpected movement.

Adjust your throttle so that your boat is moving at a commonly used slow speed. If you fish often, this could be your trolling speed. Bring your boat onto a course.

Turn ON the SP-70 or SP-80 Autopilot. To turn on the Autopilot, press the Pilot Key. The Autopilot will fist display SP, then the software version number. Finally, the present course followed by a capital letter "P" will be displayed. **[xxxP].** The Autopilot will now begin to steer the boat along the displayed course. The autopilot is in PILOT MODE and is steering by the compass.

OFF

If you wish to turn off the Autopilot, press and hold the sby/Off Key for 2 seconds. Immediately after pressing this key, you will have manual vessel steering control.

With the Autopilot on, press the Set Key. For a five second interval the display will read either **[FASt]** (fast) or **[SLOU]** (slow). This is the Rudder Response speed setting that your Autopilot is currently using.

If the display is reading **[FASt]**, press the Green Key during the five second interval to change the display to **[SLOU]**. Your vessel is now using the slow boat speed Rudder Response settings.

Allow the Autopilot to steer your boat for a few minutes, so you can measure its performance. The pilot may move back and forth across the desired course line.

This movement occurs when your rudder sensitivity is too high or your counter rudder sensitivity is set too low. The autopilot is over-correcting for course errors (refer to diagram on page 65).

To decrease the Rudder sensitivity:

Press the Set Key. The display will show [SLOU] for five seconds. During this five second interval, press the Set Key again and the Autopilot will display the Rudder sensitivity setting.

Press the Red Key once to decrease the sensitivity setting by one step.

To increase the Counter-rudder sensitivity:

Press the Set Key. The display will show [SLOU] for five seconds. During this five second interval, press the Set Key two more times to display the Counter-Rudder sensitivity setting.

Press the Green Key to increase the Counter-Rudder sensitivity setting by one step.

Wait for half a minute to let the vessel settle. To see how straight a course the Autopilot is steering, watch the wake of your boat behind you. If this new setting is still not suitable, repeat the instructions above. Continue this process until your vessel is steering well.

The vessel may also gradually fall off the desired course line:

To increase the Rudder sensitivity:

Press the Set Key. The display will show [SLOU] for five seconds. During this five second interval, press the Set Key again and the Autopilot will display the Rudder sensitivity setting.

Press the Green Key once to increase the sensitivity setting by one step.

Wait for half a minute to see if this is suitable.

If your vessel still does not hold the course, repeat the instructions above.

To decrease the Counter-Rudder sensitivity:

Press the Set Key. The display will show **[SLOU]** for five seconds. During the five second interval, press the Set Key two more times to display the Counter-Rudder sensitivity setting.

Press the Red Key to decrease the Counter-Rudder sensitivity setting by one step.

Turns and Changing Course

While you are travelling slowly, it is a good time to practice using your SI-TEX Autopilot.

Standby

Press the Sby/Off Key briefly. The autopilot is now in STANDBY MODE. This will be indicated by the mark in the top right corner of the display. **[xxx']**

In STANDBY MODE, the autopilot will display the compass heading. You can manually steer your vessel in STANDBY.

Power Steer

CAUTION

If you have a mechanical steering system, activation of either the RED or GREEN Key while in the POWER STEER mode, will cause your steering wheel to move.

Pressing the Red or Green Key in STANDBY MODE switches the Autopilot to Power Steer Mode. The display will have a degree symbol in the top right corner **[xxx º]**. You can now use the Red and Green Keys to steer.

To turn right, press the Green Key. To turn left, press the Red Key.

To return to STANDBY MODE and manual steering control, press the Sby/Off Key briefly.

In POWER STEER MODE, the rudder angle and the rate of turn will increase as long as you hold the Red or Green Key down. When you release the key, your vessel will continue to turn at a constant rate. To decrease the rate of turn, or to go straight, press the other key.

Each time you press the Red or Green Key:

- output indicators appear at the top of the display and,
- the rudder angle is displayed for two seconds.

If you wish to always see the rudder angle, press the Set Key. The display will be locked on.

To return to the compass heading display, press the Set Key.

Pilot Mode

Press the Pilot Key to place your Autopilot in PILOT MODE. The Autopilot will now steer by the compass.

In PILOT MODE the Autopilot display will show the commanded course and a capital "P" at the right-hand side **[xxxP]**.

Small Course Change

To make a one degree course change to the right, briefly press and release the Green Key. The display will change to show your new course.

To make a one degree course change to the left, briefly press the Red Key. The display will change to show your new course.

Dodge

To dodge around an object in the water, press and hold either the Green or Red Key. The letter at the right-hand side of the display will change to a "d" **[xxxd]**. The course will be displayed.

The course will change as long as you hold down the Red or Green Key. The Autopilot will turn your vessel to follow the changing course. Your vessel will turn at a rate of 5º per second in "slow" boat speed setting.

After the key is released, the Autopilot will return to its original course. The display will again show the course with a capital P [xxxP] on the right-hand side.

Large Course Change

There are several ways to make large course changes:

1. Press the Red or Green Key until your vessel is heading on the new course. Press the Pilot Key.

While turning, the vessel's heading usually falls behind the Autopilot's new course. After you release the Red or Green Key the vessel will continue to turn until it reaches the Autopilot's new commanded course as displayed.

When your vessel has settled on its new course, you will likely wish to make fine course adjustments using the Red and Green Keys.

2. First estimate or chart the difference in degrees between your new course and your present course. Press either the Red Key or the Green Key until the course to steer shown on the display is the same as your new course. Press the Pilot Key. Your vessel will turn to the new course.

The speed of the turn will be governed by the Autopilot. The Autopilot will turn the vessel at 5º per second if it is set to the "slow" boat speed setting.

3. A third way to make large course changes is to press the SBY/OFF Key. The Autopilot will go to STANDBY MODE. Press the Red or Green Key to enter POWER STEER MODE and make your course change. When your heading is correct, press the Pilot Key. The SP-70 or SP-80 will steer along the new course.

4. Press the SBY/OFF Key. The Autopilot will go to STANDBY MODE. You will be able to use the steering wheel to set the new course. Press the Pilot Key again, and your Autopilot will steer your boat along your new course.

Setting Fast Speed Rudder & Counter- Rudder Response.

Press the Pilot Key to steer a course by compass. Advance the throttle so that your vessel is moving at cruising speed. With the autopilot ON, press the Set Key. For a five second interval the display will show either **[SLOU]** (slow) or **[FASt]** (fast). This is the rudder response speed setting that your autopilot is currently using. If the display is reading **[SLOU]**, press the Green Key during the five second interval to change the display to the **[FASt]** (fast) setting. Your vessel is now using the fast boat speed Rudder Response settings.

The vessel may move back and forth across the desired course line.

This movement occurs when your Rudder sensitivity is too high or your Counter-Rudder sensitivity is set too low. The autopilot is over-correcting for course errors (see diagram on page 67).

To decrease the Rudder sensitivity:

Press the Set Key. The display will show **[FASt]** for five seconds. During this five second interval, press the **Set Key** again and the Autopilot will show the Rudder sensitivity setting.

Press the Red Key once to decrease the Rudder sensitivity setting by one step.

If your vessel continues to wander across the course line, repeat the above instructions until the Autopilot steers your boat in a straight line.

To increase the Counter-Rudder sensitivity:

Press the Set Key. The display will show [FASt] for five seconds. During this five second interval, press the Set Key two more times to display the Counter-Rudder sensitivity setting.

Press the Green Key to increase the Counter-Rudder sensitivity setting by one step.

Wait for half a minute to let the vessel settle. To see how straight a course the Autopilot is steering, watch the wake of your boat behind you. If this new setting is still not suitable, repeat the instructions above. Continue until your vessel is steering well.

If your vessel falls away from the course line:

The Rudder Response is not sensitive enough (see diagram on page 67).

To increase Rudder sensitivity:
Press the Set Key. The display will show **[FASt]** for five seconds. During this five second interval, press the Set Key again and the Autopilot will display the Rudder sensitivity setting.

Press the Green Key once to increase the Rudder sensitivity setting one step.

If the vessel continues to fall away from its course, repeat the steps above.

To decrease Counter-Rudder sensitivity:
Press the Set Key. The display will show **[FASt]** for five seconds. During the five second interval, press the Set Key two more times to display the Counter-Rudder sensitivity setting.

