

# SP120 Autopilot

## User Manual v1



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**IMPORTANT: PLEASE RETAIN ON BOARD**

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- The autopilot is a navigational aid; an adequate watch must be maintained at all times when autopilot is in use.
- The autopilot must be placed in manual mode when the vessel is stationary as the system will continue to drive the rudder to the end of its travel and damage the system can result.
- It is strongly recommended that the autopilot not be used while navigating in restricted waterways as water currents, wind changes or radio transmitter interference can endanger your own or other vessels.
- If a GPS is connected to the system, the auto mode will not engage below a speed of one knot and will disengage from auto when the vessel slows to one knot.

The SP120 Autopilot control system comprises the following units:

- SP120 display and control head.
- SI-TEX E-compass
- Rudder Feedback Unit (SP120R only).

In addition the SP120 has to be connected to a drive unit which controls the rudder actuator system in order to complete the full autopilot system. The actuator system provides the physical movement to the rudder responding to the direction of control signals provided by the SP120. A rudder actuator system comprises one of the following:

- Hydraulic system with helm pump and ram
- Mechanical steering system

The autopilot should be connected to a:

- Reversing motor / pump set connected into the existing hydraulic steering system; or
- Reversing mechanical drive unit connected to the existing steering mechanism

## Installation of System Components:

Ensure you have all the components of the autopilot.

Tools required:

- Screwdrivers – flat blade and Phillips
- Side cutting pliers
- Wire strippers
- Spanners (various) or adjustable spanner
- 75mm (3") hole saw
- Power drill +assortment of drill bits
- Multi meter (DVM)
- Ancillaries such as tape, connecting block, screws, cable ties, etc.

Access for wiring must be provided. Cables have to be run to the power switchboard, display, compass, rudder feedback (if fitted) and drive unit.

All wiring should be kept as far as possible from radio aerials and aerial cables to prevent interference to the radio and to prevent transmitted signals from the radio influencing the SP120.

The compass must be mounted a minimum distance of 1 meter from any boat compass, radios, speakers or other products with magnetic properties to avoid interference.

The SP120 must have a direct connection to power supply via a 15 amp circuit breaker or a 15 amp fused circuit and an isolating switch.

## Display Unit

### Position:

The SP120 Head unit should be mounted in a position accessible to the steering position and protected from direct rain or salt water

- Select a dry position
- For in dash mounting cut a 75mm (3") hole (an optional mounting bracket is available and may be used for display mounting– see your supplier)
- Drill mounting screw holes
- Mount the display using screws supplied (304 SS – 6G)
- Fit dome plugs to cover screws
- Ensure motor (yellow) and clutch (green) wires are not exposed before connecting power to the SP120
- Connect red wire to + 12 volts DC (Positive)
- Connect black wire to - 12 volts DC (Negative)



**SP120 Display (Rear) Wiring Diagram**

## Overview

### Standard Equipment

- SP120 CDU 'Control Display Unit'
- ELECOM - electronic compass / e-compass
- RFUS - rudder feedback unit (optional)

### Additional Equipment Required (not standard supply)

1. **Drive motor** – to allow the SP120 to control the vessels steering system.
  - Hydraulic steering systems with a helm pump and ram will require one of the following;
    - Reversing hydraulic motor/pump-set, tapped into the existing hydraulic steering system or;
    - A constant running hydraulic pump with direction control solenoids.

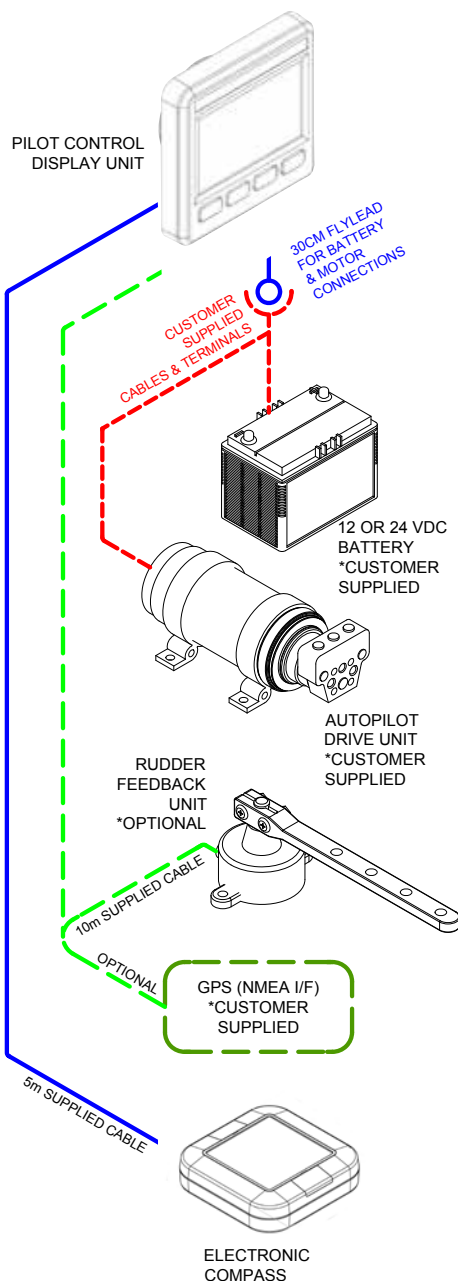
A mechanical steering system will require;

- a reversing mechanical drive, connected to the existing steering ram mechanism.

### 2. Termination hardware;

- Terminal blocks (suitable for 0.75mm<sup>2</sup> and 2.5mm<sup>2</sup> cables)
- Circuit breaker / switch (15A rated)
- Wiring extension cables / ferrules / crimp lugs & related crimp tools
- 2c x 2.5mm<sup>2</sup> for extending motor and power cables (larger for long cable runs)
- 1 pair 0.75mm<sup>2</sup> for each NMEA interface cable

