

SITEX®

SP-110 Autopilot



INSTALLATION AND SERVICE

www.si-tex.com

BLANK PAGE

Index

WWW.SI-TEX.COM.....	1
INDEX.....	3
WARNING!.....	4
SP-110 AUTOPILOT SYSTEM.....	5
BLOCK DIAGRAM OF FULL SYSTEM.....	5
INSTALLATION OF SYSTEM COMPONENTS:	6
DISPLAY UNIT	7
COMPASS.....	8
COMPASS MOUNTING.....	8
RUDDER FEEDBACK UNIT.....	9
RUDDER FEEDBACK / GPS WIRING DIAGRAMS.....	9
RUDDER FEEDBACK INSTALLATION DIAGRAM.....	10
OCTOPUS MECHANICAL DRIVE RFU CONNECTIONS	10
GPS WIRING CONNECTIONS.....	11
HYDRAULIC REVERSING MOTOR CONNECTION.....	11
MECHANICAL REVERSING MOTOR CONNECTION	11
MOTOR CONNECTIONS	12
SOLENOID VALVE USE.....	13
INITIAL OPERATIONAL SETTINGS	14
MOTOR DIRECTION – AUTOMATIC SET UP	14
MOTOR DIRECTION – MANUAL SET UP	14
SENSITIVITY	15
RUDDER RATIO	15
BACKLIGHTING.....	15
SET RUDDER LIMITS.....	15
COMPASS HEADING.....	16
COMPASS CALIBRATION.....	16
COMPASS ALIGNMENT	16
TECHNICAL ADJUSTMENTS.....	16
SP-110 DEFAULT SETTINGS:	17
SETTING UP YOUR GPS UNIT.....	18
SP-110 ALARMS.....	18
OFF COURSE ALARM.....	18
GPS ALARM.....	19
DEFINITION OF TERMS.....	19
OVERVIEW OF OPERATION	19
TROUBLE SHOOTING	21
SCHEMATIC DIAGRAM.....	22
WARRANTY	23
ADDITIONAL INFORMATION	REFER TO SI-TEXWEBSITE.. 24

Warning!

- **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 TO THE SYSTEM CAN RESULT. (NO RFU SYSTEM ONLY)**
- **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 AND USED AS THE HEADING SOURCE AT A SPEED OF ONE KNOT OR LESS THE SYSTEM WILL DISENGAGE FROM AUTO.**

SP-110 Autopilot System

The SP-110 Autopilot control system comprises the following units: -

- SP-110 display and control head.
- SI-TEX E-compass
- Rudder Feedback Unit (SP-110R only).

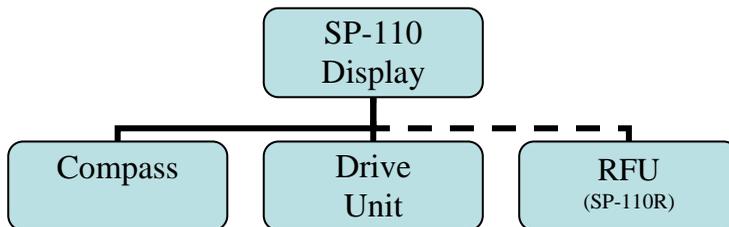
In addition the SP-110 has to be connected to a drive unit which controls the rudder actuator system in order to complete the full autopilot system. The actuator system provides the physical movement to the rudder responding to the direction of control signals provided by the SP-110. A rudder actuator 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

Block Diagram of full system



*Dashed line (RFU) only for applicable for SP-110R.

The SP-110 display provides full control of the autopilot system and indicates different modes for heading, course to steer and rudder angle.

The system requires a supply voltage of **12 Volts DC**.

Installation of System Components:

Ensure you have all the components of the autopilot.

Tools required:

- Screwdrivers – flat blade and Philips
- Side cutting pliers
- Wire strippers
- Spanners (various) or adjustable spanner
- 70mm 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 SP-110. As no steel is used in the SP-110 display, there is negligible effect on a steering compass.

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

The SP-110 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 SP-110 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 70mm (2.5”) 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 touching together before connecting power to the SP-110
- Connect red wire to + 12 volts DC
- Connect black wire to – 12 volts DC

SP-110 Display (Rear) Wiring Diagram



Compass

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.

Position:

- Select a dry position free from magnetic interference. (Note other side of bulkheads and deck heads for magnetic type objects)
- Avoid positions near radios, speakers, aerial cables or any other current carrying cable.
- Mount the compass horizontally with the arrow (bow) pointing in the same direction as the boat's bow. Use non magnetic screws (304 grade stainless steel)
- Run cable to SP-110 display position (keep away from other cables)
- Connect compass cable to SP-110 compass socket

Compass Mounting



Rudder Feedback Unit

*Only for SP-110R version.