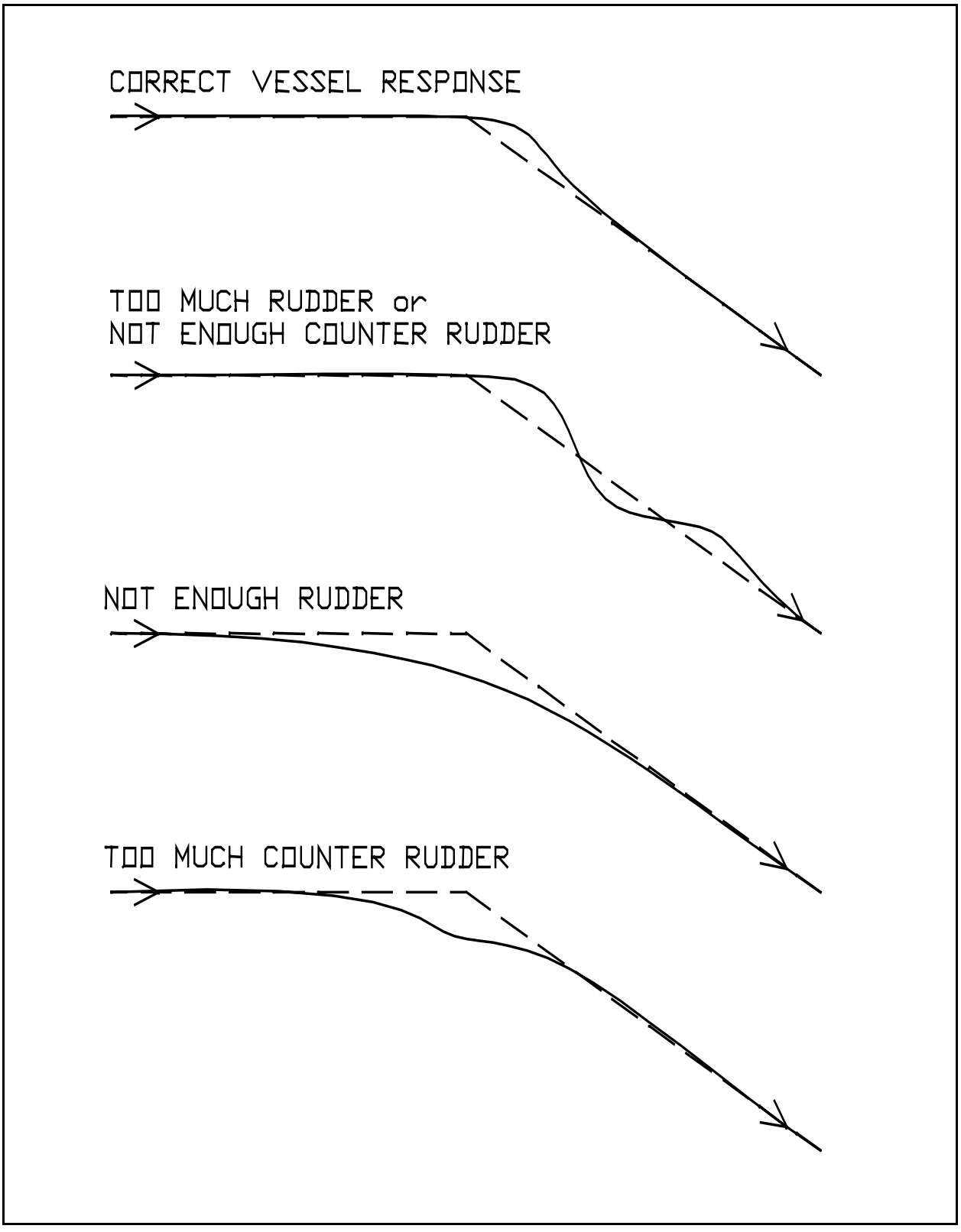
Wait for half a minute to let the vessel settle. To see how straight a course the autopilot is steering, watch the wake of your vessel behind you. If the new setting is still not suitable, repeat the instructions above. Repeat until your vessel is steering well.

Fast Speed Turns and Course Changes

Your vessel will respond more quickly to a Red or Green Key press than it did in the "slow" speed Rudder Response setting. The rate of turn in the "fast" boat speed setting is 10º per second. Experiment with this so that you will be familiar with its effect.

All commands in the fast boat speed Rudder Response setting work as they did in the slow speed Rudder Response setting.

A table of Autopilot commands is on page 73.



Correct Vessel Response During a Course Change

Adjusting Your Digital Rudder Angle Indicator (RAI)

The SP-70 & SP-80 also provide an electronic Rudder Angle Indicator.

You can adjust the R.A.I. so that it accurately reflects your rudder movements.

For this adjustment, you should have your boat out on the water away from traffic lanes. If you have power assisted steering, start with your motor idling so that you can use your power steering.

Press the Pilot Key to turn on the autopilot. Briefly press the Sby/Off Key.

With the Autopilot in STANDBY, use manual steering to move the steering gear from the left mechanical limit to the right limit. Watch the motor or rudder. Estimate in degrees the size of the arc from left to right.

This must be done manually, as the autopilot will not move the steering gear so far that the steering strikes a mechanical limit. The Autopilot sets these electronic limits during the Set-up Routine to save wear on your steering system.

Press the Green Key once and then press the Flush Key twice. The display now shows the total degrees of travel of your steering system. Press the Red and Green Keys to adjust the number until it is the same as your estimation of the actual arc.

A short interval after you have completed your adjustment, the Autopilot will return to its previous display.

Offset

Many vessels always need the rudder positioned to the right or left a small amount. This slightly offset rudder position is needed to correct for the turning effect of a single propeller. To the driver, it feels that this Offset Position is the straight-ahead position or the 0-degree position.

To avoid confusion, the RAI can be calibrated so that it will show zero degrees when the vessel is travelling straight ahead, even if the rudder is slightly offset.

While travelling straight ahead at cruising speed with the Autopilot in POWER STEER, press the Flush Key. Press the Red and Green Keys to adjust the RAI to show zero degrees.

The Autopilot will return to its previous display when you have finished.

Using Your Navigation Interface

To be safe, learn to use your Navigation Interface at slow speeds, away from other vessels.

Turn on the navigation device.

This could be a LORAN, GPS or plotter. Give it time to find its position accurately and turn off its warning indicators.

Enter a Waypoint into the navigation device.

With some navigation devices, it is necessary to tell them to send information to the Autopilot.

With all navigation devices, make sure that it is sending information in the NMEA 0183 format.

Look at the Control Unit display. Press the Nav Key.

The autopilot is now in NAV MODE. The Autopilot will display [xxxn}. The large lower case "n" at the right side of the display shows the Autopilot is in NAV MODE.

If the SI-TEX Autopilot receives usable data from your navigation device, the display will show the course changing towards the new bearing. The SP-70 or SP-80 will bring your boat onto the new course. It will steer towards the Waypoint using the information from the Nav device and the compass.

If the vessel seems to steer away from the course line, or back to it's starting point, push and hold the Flush Key and press the Green Key once. Please read the section called *"Navigation Interface."*

If the autopilot consistently beeps every five seconds and displays [n'dAt] (No Data) then it is not receiving usable data from the navigation device. The Autopilot will stay in the NAV MODE and WILL CONTINUE TO STEER TO THE PRESENT HEADING USING COMPASS INFORMATION.

Please remember that all SI-TEX SP-70 and SP-80 Autopilots are tested at the factory, so the first things to check are your wiring and your navigation device. Read your owner's manual for the navigation device to make sure that it is sending out NMEA 0183 language. Also see the next section: *"Problem Solving"*, for further help.

If the Autopilot intermittently displays [F'dat] (Faulty Data), then it is receiving a warning signal from the navigation device.

Caution

It is strongly recommended that you do not continue to use the NAV MODE if [F'dat] is displayed.

This signal indicates that the navigation information may not be accurate. Check your navigation device for warning indicators such as a flashing light or message.

The Navigation Interface

Your SI-TEX Autopilot will receive information sent to it from a navigation device (such as a LORAN, plotter or GPS) in NMEA 0183 format.