## System Block Diagram



# System Components / Installation Guides

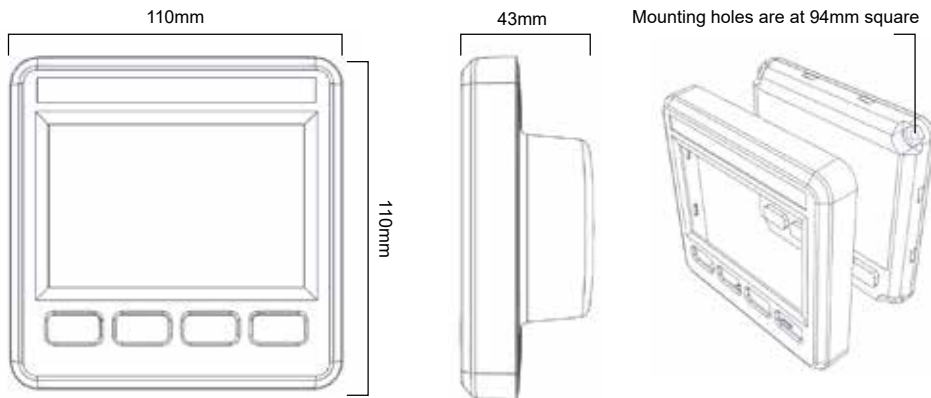
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## SP120 - Control Display Unit

- Steering control system for 4.0m - 16m vessels;
  - 'Virtual Rudder Feedback' feature, where no RFU requires to be installed.
  - 3 Control Modes – Manual Mode, Auto Mode and GPS mode
  - Live indication for 'Steering mode', 'Position & Waypoint Info', 'Heading', 'Course to Steer', 'Rudder angle', 'System Voltage' and 'Drive Current'
  - Supports all current NMEA-0183 interface standards;
  - Heading: HDG, HDT, THS, HDM/ ROT & COG
  - GPS: APA, APB, XTE, BOD, BWC & RTR \*for GPS steering mode
  - GLL, RMC, SOG, VTG \*for visual indication and assisting AUTOPILOT control
  - 30cm fly-lead for drive motor and power connections
  - 6 pin LTW connectors for Compass and Rudder/NMEA-0183 interfaces
  - Power: 12-24 Volts DC (Up to 29V During Charging)
  - Drive output up to 35A. \*If current exceeds 35A, the drive output is inhibited.
  - Software controlled rudder limits, inhibits drive control at each mechanical limit.
- 
- Additional auto switching fail safes, in case of failure of RFU or E-compass;
    - If RFU fails, the system will revert to Non-RFU mode automatically.
    - If a GPS system is connected and the standard supplied E-Compass fails, the SP120 system will automatically revert to GPS 'COG' mode for heading reference.

# Installation

## SP120 CDU Installation Dimensions



## SP120 CDU Installation Guide

- The SP120 Head unit should be mounted in a position accessible to the steering position and protected from direct rain or salt water.
- For in dash mounting cut a 75mm (3.0") hole
- An optional mounting bracket is available and may be used for desktop mounting - see your supplier
- Drill mounting screw holes
- Mount the display using screws supplied (304 SS – 6G)

**NOTE:** Use the protection cover when the system is not in use, to protect the screen and casing from UV and other physical damage

## ELECOM Electronic Compass (E-Compass V.3)

Take care when handling the compass as it is a sensitive piece of equipment.

The compass position is the most important item in the installation of the autopilot. Good course holding is dependent on the compass being free from magnetic interference and excessive rolling or pitching.

### E-Compass Specifications:

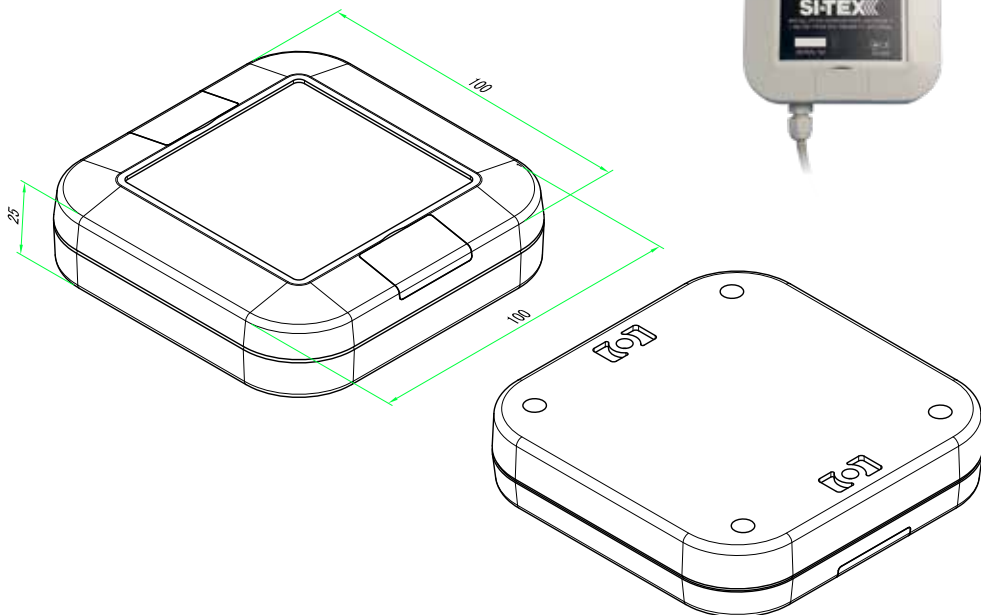
- Output based on NMEA 0183 standards
- Protocol Settings: 4800–8–N–1
- Output Sentences: HDM & ROT
- Power supply: 12-24 VDC <1Watt
- No moving parts to prevent mechanical wear-out, small size and high reliability.

- Solid state electronics with tilt and roll compensation up to 35degrees.

### **E-Compass Installation Guide:**

- **IMPORTANT!** The compass must be fitted in an area at least 1 meter away from steel objects.
- Avoid positions near radios, speakers, aerials, antenna cables or any other current carrying cables.
- Select a dry position free from magnetic interference.
- If system is fitted to a steel hull vessel, the compass must be mounted at least 1m above the steel structure on a non-magnetic post or bracket (aluminum and wood are good options in this case)
- A lower / aft mounted position along the center of the hull is preferred, to reduce the influence of vessel roll and pitch.
- Check other side of bulkheads and deck heads for magnetic interfering type objects before mounting.
- Mount the compass horizontally with the arrow (bow) pointing to the front of the vessel, preferably on a stainless steel, wooden or plastic bracket.
- Use non-magnetic screws to mount the compass unit (316 grade stainless steel)
- The unit must be mounted on a flat horizontal surface.
- Before selecting the E-compass installation position, it is good to test the installation position is free from interference by checking the location with a portable magnetic compass.

### *E-Compass Dimensions*



# Rudder Feedback Unit

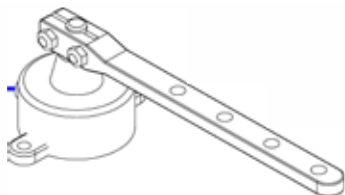
## Rudder Feedback Unit (RFUS)

The RFU is optional, although recommended for the best possible performance on some types of vessels.