The SP-110R Autopilot is supplied with an RFU (rudder feedback unit), which provides to the pilot a precise position of the boat rudder.

Position:

- Refer diagram on page 8
- Mount rudder feedback adjacent to the tiller (rudder feedback movement must copy the angular movement of the tiller). Use mounting bracket if required
- Note markings on the rudder feedback unit. P & S indicate the required movement of the tiller for course correction
- Rudder feedback is mounted with shaft uppermost
- Fit snap lock swivel joint to rudder feedback arm

- Fit link block to tiller arm
- Fit link arm from rudder feedback to tiller – adjust for correct angle
- Route cable to SP-110 display position
- Connect rudder feedback cable to SP-110 rudder socket
- When installation is complete, slowly move the steering by hand 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

NOTE: *The rudder feedback unit is water resistant. However, if it is to be mounted in a wet position, some protection should be provided to ensure the unit does not become excessively exposed to water.*

The rudder feedback unit may be mounted upside down, in which case the blue and red wires in the cable must be reversed (yellow wire in cable is not used in the feedback).

Rudder Feedback / GPS Wiring Diagrams

Pin connections from rear of plug, solder connection side. Pin 1 has adjacent dot.

Pin 1	5V Rudder Feedback Supply
Pin 2	Rudder Feedback Wiper Return
Pin 3	0v Rudder Feedback Supply
Pin 4	TX Data (heading information)
Pin 5	+ GPS Input (Positive)
Pin 6	- GPS Input (Negative)

GPS Wiring Connections

Pin connections from rear of plug, solder connection side.

Pin 5	+ GPS Input (Positive)	– white wire
Pin 6	- GPS Input (Return)	– green wire

For GPS navigation, connect the GPS unit via the two wires coming from the back of the rudder feedback plug on the SP-110 display unit.

Heading Data out is also available

Pin 4	+ Heading Data Out (positive)	- red wire
Pin 3	- Heading Data Out (negative)	– blue wire (0 volt line)

Note: For information on connecting different brands of GPS units, refer to the relevant GPS manual

Hydraulic Reversing Motor Connection

- Route suitable two core cable (10 amp min) from motor to SP-110 display
- Connect motor cable to the yellow and yellow/black motor wires at SP-110

Notes:

- 1 *With SP-110 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 SP-110 in MANUAL by pressing ◀ or ▶ once power has been connected to the SP-110*

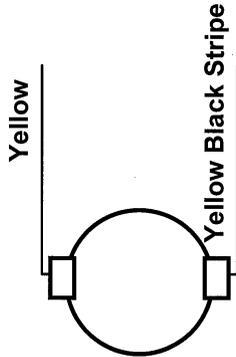
Mechanical Reversing Motor Connection

- Route suitable four core cable (10 amp min) from motor to SP-110 display
- Connect motor wires to the yellow and yellow/black motor wires at SP-110
- Connect one clutch wire to green wire at SP-110
- Connect second clutch wire to + 12 VDC voltage supply

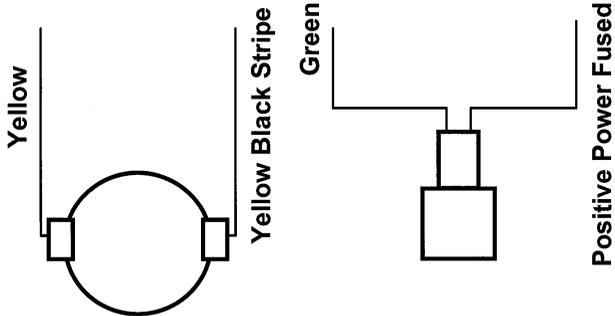
Note:

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

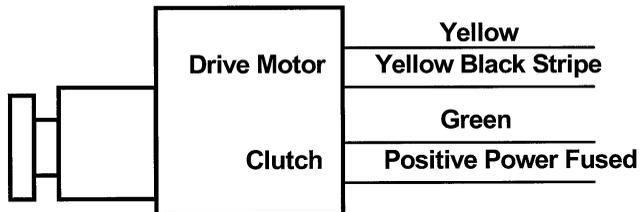
Motor Connections



Reversing Motor Connections



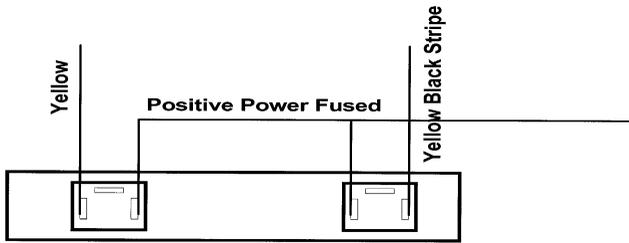
Reversing Motor and Bypass Valve Connections



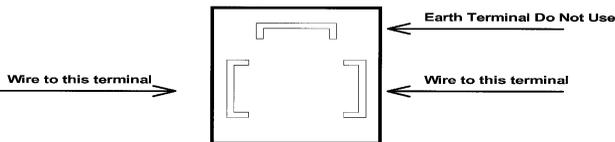
Mechanical Drive Motor

Solenoid Valve use

Solenoid Valve use, Wire the solenoid valves to Yellow and the 12 volt power feed and Yellow with Black stripe and 12 volt power feed on second terminal block. Ensure 12 volt is via a suitable fuse, less than 5 amps.