See page 41 for navigation input connection instructions.

Using information from a compass and the navigation device, the Autopilot will steer your vessel along a course line to a waypoint. The Autopilot will also steer your vessel through a series of way points which the navigation device has grouped together as a route.

The Autopilot cannot steer by the information from the navigation device alone.

Cross Track Error

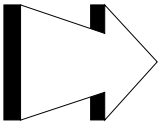
Cross track error is a measure of the distance your boat has fallen away from the course line.

Cross track error is measured as the length of a line drawn from the course line to your position at right angles to the course line.

Cross track error also has a left or right hand direction. For example: The boat can be one half a mile to the left of the course line.

Manufacturers have defined the direction of the cross track in different ways. There is no agreement on whether a left hand cross track error means that the boat is to the left of the course line or the course line is to the left of the boat.

Because of this, the SI-TEX Autopilot lets you change the way it interprets the direction of cross track error. In NAV MODE, press the Flush Key. The display will show either [---'n] (normal) or [---r] (reversed). Use the Green Key to change the setting.
Your cross track error direction is correct if the Autopilot is following the course line.



If the Autopilot is steering away from the course line while the Navigation Interface is on, then the cross track error direction may be incorrect. Change the cross track error sense. If the Autopilot begins steering towards the course line, you have solved the problem.

NMEA 0183

The SP-70 AND SP-80 receives information from LORAN, plotters, and GPS in the *National Marine Electronics Association* 0183 language. A list of the usable data sentences is as follows:

1. RMB + RMC
2. RMB + RMA
3. APB
4. APA
5. XTE + BOD
6. XTE + HSC
7. XTE + WBD
8. VBW
9. VHW
10. VTG

Your SI-TEX SP-70 and SP-80 Autopilot conforms to the standards of the NMEA 0183 language.

Be aware that not all LORANS, GPS, or plotters conform to the NMEA standard. Statements that a GPS, LORAN, or plotter provide navigation data may mean that the data is provided only in the manufacturer's own language.

If you are purchasing a LORAN, GPS or plotter, make sure that it sends out at least one of the listed sentences.

If you have further questions about the purchase of a navigation device, or if you experience difficulties using the NAV MODE of your SP-70 or SP-80 Autopilot, contact your SI-TEX dealer.

SP-70 and SP-80 Operation Commands

COMMAND	ACTION	RESULT
Steer by compass	SP-70/80 is off or in STANDBY MODE. **Point bow and press Pilot Key.**	Boat will settle on course. Display will show **[xxxP].** **x x x P**
Turn OFF	**Press and Hold Sby/Off Key for two seconds.**	Immediately upon pressing the Sby/Off Key you will have manual steering control. The Autopilot will turn off in two seconds.
Course Change: small, left	SP-70/80 in PILOT MODE. **Press Red Key Once.**	One degree course change to left.
Course Change: small, right	SP-70/80 in PILOT MODE. **Press Green Key once.**	One degree course change to right.
Course Change: large, left	SP-70/80 in PILOT MODE. **Press and hold Red Key.** Display will show: **x x x d** Displayed course will decrease. When it reaches your desired heading release the key. **Press the Pilot Key**. Actual vessel heading will likely lag behind displayed course.	Boat will settle on new heading. Display will show: **x x x P**
Course change: large, right.	SP-70/80 in PILOT MODE. **Press and hold Green Key**. Display will show: **x x x d** Displayed course will increase. When it reaches your desired heading release the key. **Press the Pilot Key**. Actual vessel heading will likely lag behind displayed course.	Boat will settle on new heading. Display will show: **x x x P**

Operation Commands cont.

Dodge: left	In PILOT or NAV MODE. **Press and hold Red Key**. Display will show: **x x x d** **Release Red Key to return to PILOT or NAV MODE.**	Vessel turns left. When key is released PILOT display returns and vessel returns to original course.
Dodge: right	In PILOT or NAV MODE. **Press and hold Green Key**. Display will show: **x x x d** Release Red Key to return to PILOT or NAV MODE.	Vessel turns right. When key released PILOT display returns and vessel returns to original course.
Rudder response: change	In PILOT MODE. **Press Set Key once**. Display will show either: **F A S t** or **S L O U** **Press Red or Green Key.**	Autopilot will switch to the other set of rudder response adjustments.
Steer by Loran, GPS or plotter.	Select Waypoint. **Press Nav Key.**	Display will show [xxxn] Pilot will steer by compass and NMEA data received. If no NMEA data received, pilot will remain in NAV mode but will steer by compass.
Dim or brighten lights on Control Unit.	**In STANDBY.** **Press Set Key once.** **Press Green Key to increase or Red Key to decrease brightness.**	Control Unit's backlight will move through eight levels of brightness.
Change from compass display to permanent rudder angle display.	In POWER STEER MODE, press the Set Key.	The SP-70 or SP-80 will constantly display the rudder angle while in STANDBY. Pressing the Set Key again will return to the compass display.

Adjustment Commands

COMMAND	ACTION	RESULT
Rudder sensitivity: increase	PILOT or NAV MODE. Press Set Key twice. Press Green Key.	Autopilot will steer with a "harder" turn to correct course deviations, causing a shorter correction, but more overshoot of the intended course. Changes will only affect the current speed (fast or slow) sensitivity setting.
Rudder sensitivity: decrease	In PILOT or NAV MODE. Press Set Key twice. Press Red Key.	Autopilot will steer with a "softer" turn to correct course deviations, causing a longer correction distance but less overshoot of the intended course. Changes only affect the current speed (fast or slow) sensitivity setting).
Counter-Rudder sensitivity: decrease	In PILOT or NAV MODE. Press Set Key three times. Press the Red Key.	Autopilot will steer with a "harder" turn to correct course deviations, causing a shorter correction, but more overshoot of the intended course. Changes will only affect the current speed (fast or slow) sensitivity setting.
Counter-Rudder sensitivity: increase	In Pilot or Nav Mode. Press Set Key three times. Press the Green Key.	Autopilot will steer with a "softer" turn to correct course deviations, causing a longer correction distance but less overshoot of the intended course. Changes only affect the current speed (fast or slow) sensitivity setting.
Cross Track Error Sense: change	In NAV MODE. Press Flush Key. Press Green Key.	Autopilot will steer properly along course line when Cross Track Error Sense is correct. See Navigation interface section for more information.
Set-up Routine	Pilot is OFF. Press and hold Flush Key. Press and hold Pilot Key.	Set-up Procedure begins.

User Codes for the SI-TEX SP-70 & SP-80

BLED	Bleed mode. See Set-up section.
[NTR	Center the rudder
DTST	Drive Test Display
EEPR	Faulty EEPROM. The autopilot will not function. The processor has failed. Have your autopilot serviced by a SI-TEX dealer.
FAST	Momentarily indicates FAST MODE has been selected
FC (digit) (digit)*	Fast mode counter rudder value
F'CMP	The fluxgate or the magnetic compass sensor is faulty and must be serviced. Contact your nearest SI-TEX dealer.
F'DAT	The autopilot is in NAV MODE. The navigation device is sending the autopilot a warning signal indicating that the navigation data may be faulty. **CHECK:** The navigation device (LORAN, GPS) for warning signals such as a flashing display, a blinking light, or a warning message. You may be able to correct the problem using information from the owner's manual for the device. *It is strongly recommended that you do not continue to operate the SI-TEX SP-70 or SP-80 Autopilot in NAV MODE while it is displaying this error message.*
FLUX	Fluxgate compass detected.
FR (digit) (digit)*	Fast mode rudder value
F'RST	Full reset. The SP-70 or SP-80 requires that the Set-up Routine be repeated. After the Set-up Routine is done, the problem should be fixed. If this error message continues to occur, take your Autopilot to a SI-TEX dealer for servicing.
GHrd	Ghost Rudder active. The Rudder Feedback has failed and the Ghost Rudder program is running. Your Autopilot will work but the quality of steering control will not be as good. **CHECK**: The Rudder Feedback wiring at the Processor. Cancel the alarm using the Pilot Key. The message will reappear whenever the SP-70 or SP-80 is in Pilot Mode. The digital and analog RAI will not work.
X8	The battery voltage is more than 40 volts. If this problem is not fixed, the Processor could be damaged. You could damage your battery if you do not fix this problem. **CHECK**: Your batteries fluid level and the regulator in your generating system.
XEAD*	Faulty Head
XEYS	Stuck key in the control head.
X0 P	Request Rudder Hard Over Port.
X0 S	Request Rudder Hard Over Starboard.