For example: A RFU must be installed on vessels with high sides that are sensitive to winds turning the boat, or high powered 5-6m Deep V (22-25 deg dead rise / 175HP+) type vessels used in rough seas and high winds. Or any other vessels that are overly sensitive and very responsive to small amounts of 'rudder' at high speeds.

When the RFU is installed, the configuration settings are simplified. Non-RFU mode is slightly more complicated.

**NOTE:** *The RFUS is factory aligned. The arm should not be removed or loosened. It is also water resistant, however, if mounted in a wet position some protection should be provided to prevent water damage or physical damage.*

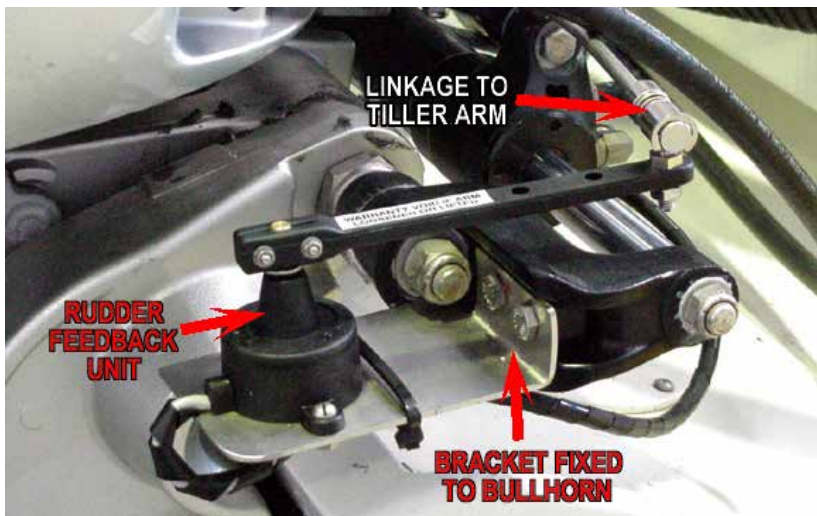
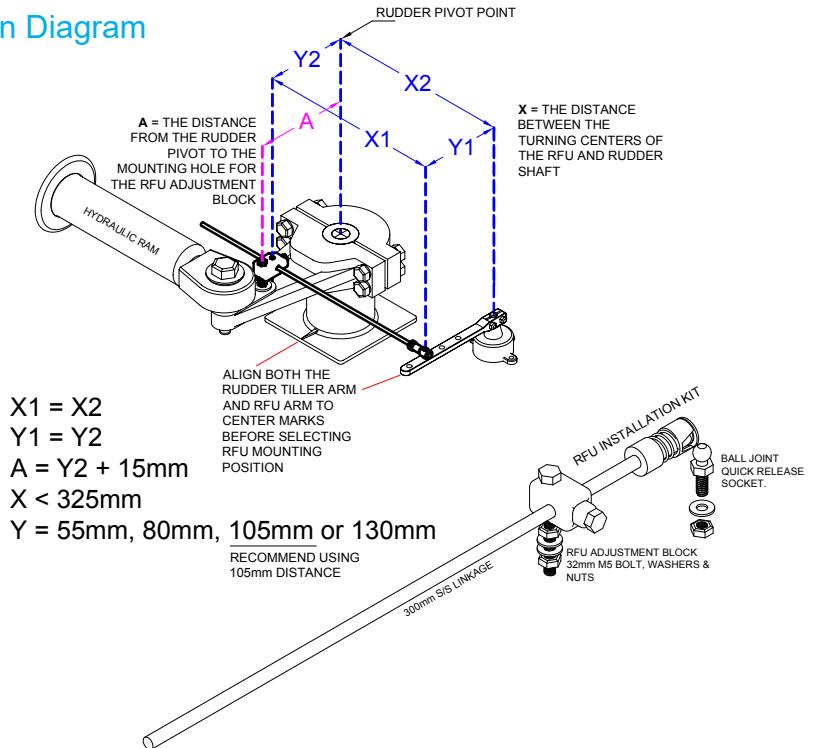


## RFU Installation Guide

1. Refer to installation diagram and installation template supplied with the unit
2. Mount rudder feedback adjacent to the tiller (**NOTE:** *rudder feedback movement must copy the angular movement of the tiller like a pendulum*)
3. Use a mounting bracket if required.
4. Note the markings on the rudder feedback unit. 'P & S' (Port and Starboard) to check ruder moves in the correct direction, manually, before testing on the water.
5. Check installation is suitable by slowly moving the steering manually, to ensure:
  - a. The direction indicated on the top of the RFU is correct
  - b. No undue mechanical strain is placed on the feedback or linkage. (Also check for strain when the tiller is tilted upright (for outboard engine installations))
6. To complete the install, use the SP120 advanced menu to calibrate the rudder limits and center point of the RFU.