Solenoid Valve Drawing



Solenoid Valve Connections

Green Wire is not used

Initial Operational Settings

The initial set up of the SP-110 is done once the system installation is complete and power has been connected to the SP-110 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 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 SP-110
- 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 SP-110
- 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 SP-110R version only.

Factory default setting is 05 and should only be altered during seas trials

- SP-110 in MANUAL
- Press MODE button until display shows 05
- Press ► to increase setting (wide heading deadband)
- Press ◀ to decrease setting (narrow heading deadband)
- Display returns to MANUAL and shows heading after 3 seconds

Rudder Ratio

Factory default setting is 08 and should only be altered during seas trials

- SP-110 in MANUAL
- Press MODE until display shows r 08
- 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 ” ie: 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 ” ie: oversteer through too much rudder applied.

Backlighting

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

- Press MODE four times SP-110R
- Press MODE until display shows LitE
- Press either ◀ or ► to turn the backlight on
- Press either ◀ or ► again to turn the backlight off

Set Rudder Limits

Available on the SP-110R version only

- SP-110 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 SP-110
- 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 SP-110
- 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 SP-110. Routines 1, 2 and 4 are not used in the SP-110R.

Each routine can be set or reset and can be displayed individually.

To enter the procedures:

- SP-110 in MANUAL
- Press MODE until display shows P-23
- Press ► to access the first routine
- Display changes to 1- 05
- Press ◀ and ► together to enter the first routine
- Display changes to 1= 05
- Change the setting by pressing ◀ or ► to increase or decrease
- Press ◀ and ► together accept the new setting
- Display changes back to 1 – 06 (example if setting was increased by one)
- Press ► again to access the next routine and continue as above

Press MODE or AUTO to return SP-110 to MANUAL operation.

Parameters List:

- 1 **Pulse Length** (When system is near desired position motor will be pulsed; this adjustment sets the size of the pulse - or pulse width.)
- 2 **Reverse Delay** (Sets the delay time between motor direction changes)
- 3 Dead Band (Sets the motor dead band.)
- 4 **Pulse Frequency.** Used in conjunction with 1 (pulse length) to set the number of motor drive pulses per second.
- 5 Minimum Speed in Knots (set at 1 knot)
- 6 rF – 0: no rudder feedback 1: with feedback
- 7 Not shown
- 8 Auto Trim Timer sets delay before applying auto trim
- rEst General reset by double pressing both arrows ◀ ▶◀ ▶▶
- A BOD Correction Factor
- B Pulse Type – 0: Pulse 1: Bandwith (solenoids use)
- C Wind damping ON (1) / OFF (0)

SP-110 default settings:

<u>Front panel set:</u>	<u>Setting</u>
Rudder Ratio	8
Sensitivity	5

<u>Parameters:</u>	<u>Setting</u>
1. Pulse Length	5
2. Reverse Delay	15
3. Dead Band	5
4. Pulse Frequency	15
5. Minimum Speed	1 (knot)
6. No RFU	rf – 0
7. Not used	
8. Auto Trim Timer	3
A BOD Correction Factor	15
B Pulse type	0
C Wind damping	0

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 SP-110 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 SP-110 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.

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

SP-110 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 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 SP-110. ALARM and GPS lights will also flash on and off.

Definition of Terms

SP-110 Display: The operational control unit with LCD display and push buttons.

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

Course-to-steer: The heading which the autopilot is attempting to maintain.

** If a GPS is used as heading reference the display shows COG (course over ground) and no compass is connected*

Overview of Operation

- **MANUAL Mode:** “H***”

The autopilot display unit shows the current heading.

The boat is under **manual** steering control; **the autopilot will not apply any steering control.**

- **AUTO Mode:** “A***”

The autopilot will maintain your vessel on the course indicated. This course can be set or altered from the display unit.

- **WAYPOINT 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 specially useful for sailboats.

- **JOG Mode:**

When the autopilot is in manual mode, ◀ (port) or ▶ (starboard) buttons may be pressed and the steering will be driven in the relevant direction.

Testing Procedure

Initial Inspection and Testing



1. Confirm power to be connected is the required DC voltage.	
2. Power Supply 12V DC is available.	
3. Ensure polarity of the voltage supply is correct.	
4. All electrical connections are correct.	
5. Loose cables are clipped or tied up.	