X0T	The Processor is too hot. This is usually due to a very high demand for electrical power from the reversing pump. It could also indicate a failure inside the Processor. **CHECK:** The Processor and the Processor space for heat sources. Should the temperature rise still higher, the SP-70 or SP-80 will turn off the steering outputs. When the temperature falls, the steering outputs will turn back on. We recommend that you have the Autopilot serviced by a SI-TEX dealer before it is used again.
LBAT	The supply voltage is less than 9.5 Volts. The Autopilot cannot operate reliably. **CHECK**: Your batteries fluid level and the regulator in your generating system.
L0AD	This warning indicates that the SP-70 or SP-80 has been producing a larger than normal output current for a period of time. This might be due to increased mechanical resistance in your steering system. If this warning appears after an extended period of use, try to think of something that might have changed after the Autopilot was installed. Has the rudder struck any submerged objects? Are there any bearings that need grease? Is the rudder fouled? If this warning appears when you first use your Autopilot, check that your steering gear moves easily. **CHECK**: Your wiring is correct. Look for any connections which allow a short circuit. If you have an electric motor in your steering system, look for burned or shorted windings.
LT (digit)(digit)*	Light intensity.
M,AG	Indicates magnetic compass detected.
N[ER	No compass error during Dockside Set-up. **CHECK**: • The compass cable is connected to the correct Processor terminals. • There are no poor or loose connections on the Compass cable. • When using a Magnetic Compass Sensor, the sensor reads the Compass card position properly. Some Magnetic Compasses have magnets so weak that the Sensor will not function properly. Press the Pilot Key to clear the alarm.
M;[M,P	Magnetic/fluxgate compass fault
M,DAT	Not receiving NAV Data
NORT	North (see Dockside Set-up),
N0UE	Move. Unsatisfactory compass adjustment. See page 49 or 54.

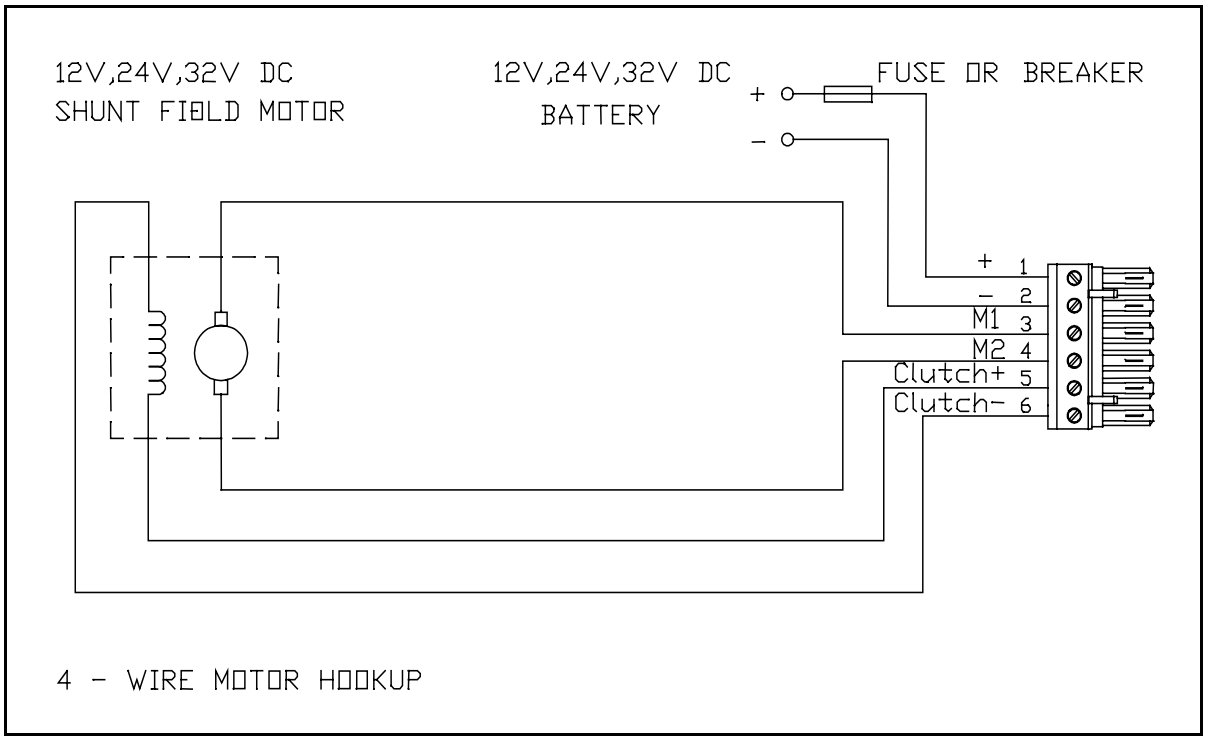
0[VR	The Reversing Pump or the mechanical steering is drawing too much current from the Processor. This may be caused by a defective motor or perhaps because the rudder is stuck. You must take control of the vessel. If you cannot find an obvious reason for the problem, have the autopilot serviced before you use it again.
0FF [0RS	Off course error. Vessel has fallen off course more than 20 degrees for over 30 seconds.
P (digit) (digit)*	Port Rudder indicator
PRON	EPROM Error. This indicates a failure in the Processor. Take the Autopilot to a SI-TEX service center.
RAN	Ram Error. This indicates a failure in the Processor. Take the Autopilot to a SI-TEX service center
RED0	Occurs during Set up Routine. See page 45 or 51.
RFU	Rudder Feedback failure. This message will appear ONLY in PILOT or NAV modes. Digital and analog RAI's will not work. **CHECK:** The Rudder Feedback.
RVDR	The rudder is not moving according to the Autopilot's commands. **CHECK:** The rudder mechanism and the Rudder Feedback.
RT(digit) (digit)*	Rudder travel for calibrating the digital rudder angle reading.
RTST	Rudder test message
S (digit) (digit)*	Starboard Rudder indicator.
SC (digit) (digit)*	Slow mode counter rudder value.
SL0U	Momentarily indicates slow mode has been selected.
-SP-*	Sign-on message.
SR (digit) (digit)*	Slow mode rudder value.
TVRN	While adjusting compass, if the autopilot will not stop displaying turn, you may have such a strong magnetic field aboard your vessel that the compass is not able to sense any motion. If this occurs, try moving the compass far away from it's present location.
UAIT	Wait.