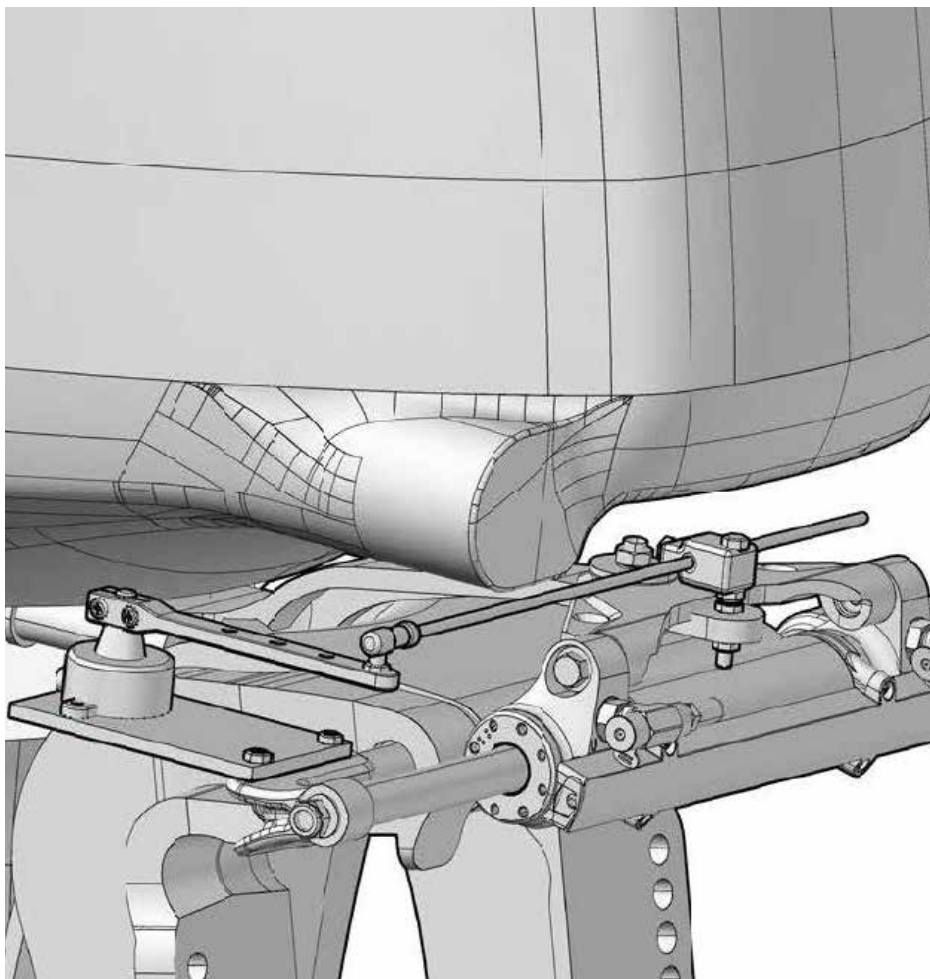
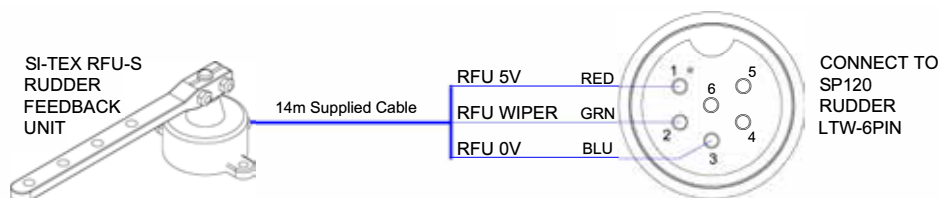
# Rudder Feedback Unit

## Installation Diagram



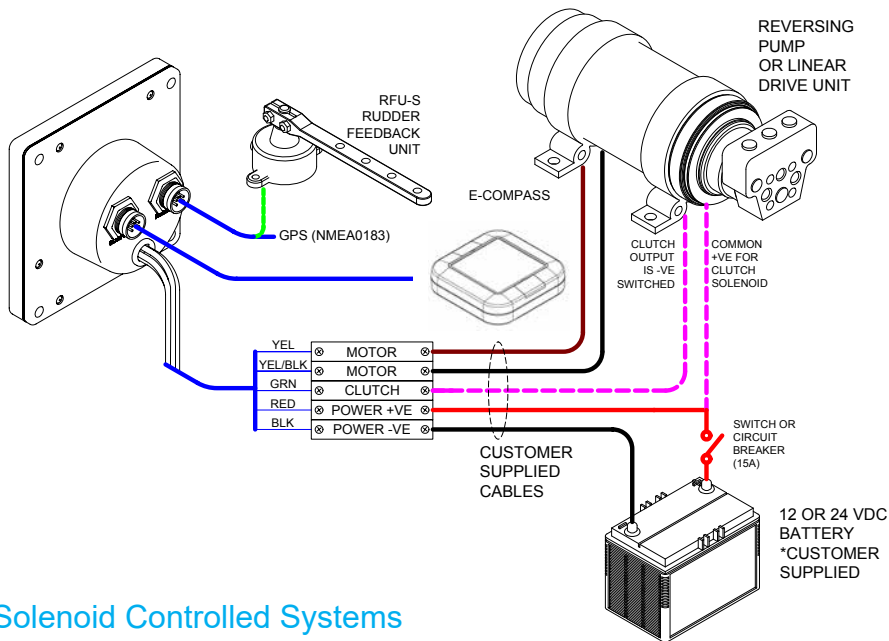
# Rudder Feedback Unit

## Rudder Feedback Unit Wiring

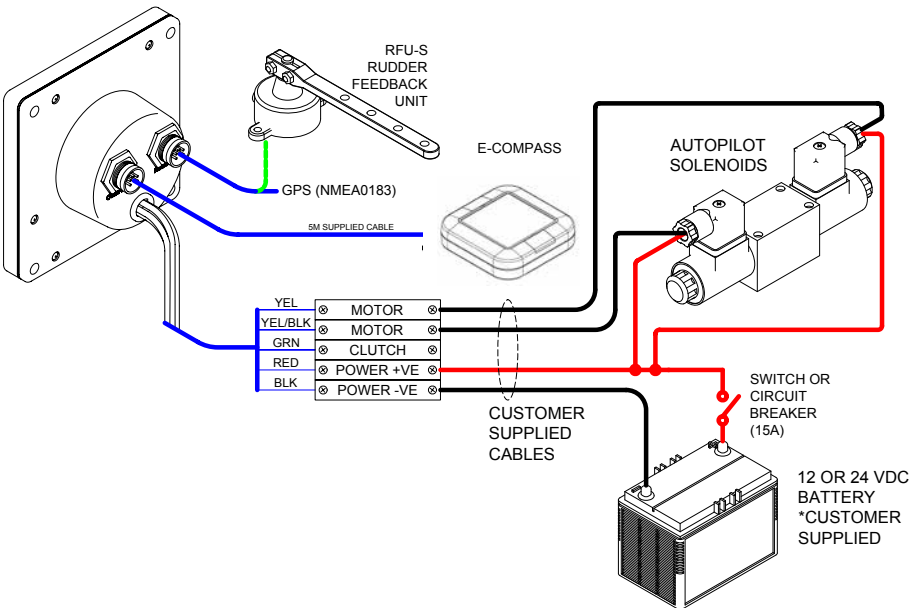


# Installation & Wiring

## Reversing pump or linear drive systems



## Solenoid Controlled Systems

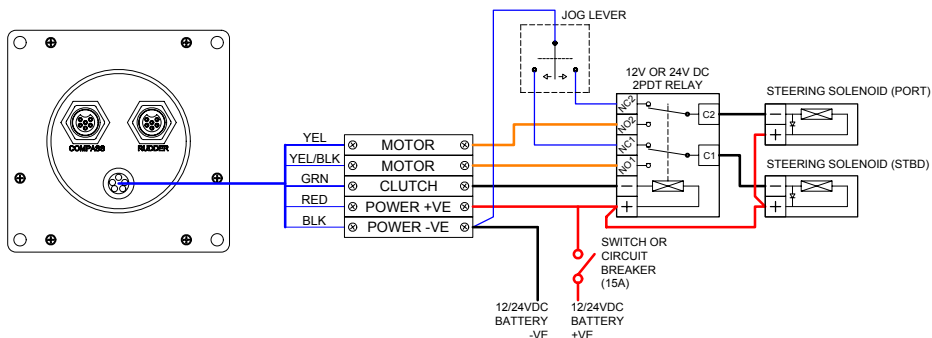


# Wiring Information

## Solenoid Valves - Important Information

If an emergency jog lever is fitted then the motor outputs must be isolated! to prevent damage to the drivers. To isolate, a 2 pole change over relay must be installed between the SP120 and the Solenoids, as per diagram below;