Dockside Tests

1. Turn steering wheel fully clockwise and visually check that moving (mechanical) parts do not foul;	
2. Repeat step 1 for anti-clockwise.	
3. Return Steering to centre.	
4. Switch on SP-110 Autopilot system.	
5. Press arrow button to operate steering in that direction	
6. Check that rudder moves in correct direction	
7. Check Rudder direction follows change request	
8. Check Course change provides sufficient Rudder movement	
9. Check magnetic heading display on SP-110	
10. Return steering to centre	

Trouble Shooting

SP-110 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 SP-110 red wire
- Check all wiring connections

SP-110 does not move rudder when AUTO is selected

- Confirm SP-110 display is showing heading information.
- Check voltage is present at the SP-110 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.

SP-110 display shows LOSP when AUTO selected (when using GPS input)

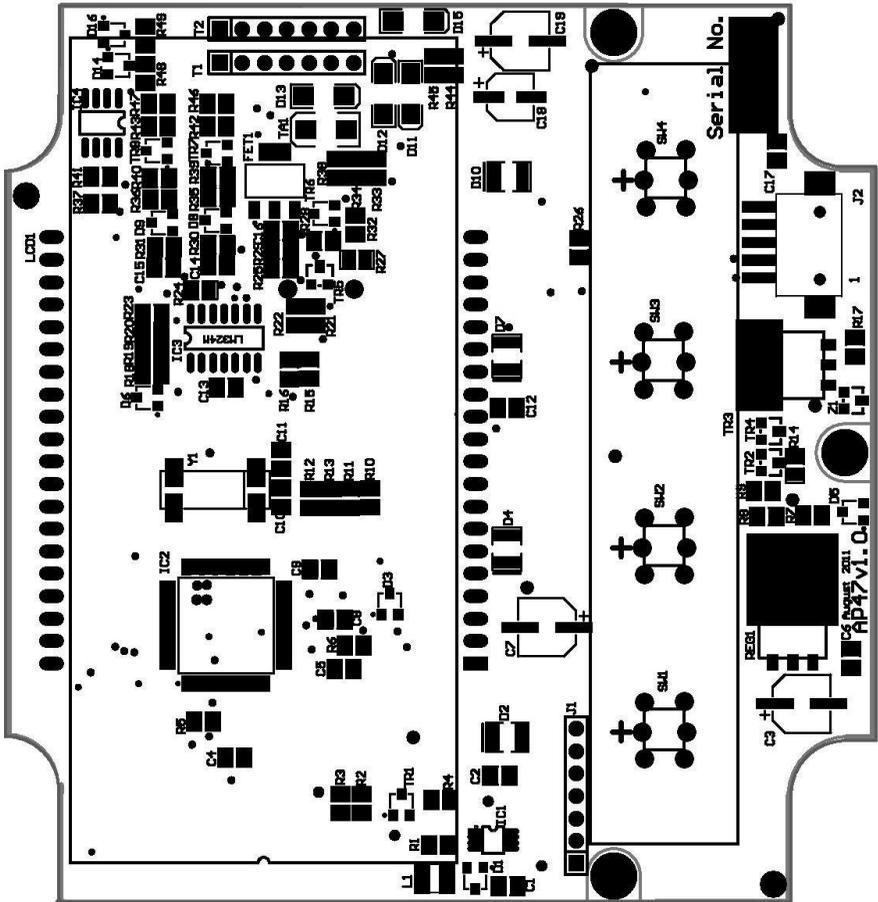
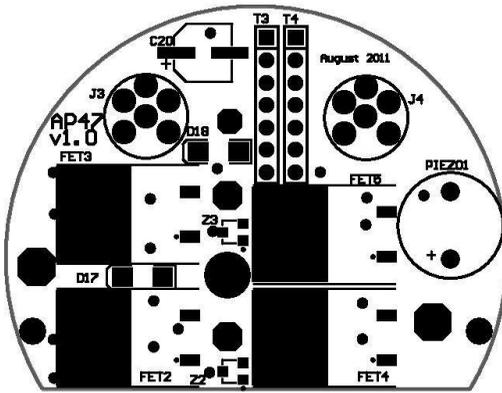
- Check speed setting in parameter adjustment is greater than one
- Vessel must be moving forward.

SP-110 does not follow waypoint route

- Check GPS plotter waypoint setting
- Check GPS and AUTO selected on SP-110
- Check alarm status of SP-110
- Ensure that the GPS unit has the correct magnetic correction factor.
- Check SP-110 compass alignment and possible magnetic interference

No GPS Data Alarm

- Check wiring of the GPS to the SP-110 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.



Warranty

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 customers account and must be paid in advance.

This warranty does not cover defects or damages caused by unauthorised 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

Refer to SI-TEX website