Problems Without An Error Code

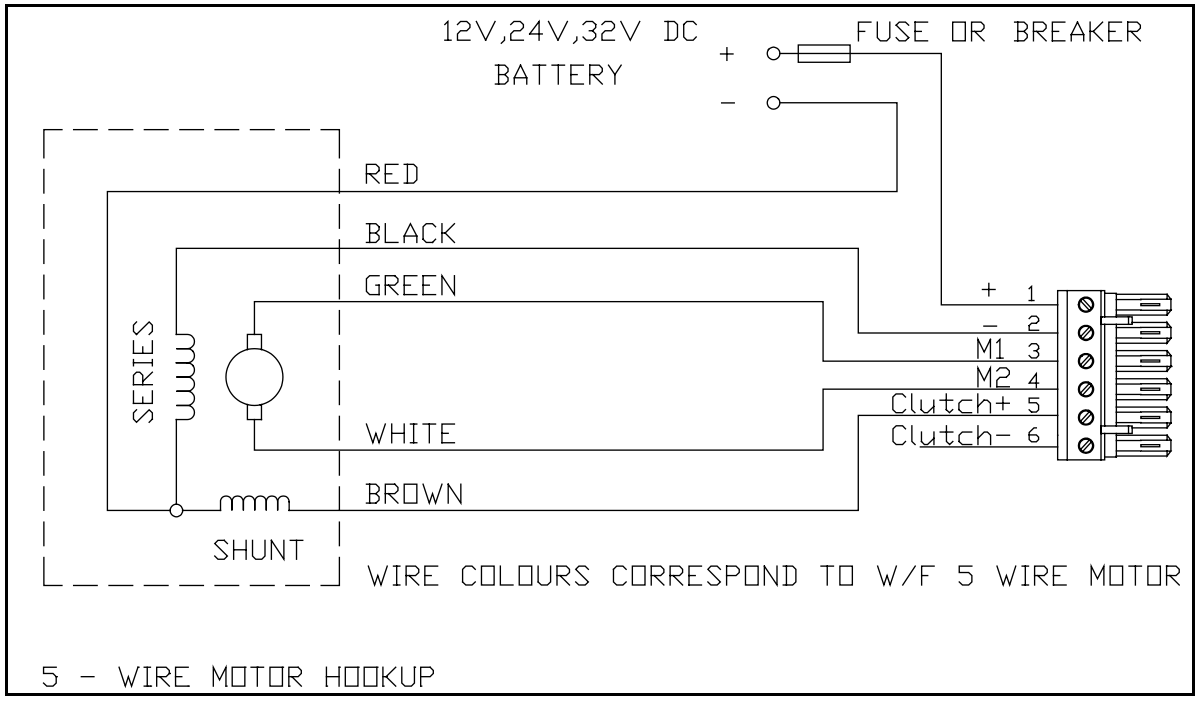
The Autopilot will not turn on.	You have one of the following problems: 1. The battery is dead or the battery connections are faulty. 2. The computer is faulty. 3. The program is faulty. 4. The fuse is faulty and must be replaced. See page 40. 5. A short on the +5V line. Check RFU cable for short between 1 & 3.
The Autopilot starts the Set-up Routine. The display shows **[HO S]**.	The Autopilot detected an error in its memory and then erased the defective memory. You must now do the Set-up Routine. You will not have to bleed your hydraulic system unless you have opened the hydraulic lines or run out of hydraulic fluid. The random occurrence of this problem is possible but unlikely. If this problem occurs twice, your Autopilot may need servicing. Contact your SI-TEX dealer.
The Control Head display goes blank, the Autopilot ceases steering and you have manual control.	The SP-70 or SP-80 Control Head may be disconnected. For safety reasons, should the Control Head inadvertently be disconnected, the Autopilot will automatically switch off. +5V may be shorted due to short on the Rudder Feedback Pot or cable.

APPENDIX A

Connections to 4 and 5 Wire Motors



4 – WIRE MOTOR HOOKUP

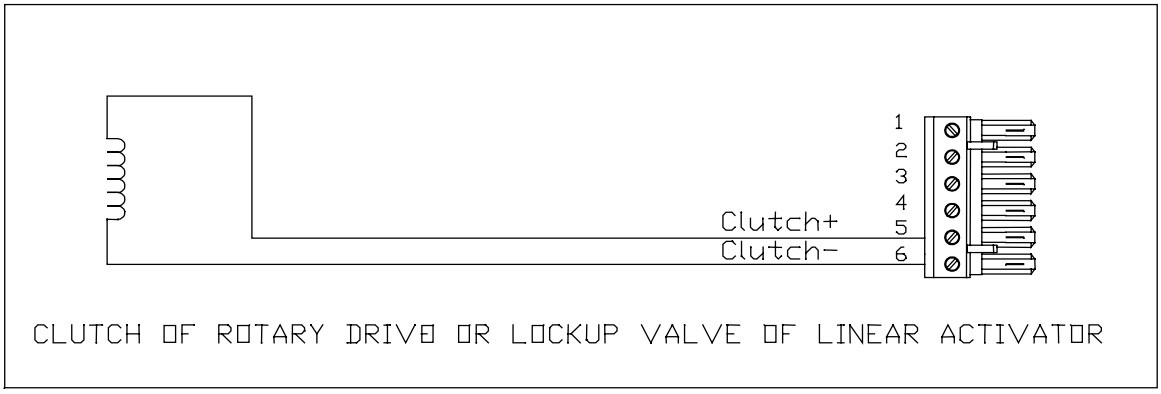


5 – WIRE MOTOR HOOKUP

APPENDIX A

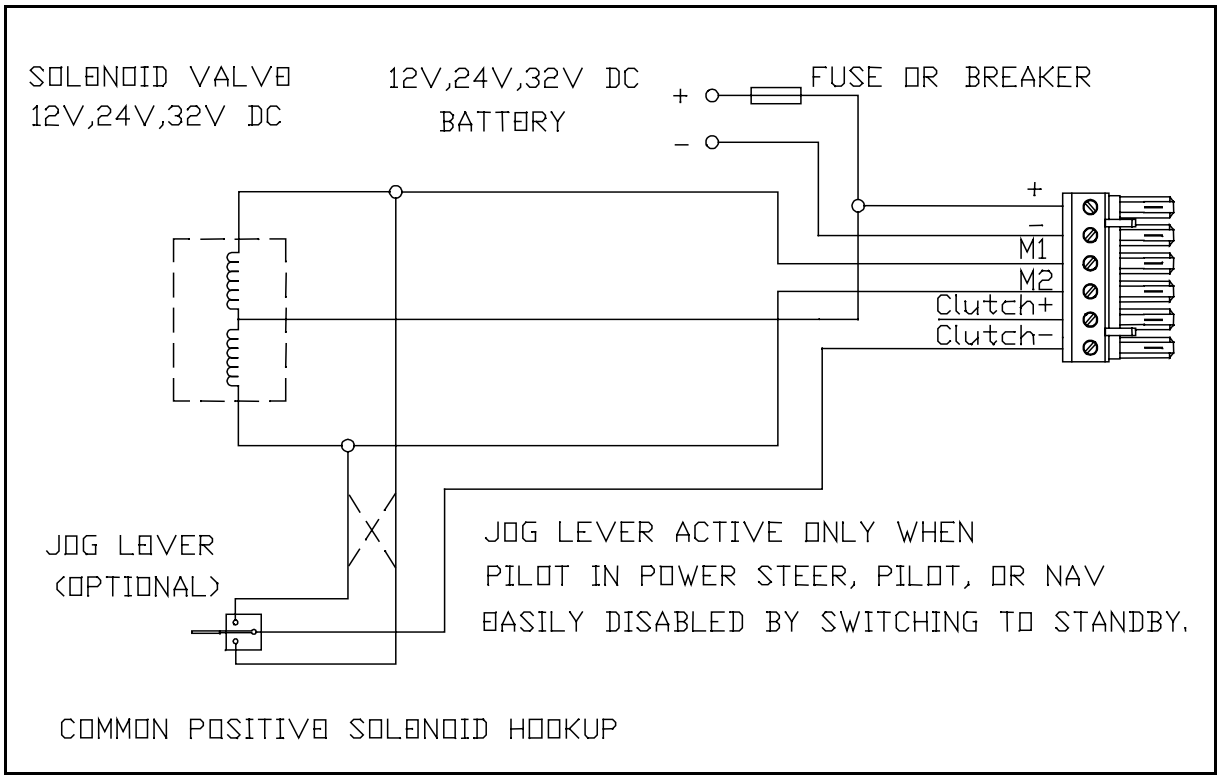
Connections to 4 and 5 Wire Motors (using a clutch or lockup valve)