Also as a preventative measure to ensure voltage spikes do not interfere with the AUTOPILOT or other equipment, spike suppression diodes should be fitted on solenoid valves.

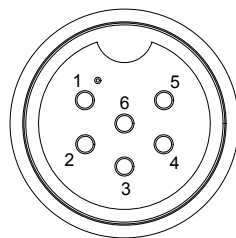


## Rudder Connector

Pin connections from rear of plug, solder connection side.

**NOTE:** Pin 1 has dot adjacent.

- Pin 1 5V RFU Supply
- Pin 2 RFU Wiper
- Pin 3 0V RFU Supply / TX- RS-232 GND
- Pin 4 TX+ RS-232 Data + (heading information)
- Pin 5 + GPS Input (Positive)
- Pin 6 - GPS Input (Negative)



## Supplied GPS Cable (for NON-RFU models)

The standard system is supplied with a short 4 core 30cm fly-lead, for wiring direct to a GPS unit. See below for the color codes used for external connections;

**NMEA input from GPS:**

- Pin 5 +GPS Input (Positive) White wire
- Pin 6 - GPS Input (Return) Green wire

**NMEA output for Heading data to external systems:**

- Pin 4 + Heading Data Out (Positive) - Red wire
- Pin 3 - Heading Data Out (Negative) - Blue wire (0 volt line)

**NOTE:** For further interfacing information, refer to the installation manual supplied with your GPS unit.

## Hydraulic Reversing Motor Connection

- Route suitable two core cable (10 amp min) from motor to SP120 display
- Connect motor cable to the yellow and yellow/black motor wires at SP120

### NOTES:

1. *With SP120 in MANUAL yellow motor wires are both at + 12 VDC*
2. *Yellow/black wire will give negative voltage out when port rudder movement is required.*
3. *Motor direction can be checked with SP120 in MANUAL by pressing ◀ or ▶ once power has been connected to the SP120*

## Mechanical Reversing Motor Connection

- Route suitable four core cable (10 amp min) from motor to SP120 display
- Connect motor wires to the yellow and yellow/black motor wires at SP120
- Connect one clutch wire to green wire at SP120
- Connect second clutch wire to + 12 VDC voltage supply

**NOTE:** *If a linear hydraulic drive is used, the connections are for mechanical drive.*

## Initial Operational Settings

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The initial set up of the SP120 is done once the system installation is complete and power has been connected to the SP120 display control. The set up can be done automatically or manually

Automatic installation set up determines the output polarity for motor direction and rudder limit setting. This method can only be used where a rudder feedback is fitted. The installation procedure is designed to work on a rudder speed of 8 to 20 seconds hard over to hard over. The process may fail with faster or slower rudder movement in which case the manual set up should be used.

The maximum rudder travel will be set to approx. 33° each side in the automatic set up.

**NOTE:** *If the manual set procedure is used both motor direction and rudder must be set individually.*

## Motor Direction – Automatic Set up

To commence:

- Switch power on to SP120
- MANUAL light is lit
- Press MODE button until display shows InSt
- Press ◀ and ▶ together to start the process
- Display will show UAIt (Wait)
- Process will take between 20 and 60 seconds to complete depending on the speed of the motor
- If process is successful display will show dOnE (Done)
- Press either MODE or AUTO to cancel the installation process
- Display will show CAnC (Cancel)
- If ErrO is displayed an error has occurred
- Check the drive output is connected and rudder feedback is moving
- If FAIL is displayed the installation process has not been successful because rudder travel angle is too narrow
- Check rudder feedback installation

## Motor Direction – Manual Set up

- Switch power on to SP120
- MANUAL light is lit
- Display indicates compass heading – example H123
- Press ◀ Rudder should move to port
- Press ▶ Rudder should move to starboard
- If direction is incorrect, reverse the yellow wires.

## Sensitivity

*Available on the SP120R version only.*

Factory default setting is 04 and should only be altered during sea trials

- SP120 in MANUAL
- Press MODE button until display shows 04
- Press ▶ to increase setting (more tolerance to the rudder position error)
- Press ◀ to decrease setting (less tolerance to the rudder position error)
- Display returns to MANUAL and shows heading after 3 seconds

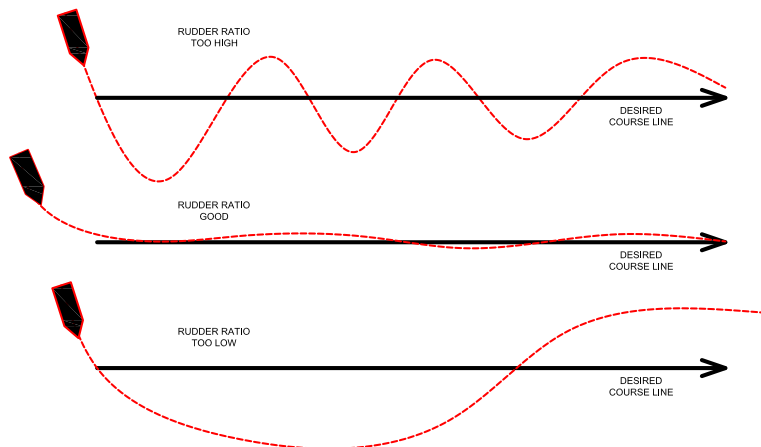
## Rudder Ratio

Factory default setting is 03 and should only be altered during sea trials

- SP120 in MANUAL
- Press Mode until display shows r 03
- Press ▶ to increase setting (larger rudder ratio)
- Press ◀ to decrease setting (smaller rudder ratio)
- Display returns to MANUAL and shows heading after 3 seconds

**NOTE:** *A value of 1 signifies the minimum amount of applied rudder. When the rudder setting is too low, vessel track will be a slow “S” i.e. : understeer through too little rudder applied.*

A value of 20 signifies the maximum amount of applied rudder. When the rudder setting is too high, vessel track will be a rapid “S” i.e. : oversteer through too much rudder applied.