Rated for 3 amps continously/5 amps intermittently



APPENDIX B

Connections to Solenoid Valves



APPENDIX C

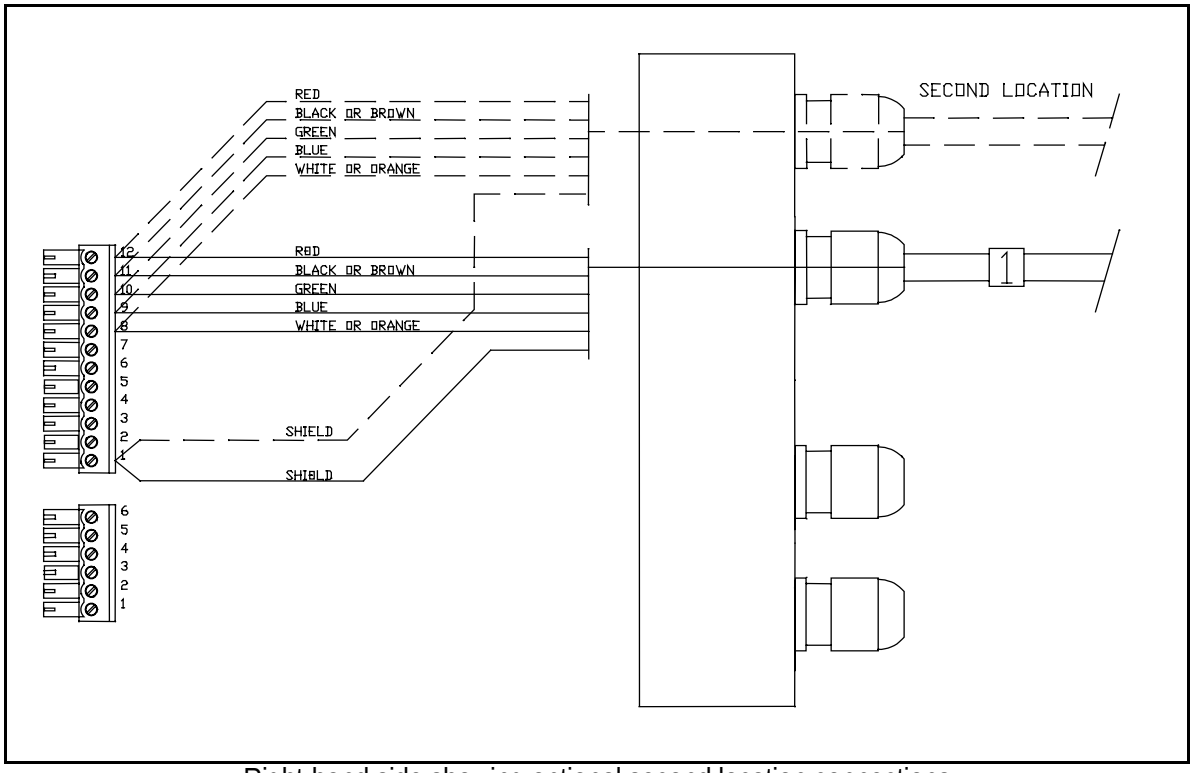
Connecting a Second Location or Second Station Options

Your Autopilot system can support remote autopilot operation in one of two ways:

1) The first option is to install one or more Second Location Kits (part #10080034). This allows the user to connect and use an SP-70 Control head at several locations. If you chose this method, it is important to note that only one SP-70 Control Head can be connected at any given time. You are in fact only moving your Control Head from one location to another.

2) The second option is to install a Second Station Kit (part #10080035). This allows the user to connect two fully functional Control Heads at different locations. Only one of the two Control Heads can be in command at any time, but transferring command from one to the other is as simple as holding down the Red & Green Dodge Keys for 2 seconds.

Second Location Kit



Right-hand side showing optional second location connections

Part Number 10080034

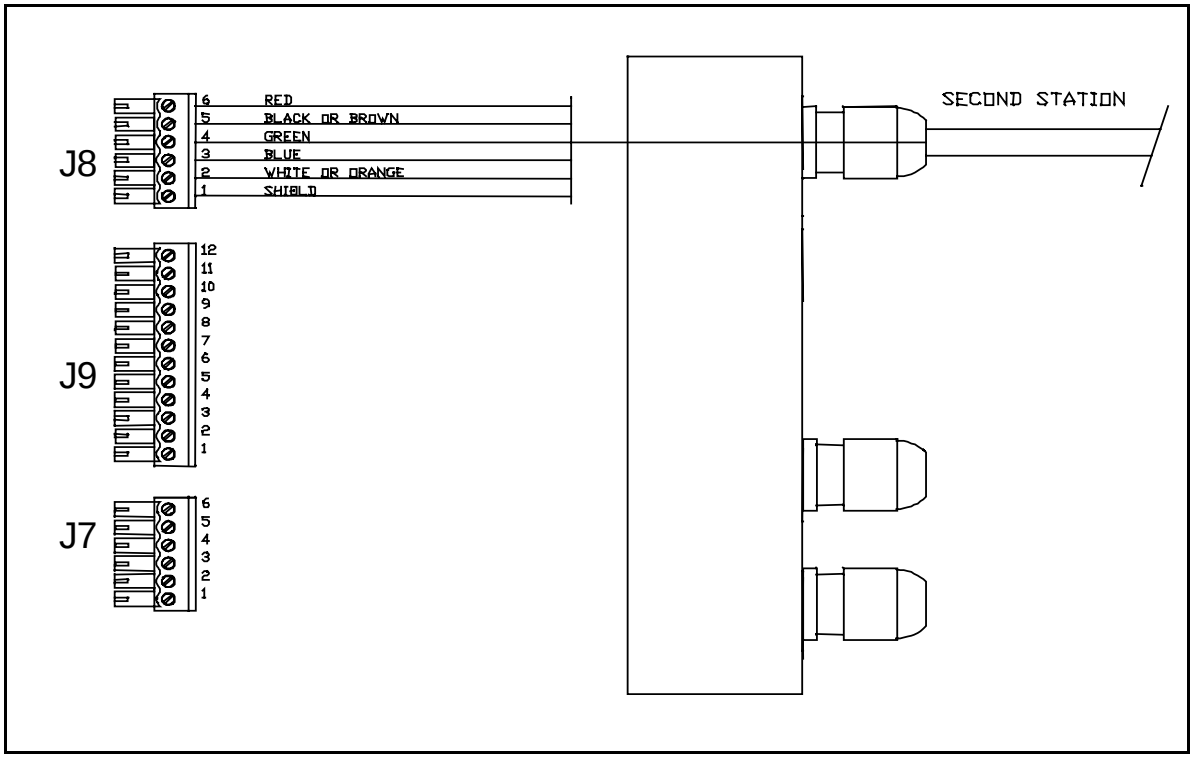
The Second Location Kit contains all the items you will require to install a second location outlet for your autopilot. The kit should contain the following items:

1. 1 only Mounting Clip for the SP-70 Control Unit.
2. 1 only Cable Gland and Nut.
3. 1 only Receptacle and Cap with 30 foot cable.
4. 1 only Stainless Steel mounting washer.

To connect the cable, first loosen off the right-hand cap on the SI-TEX Processor Box and remove the “knock-out” at the top of the cap by using a 9/32 inch (7mm) drill. Once the “knock-out” has been removed, install the cable gland and the cable. Next connect the individual wires on the second location cable to the middle terminal strip, paralleling the existing main receptacle wiring (Cable 1). Test your connections by disconnecting the control unit from the main receptacle and connecting it to the second station receptacle. For specific information on the installation of the receptacle and the mounting clip, please refer to page 25 of this manual.

Second Station Kit

Part Number 10080035



Right-hand side showing optional second station connections

The Second Station Kit contains all the items you will require to install a second station outlet for your autopilot. The kit should contain the following items:

1. 1 only SP-70 Control Head
2. 1 only Mounting Clip for the SP-70 Control Unit.
3. 1 only Cable Gland and Nut.
4. 1 only Receptacle and Cap with 30 foot cable.
5. 1 only Stainless Steel mounting washer.
6. 1 only 6 pin miniature plug.

To connect the cable, first loosen off the right-hand cap on the SI-TEX Processor Box and remove the “knock-out” at the top of the cap by using a 9/32 inch (7mm) drill. Once the “knock-out” has been removed, install the cable gland and the cable. Next connect the second station wires to the 6 position miniature plug according to the above diagram. Insert the plug into the top position on the right-hand side. For specific information on the installation of the receptacle and the mounting clip, please refer to page 25 of this manual.

Operation

The Second Station is identical in operation to the Main Station as described in “Piloting with the SP-70 or SP-80 Autopilot”. Only one of the controls can operate the autopilot at any given time. The unit that is non-active will have a continuously flashing LCD display and the active control will have a steady display. To activate the non-active control, press and hold both the Red and Green pushbuttons for 2 seconds. This control will now become active and go into the same mode as the previously active control was operating in.