## Backlighting

When using the autopilot at night, the backlighting can be turned on.

- Press MODE four times SP120R
- Press MODE until display shows LitE
- Press **e ►** to increase the backlight
- Press **◀** to decrease the backlight

## Set Rudder Limits

Available on the SP120R version only

- SP120 in MANUAL
- Press MODE until display shows PL -- (port limit)
- Turn boat helm until rudder reaches required angle - example 28° Port
- Press **◀** and **►** together to save this setting
- Press MODE again until display shows SL -- (starboard limit)
- Turn boat helm until rudder reaches required angle - example 28° Stbd
- Press **◀** and **►** together to save this setting
- Press AUTO to return to MANUAL

## Compass Heading

- Switch on power to SP120
- Check display heading - example H 123
- Check this heading against a known accurate bearing
- If display reading differs from known heading\*, the compass can be calibrated.

**\* NOTE:** *Compass headings rarely agree on every heading for 360° rotation. The compass heading is set for optimum alignment only*

## Compass Calibration

To carry out this procedure the boat must be in open waters and be able to safely turn through 360°.

- Switch on power to SP120
- Press MODE button until display reads CCAL
- Slowly turn boat in a circle
- Display shows dOnE when calibration is complete

## Compass Alignment

The compass may need to be aligned with a known heading

- Loosen the two mounting screws on the compass base plate
- Rotate compass until display reads the same the known bearing
- Re-tighten the screws

## Technical Adjustments

These procedures are used to adjust internal parameters of the SP120. Each routine can be set or reset and can be displayed individually.

To enter the procedures:

- SP120 in MANUAL
- Press MODE until display shows P-41 (if the firmware version is 41)
- Press ► to access the first technical parameter
- Display changes to 1- 02
- Press ◀ and ► together to entered the first routine
- Display changes to 1= 02

- Change the setting by pressing ◀ or ► to increase or decrease
- Press ◀ and ► together accept the new setting
- Display changes back to 1 - 03 (example if setting was increased by one)
- Press ► again to access the next routine and continue as above

Press MODE or AUTO to return SP120 to MANUAL operation.

## Parameters List:

### 1. Pulse Drive Time

The minimum pulse width when the autopilot is in NO RFU mode.

When the system is near to the desired position, the pulse of current applied to the motor will have this length. This parameter is not used when in RFU mode.

This parameter may be necessary to be increased if the rudder is not moving and the course error of the boat is bigger than the dead band. It depends on the power of the system which moves the rudder and the inertia of the rudder. The pulse must be long enough for start moving the rudder.

Range: 0 to 99

Recommended: 25

### 1. Reverse Delay

Sets the delay time between rudder movement direction changes. The purpose of this parameter is to prevent damage to the system that moves the rudder due high electrical currents.

Range: 0 to 99

Recommended: 40

### 2. Dead Band

Sets the tolerance in degrees concerning the desired heading. For example, if the desired course is 90° and the dead band is 1°, the control will actuate for correcting the heading when it is out of the interval from 89° to 91°.

The dead band can not be zero, as there are some oscillation in the heading readings due the movement of the waves and the accuracy of the compass.

Range: 0 to 50

Recommended: 5

### 3. Maximum Rate of Turn

It limits the rate of turn of the boat, mainly when occur big changes in the desired course.

The bigger the course error of the vessel, the faster is the turn speed calculated by the control for correcting this error. Therefore, it has to have a limit on this turn speed accordingly to the type of boat.

The number of this parameter represents the degrees per minute allowed.

Range: 0 to 400

Recommended: 250 (260°/min)

### 4. Minimum Speed in Knots

Set at 1 knot in the factory, it gives the minimum speed acceptable for turning on the autopilot in NO RFU mode.

The position of the rudder will turn the boat as expected only above of certain speed. Therefore, it is necessary to set a minimum speed for the control start working.

Range: 5 to 100

Recommended: 10 (1.0 knot)

### 5. rF – 0: no rudder feedback mode 1: with feedback mode

When it is not provided a rudder feedback sensor in the vessel, this parameter must be set to 0. With this information, the control will make its calculations based only on the heading readings

Range: 0 or 1

Recommended: 1 if there is an RFU available

### 6. Integral Control Gain

Sets the integral parameter for the PID control. It is used only when in RFU mode. See the section “Adjusting the PID control” below for further information.

Range: 0 to 99

Recommended: 5

### 7. Derivative Control Gain

Sets the derivative parameter for the PID control. It is used only when in RFU mode. See the section “Adjusting the PID control” below for further information.

Range: 0 to 99

Recommended: 20

## **rESt**

**General Reset** – Reset all the configurable parameters of the device to the factory values. It must be double pressed both arrows ◀ ▶◀ ▶.

After this command is applied, it may be required setting some parameters again, according the vessel.

## **A XTE Proportional GAIN**

Sets the correction factor associated with the current Cross Track Error value. Care must be taken if a quick response of the control is desired. If this parameter is too high, the direction of the vessel can become oscillatory.  
Range: 0 to 99  
Recommended: 10

## **B Steer Routine;**

**This version is equipped with 2 steering routine parameters that can cater for all types of vessels. In some cases the PID routine will cause oscillations, so it could be recommended to select the different routine.**

**0 is for PID.**

**1 is for a conventional Bang Bang Linear system.**

## **C Wind Damping**

This parameter can be set ON (1) or OFF (0). When it is ON, the action of the wind on the desired course the vessel will be compensated.

For this functionality works, it is necessary to feed the autopilot with the wind value information via serial port.

Range: 0 or 1

Recommended: depends on the availability of wind information.

## **D Power supply voltage**

Displays the voltage of the power supply.

## **E SI-TEX Use Only**

## **F XTE Integral Multiplier**

Allows for adjustment of fine control of the Steering routine.

If the vessel is not keeping on course with a tide or large course different. Then increasing this value will help. To high a value will cause oscillation.

Range: 0 to 99

Recommended: 5

## **G Steering Control period**

Adjusts the timing routine of the Steering PID routine. Slightly related to the speed of the rudder.