Turning the Autopilot ON From The Main Station or the Second Station

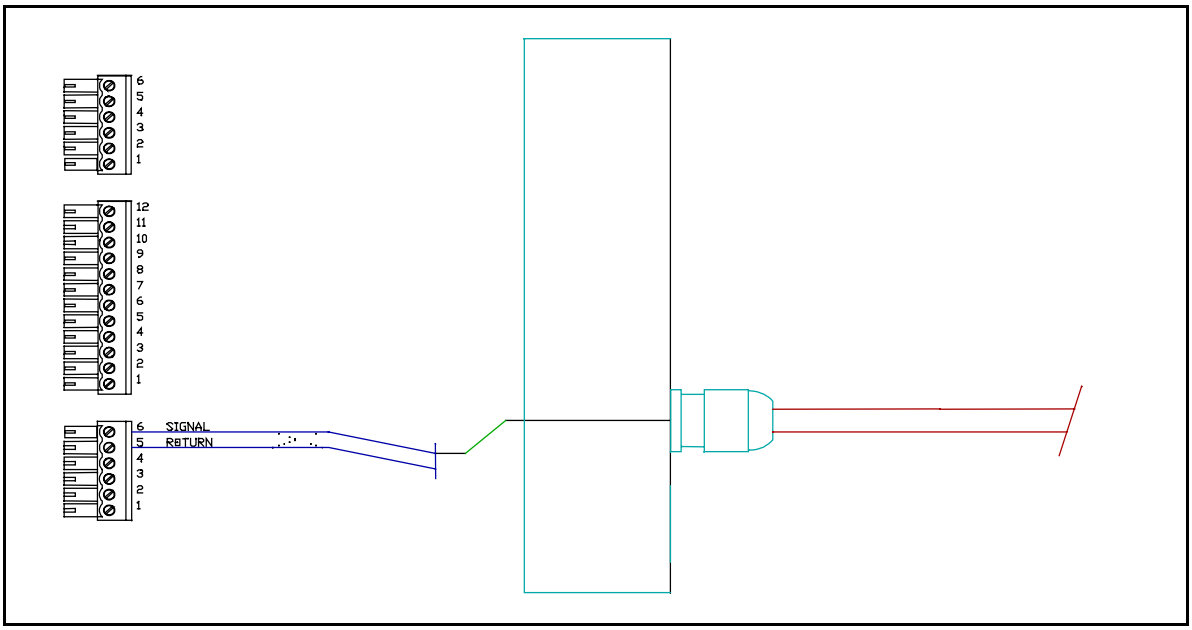
To turn the autopilot on from either the Main Station or the Second Station, press the pilot key on one of these units. The Autopilot will turn on and the same station will become active. The display is solid.

Turning the Autopilot off from the Main or Second Station

The autopilot can only be turned off from the active station. From the station that is in command, press and hold the Off key for 2 seconds. The autopilot system will now turn off.
NON ACTIVE Station: The display keeps blinking or flashing.

APPENDIX D

Connecting a Rudder Angle Indicator

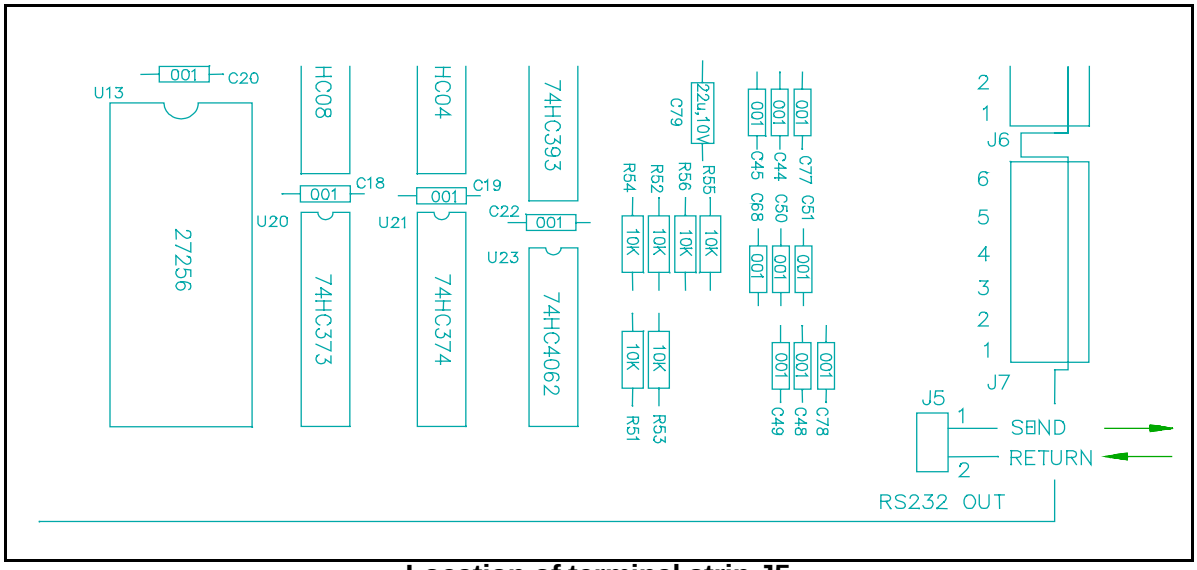


Right-hand side showing optional RAI connection.

The cable gland for a rudder angle indicator is in your Accessory Bag. We **do not** supply a cable for this installation but recommend a #22 gauge, two conductor cable that is **round** in order to make a water-tight seal. The outer diameter of this cable must not exceed ¼ inch (6.5mm) or be less than 5/32 inch (4mm). The gland for this input must be mounted on the end cap. To locate the hole for the gland, look on the inside of the end cap. You will see several places where the plastic has been formed so that a hole may be easily drilled. Drill the hole using a 9/32 inch (7mm) drill. Place the gland from the accessory kit in the hole. Fasten it with the supplied plastic nut and tighten securely.

APPENDIX E

Connecting the NMEA 0183 Heading Output



Location of terminal strip J5

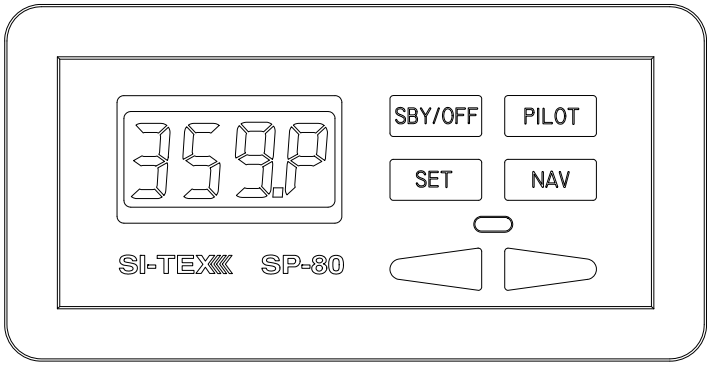
The SP-70 autopilot has a data bus that sends out NMEA 0183 heading information to other external devices such as radars. Heading data is transmitted once per second and provides two data sentences: HDM (magnetic heading) and HDG (magnetic heading, deviation & variation). The signal is transmitted at 4800 baud and has enough output to drive one 0183 "listener". For applications requiring more than one "listener" please contact the factory.

The NMEA 0183 data output format is a two wire signal. One wire (signal) connects to pin 1 of terminal strip J5 and the other wire (return) connects to pin 2 of terminal strip J5. Terminal strip J5 is located in the lower right side of the SP-70 Processor circuit board (see above). The two pin connector required for connecting the heading output is included in your accessory kit.

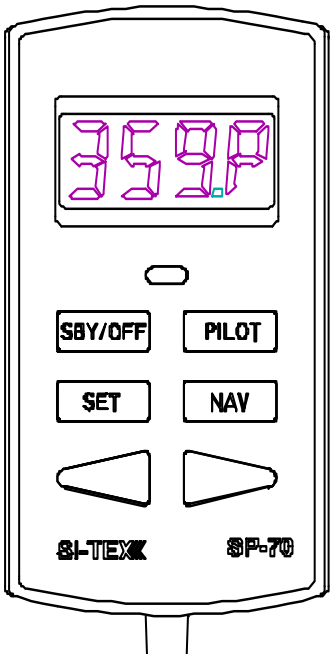
SI-TEX MARINE ELECTRONICS INC

INSTALLATION and OPERATION MANUAL
SI-TEX SP-70 AND SP-80 AUTOPILOTS

Addendum 1
Wiring the Control Unit & Compass
(New Cable Colour Codes)



SP-80 AUTOPILOT



SP-70 AUTOPILOT

Introduction

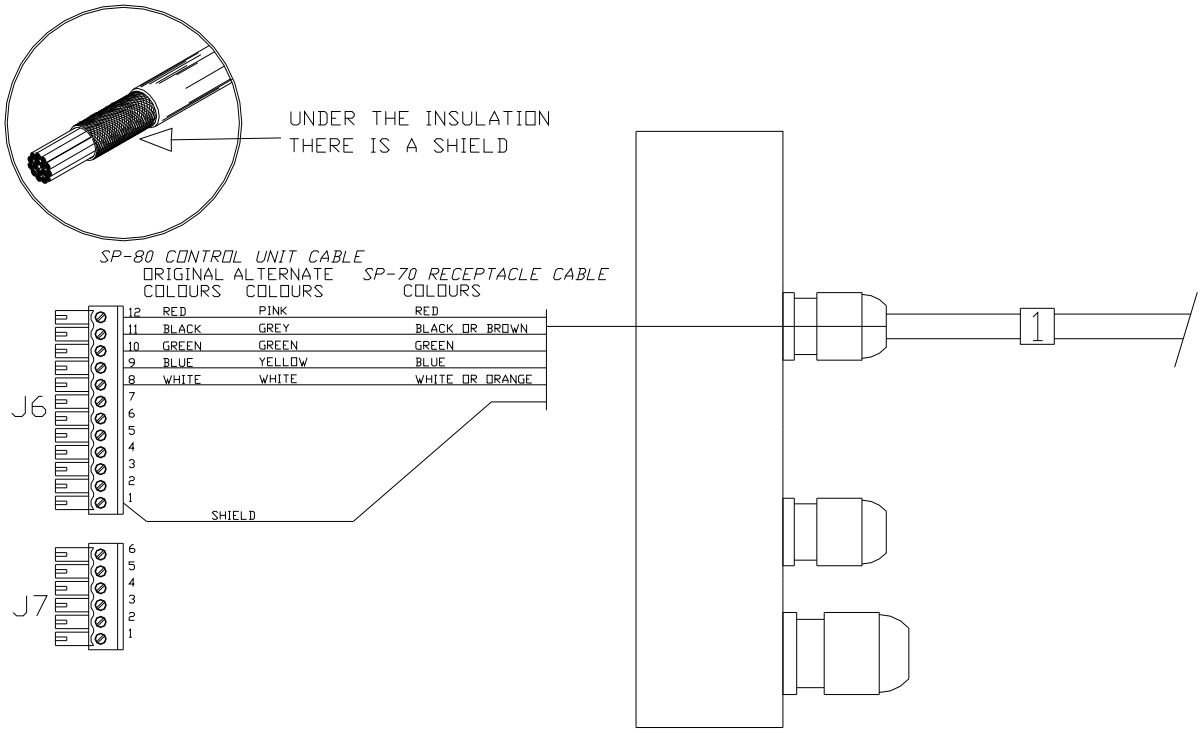
There is an alternate new cable type for the SP-80 Control Unit cable and the Fluxgate Compass cable. This cable has a different colour code than the original cable type, although it is otherwise identical.

As well, there is now an alternate SP-70 Control Unit Receptacle cable, with a different colour code than the original cable.

Starting with systems manufactured in the Summer of 2009, either the original or the alternate type of cable may be used, for any of the items above.

As a result, the wiring information for the SP-70 Control Unit Receptacle cable, the SP-80 Control Unit and the Fluxgate Compass, in the Installation & Operation manual (PN 20910049, version 1.2, April 2004) must be revised.

Please use the next two pages of this Addendum, instead of pages 37 & 38 in the current manual.



Right Side, Cable 1 (Control Unit) to J6

Note: There is an extra wire that is <u>not</u> used, in the Receptacle & Control Unit cables; the wire is yellow on the original cable, brown on the alternate cable.

Right Side Connections

Pull all of the terminal strips from the right hand end of the Processor.

Note that there is an empty socket that does not have a terminal strip. When you replace the terminal strips, do not accidentally place one into the empty socket!

Pass the cables numbered "1", "2" and "3" through the watertight glands on the right end cap, and then connect each cable's wires to the terminal strips, as shown in the diagram above & those on the following pages:

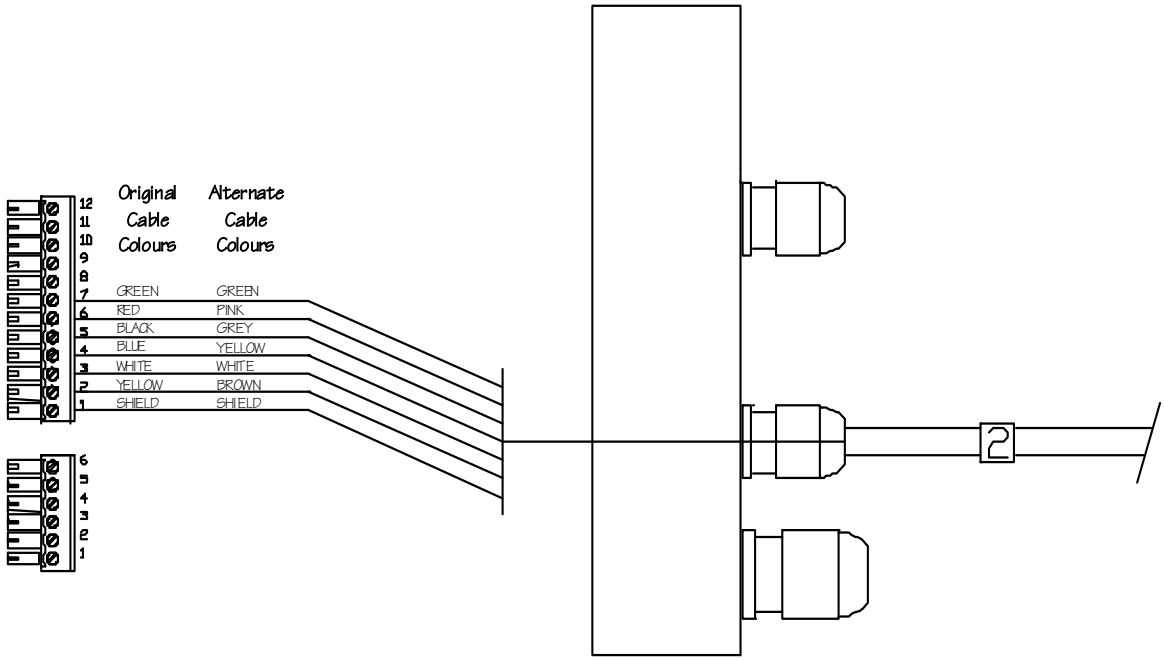
- Right Side, Cable 1 (Control Unit) to J6
- Right Side, Cable 2 (Compass) to J6
- Right Side, Cable 3 (Rudder Feedback) to J7

***Caution**: there are some differences in the colour codes of the cable types that can be used for Cable 1 (the SP-70 Receptacle, or the SP-80 Control Unit), and Cable 2 (the Fluxgate Compass). Pay attention to the colours shown in the wiring diagrams, and in the wiring table on the next page!*

Insert the bared end of the wire into the terminal strip and fasten it there by tightening the screw on the terminal strip. Start from one end of the terminal strip and work to the other in sequence.

Check your work!

Leave the strips unplugged when you are done; they will be plugged back in when you mount the Processor (see page 42)



Right Side, Cable 2 (Compass) to J6

Be Careful

The entire stripped end – but no portion of the insulation – of all wires into the terminal strip plugs must be completely inside the plugs. The stripped ends of wire must not be able to touch each other.

Every wire must be connected to the correct terminal on its plug!

Connections For Fluxgate Compasses

J6 PIN	Cable 2		Signal Function	
	Original Wire Colours	Alternate Wire Colours	SP-70/80 Fluxgate Compass	Other Compass
1	SHIELD	SHIELD	GROUND	GND
2	YELLOW	BROWN	COSINE	COSINE *
3	WHITE	WHITE	REF	REF
4	BLUE	YELLOW	SINE	SINE *
5	BLACK	GREY	DRIVE P2	N/C **
6	RED	PINK	DRIVE P1	N/C **
7	GREEN	GREEN	+12V	+12V

* *If the compass reading is reversed, swap these two wires*

** *These wires must not be connected to any compass other than the one supplied with the SP-70/80*