## **H Heading adjustment**

In this mode you can adjust the heading offset of the compass. Range: -10.0 to 10.0

## **I Baud rate of Serial Port 1**

The GPS input port. Baud rates up to 38400 are available.

## **J Baud rate of Serial Port 2**

The Compass input port.

However, this proportional value may be not enough when the vessel's direction is being disturbed by some force that takes it from its route (unbalanced load, wind...).

In the autopilot, the gain (contribution) of this value is adjusted with the rudder ratio.

### **• Integral value:**

This portion of the control value integrates the error, for the compensation of forces and disturbances that the proportional control value can't cope with. It is intended to provide no error on the vessel's direction result.

The adjustment of the gain for this parameter is explained in the sections "Technical Adjustments" and "Parameters List" (parameter 7) above;

### **• Derivative value:**

This value is intended for providing stability to the system avoiding "hunting". It is based in the variation of the error, in this case, how fast the boat is turning. This value will be zero when the vessel is not turning, and will oppose the to the turn movement when it happens.

The adjustment of the gain for this parameter is explained in the sections "Technical Adjustments" and "Parameters List" (parameter 8) above.

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## ***Adjusting the PID control***

PID stands for Proportion, Integral and Derivative, which are the three calculated values that when summed, result in the adjustment value. This value is the position to where the Rudder must be driven.

Below it is described how each of these values contributes to the control of the vessel. These value differ for the different vessel setups and different types of rudder feedback used.

### **• Proportional value:**

The larger the error from the desired direction from the current direction of the vessel, the larger this value is. It provides a more responsive system when the boat is too far from its desired direction.

## SP120 default settings

### Front panel set:

| <u>Front panel set:</u> | <u>Setting</u> | <u>Range</u> |
|-------------------------|----------------|--------------|
| Rudder Ratio            | 3              | 1-40         |
| Sensitivity             | 4              | 0-10         |

### Parameters:

| <u>Parameters:</u>              | <u>Setting</u> | <u>Range</u>               |
|---------------------------------|----------------|----------------------------|
| 1. Pulse Length                 | 25             | 0 to 99                    |
| 2. Reverse Delay                | 40             | 0 to 99                    |
| 3. Dead Band                    | 5 (1°)         | 0 to 50                    |
| 4. Maximum Rate of Turn         | 250 (250°/min) | 0 to 400                   |
| 5. Minimum Speed                | 1.0 (knot)     | 5 to 100 (0.5 to 10 knots) |
| 6. No RFU                       | rf – 1         | 0 or 1                     |
| 7. Integral Control Gain        | 5              | 0 to 99                    |
| 8. Derivative Control Gain      | 3              | 0 to 99                    |
|                                 |                |                            |
| A. XTE Proportional Gain        | 10             | 1 to 99                    |
| B. Not used                     | --             | --                         |
| C. Wind damping                 | 0              | 0 or 1                     |
| F. XTE Integral Gain Multiplier | 3              | 0 to 99                    |
| G. Control Calculation Period   | 60             | 0 to 99                    |
| H. Heading offset.              | 0              | -10.0 to +10.0             |
| I. Baud Rate GPS                | 4800           | 4800 - 57600               |
| J. Baud Rate Compass            | 4800           | 4800 - 57600               |

## Setting up your GPS Unit

*Because there are a great variety of GPS units that will work with this autopilot, the following is a guide only. For more information, consult your GPS manual.*

The GPS unit must be set up to output “NMEA 0183” data on a pair of wires, which are connected to the SP120 unit via the rudder feedback connector. The data generated must include at least one of the following:

- The APA sentence.
- The APB sentence.
- The BOD and XTE sentences.
- If only the XTE data sentence is available, the pilot can steer in a restricted manner only. (See later in this section.\*\*)

The GPS unit must be programmed and activated to navigate to a waypoint, or to follow a line joining two or more waypoints (called a route). This unit should then send information to the autopilot from which can be calculated the course-to-steer.

Under the following conditions:

- several waypoints are linked together into a single route,
- the GPS unit is set and capable of “auto-sequence” between them,
- an “arrival zone” of more than 0.05 NM (Nautical Miles) is set so that the GPS can detect when the vessel has reached a waypoint; then the SP120 will be able to steer from each waypoint to the next without intervention.

\*\* If only the XTE information is available from your GPS unit then your vessel must be on track, and heading in the correct direction, before engaging the GPS unit. The “auto sequence” feature is not available in this instance.

**NOTE:** *Prior to engaging GPS mode, a route or destination must be programmed and selected in the GPS for the Autopilot to follow.*

## SP120 Alarms

A number of conditions will cause alarms to sound and an alarm message to flash on the display

### Off Course Alarm

In AUTO mode an audible alarm of 3 “beeps” per second will sound when boat heading is greater than 45° from the desired course. The ALARM light will also flash RED on and off.

### GPS Alarm

In Waypoint Steering mode an audible alarm of 1 “beep” per second will sound when no GPS data is received by the SP120. The ALARM LED will flash RED and GPS light will also flash RED / GREEN.

## Definition of Terms

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**SP120 Display:** The operational control unit with LCD display and push buttons.

**Heading:** This is the magnetic direction of the vessel at the current time.

**Course-to-steer:** The direction (heading) which the autopilot is attempting to maintain.

**\*NOTE:** *If there is no compass connected and a GPS is used as heading reference, the display shows COG (course over ground).*

## Overview of Operation

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### **MANUAL Mode: “H\*\*\*”**

The autopilot display unit shows the current heading. The Manual LED will show YELLOW.

The boat is under manual steering control; the autopilot will not apply any automatic steering control. Vessel can be steered using ◀ or ▶ Buttons or original wheel / lever etc. When vessel is steered, the Manual LED will indicate drive direction.

### **AUTO Mode: “A\*\*\*”**

The autopilot will maintain your vessel on the course indicated. The Auto LED will be YELLOW. This course can be set or altered from the display unit. If drive is required. The Auto LED will Show GREEN / RED.

### **WAYPOINT (SPG) Mode: “A\*\*\*”**

When receiving information from a GPS plotter, the autopilot can steer a vessel to a precise latitude and longitude (waypoint) or through a sequence of latitudes and longitudes (route).

### **WIND Mode: “S\*\*\*” or “P\*\*\*”**

When receiving information from a Wind Direction System, the autopilot can steer a vessel based on the wind direction. This is especially useful for sailboats.

\*\*\* Will be the displayed number for heading etc.

# Testing Procedure

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## Initial Inspection and Testing

- |                                                              |                          |
|--------------------------------------------------------------|--------------------------|
| 1. Confirm power to be connected is the required DC voltage. | <input type="checkbox"/> |
| 2. Power Supply 12V DC is available.                         | <input type="checkbox"/> |
| 3. Ensure polarity of the voltage supply is correct.         | <input type="checkbox"/> |
| 4. All electrical connections are correct.                   | <input type="checkbox"/> |
| 5. Loose cables are clipped or tied up.                      | <input type="checkbox"/> |

## Dockside Tests

- |                                                                                                       |                          |
|-------------------------------------------------------------------------------------------------------|--------------------------|
| 1. Turn steering wheel fully clockwise and visually check that moving (mechanical) parts do not foul; | <input type="checkbox"/> |
| 2. Repeat step 1 for anti-clockwise.                                                                  | <input type="checkbox"/> |
| 3. Return Steering to center.                                                                         | <input type="checkbox"/> |
| 4. Switch on SP120 Autopilot system.                                                                  | <input type="checkbox"/> |
| 5. Press arrow button to operate steering in that direction                                           | <input type="checkbox"/> |
| 6. Check that rudder moves in correct direction                                                       | <input type="checkbox"/> |
| 7. Check Rudder direction follows change request                                                      | <input type="checkbox"/> |
| 8. Check Course change provides sufficient Rudder movement                                            | <input type="checkbox"/> |
| 9. Check magnetic heading display on SP120                                                            | <input type="checkbox"/> |
| 10. Return steering to center                                                                         | <input type="checkbox"/> |

## Trouble Shooting

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### **SP120 Display is not displaying any heading and no light is lit.**

- Check power is available:- 12VDC
- Check boat master switch for autopilot
- Check circuit breaker (if applicable)
- Check in-line fuse of SP120 red wire
- Check all wiring connections

### **SP120 does not move rudder when AUTO is selected**

- Confirm SP120 display is showing heading information.
- Check voltage is present at the SP120 motor connections (Yellow and yellow with black stripe) when AUTO is selected and a course change applied.
- Confirm that the supply voltage is 12 volts DC (Red and Black).
- Check all motor and clutch wiring
- Check motor brushes
- Check the hydraulic system:
  1. Ensure there is sufficient hydraulic fluid.
  2. Purge the system of possible air locks / contamination.
  3. Ensure that any flow restricting valves are not completely closed.
  4. Check all connections for leaks.

### **SP120 display shows LOSP when AUTO selected (when using GPS input)**

- Check speed setting in parameter adjustment is greater than one
- Vessel must be moving forward.

### **SP120 does not follow waypoint route**

- Check GPS plotter waypoint setting
- Check GPS and AUTO selected on SP120
- Check alarm status of SP120
- Ensure that the GPS unit has the correct magnetic correction factor.
- Check SP120 compass alignment and possible magnetic interference

### **No GPS Data Alarm**

- Check wiring of the GPS to the SP120 unit.
- Check sentence in GPS unit for correct data output
- Check route is set up or selected in the GPS unit
- Check location fix at the GPS unit.
- Check location fix at the GPS unit.

## Troubleshooting

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### SP120 Display is completely Black

- ☐ Check power is available: 12V-24VDC
- ☐ Check boat master switch for AUTOPILOT
- ☐ Check circuit breaker (if applicable)
- ☐ Check in-line fuse of SP120 red wire
- ☐ Check all wiring connections SP120
- ☐ Check Backlight setting

### SP120 does not move rudder when AUTO is selected

- ☐ Confirm SP120 display is showing compass heading information & No alarm situation.
- ☐ Check voltage is present at the SP120 motor connections (Yellow and yellow with black stripe) when AUTO is selected and a course change is applied.
- ☐ Confirm that the supply voltage is 12V-24VDC (Red and Black).
- ☐ Check all motor and clutch wiring
- ☐ Check motor is functioning in manual mode, then check motor brushes
- ☐ Check the hydraulic system is operational:
  1. Ensure there is sufficient hydraulic fluid.
  2. Purge the system of possible air locks / contamination.
  3. Ensure that any flow restricting valves are not completely closed.
  4. Check all hydraulic connections for leaks.

## Troubleshooting - continued

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### SP120 Display will not change from MANUAL STEER mode.

- ☐ Vessel speed may be below the set threshold, if USE RFU is set to NO.
- ☐ Check speed setting in the SP120 settings
- ☐ Vessel must be moving forward at or higher than that set speed.

### SP120 does not follow a waypoint or route

- ☐ Check GPS plotter waypoint or route is set to 'go-to' or activated.
- ☐ Check GPS mode is selected on SP120
- ☐ Check alarm status of SP120
- ☐ Ensure that the GPS unit has the correct magnetic correction factor.
- ☐ Check SP120 compass alignment and possible magnetic interference

### No GPS Data Alarm

- ☐ Check wiring of the GPS to the SP120 unit.
- ☐ Check sentence in GPS unit for correct data output (APA/APB/BOD & XTE)
- ☐ Check route is set up or selected in the GPS unit
- ☐ Check location fix at the GPS unit.

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## Warranty

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SI-TEX products are thoroughly inspected and tested before shipment from the factory and are warranted to be free of defects in workmanship and materials for a period of one year from the date of shipment from the factory.

This warranty is extended to and is solely for the benefit of the original consumer purchaser.

All units in need of repair will be repaired without charge to the purchaser during the above mentioned period in accordance with the following terms and conditions:

1. The defective unit is returned "freight prepaid" to SI-TEX Marine Electronics : 25 Enterprise Zone Drive, Suite #2 Riverhead, NY 11901
2. Proof of purchase is supplied and original Serial Numbers on equipment have not been changed.
3. Information is provided regarding the nature of the failure or problem occurring.
4. A return address is supplied to enable the equipment to be returned by road freight. Any other means of transport will be charged to the customer's account and must be paid in advance.

This warranty does not cover defects or damages caused by unauthorized service or damage through accident, misuse or abuse. The owner is also responsible for providing reasonable maintenance and weather protection of the equipment.

SI-TEX shall not be liable for damage or loss incurred resulting from the use and operation of this product.

SI-TEX reserves the right to make changes or improvements to later models without incurring the obligation to install similar changes to equipment already supplied. Some states do not allow the exclusion or limitation of incidental or consequential damages; therefore the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights and you may also have other rights, which vary from state to state.

## Additional Information

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### SI-TEX Marine Electronics

Please refer to the SI-TEX website for more information

Web: [www.si-tex.com](http://www.si-tex.com)

## This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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