

AP47C Autopilot

User Manual

(TMQ AP47C - SS35)



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IMPORTANT: PLEASE RETAIN ON BOARD

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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 MAY 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.

AP47C Autopilot System

The AP47C Autopilot control system comprises the following units:

- AP47C display and control head.
- TMQ E-compass
- Rudder Feedback Unit (AP47CR only).

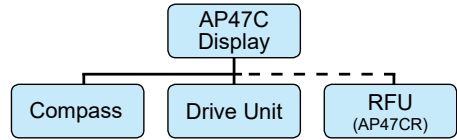
In addition the AP47C has to be connected to a drive unit which controls the rudder actuator system in order to complete the full autopilot system. The actuator system provides the physical movement to the rudder responding to the direction of control signals provided by the AP47C. A rudder actuator 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
- Continuously running Hydraulic Pump with solenoid control.
- Reversing mechanical drive unit connected to the existing steering mechanism

Block Diagram of full system



**Dashed line (RFU) only for applicable for AP47CR.*

The AP47C 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 12-24 Volts DC (Up to 29V During Charging)

Installation of System Components

Ensure you have all the components of the autopilot.

Tools required:

- Screwdrivers – flat blade and Phillips head
- 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 AP47C.

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 AP47C must have a direct connection to power supply via a 15 amp circuit breaker or a 15 amp fused circuit and an isolating switch.

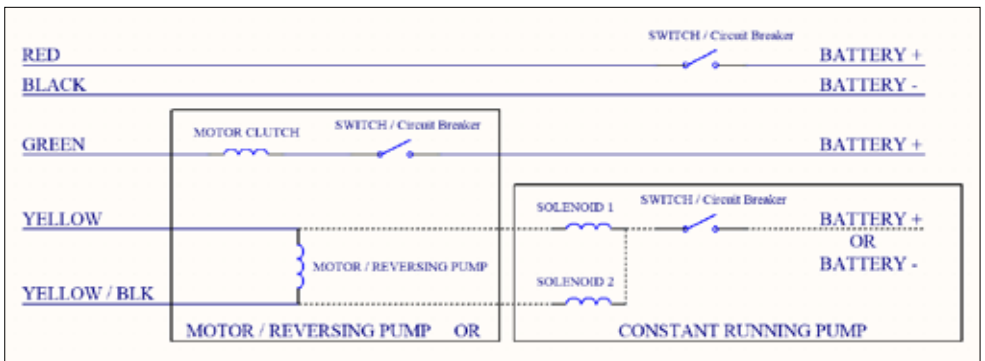
Display Unit

Position:

The AP47C 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 exposed before connecting power to the AP47C
- Connect red wire to + 12 volts DC (Positive)
- Connect black wire to - 12 volts DC (Negative)

Figure 1: (below) 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 (316 grade stainless steel)
- Run cable to AP47C display position (keep away from other cables)
- Connect compass cable to AP47C compass socket

Compass Mounting:

Vessel Bow

Figure 2: E-Compass V3



Figure 3: E-Compass V4



Rudder Feedback Unit

**Only for AP47CR version.*

The AP47CR Autopilot is supplied with an RFU (rudder feedback unit), which provides to the pilot a precise position of the boat rudder.

Position:

- Refer to diagram on page 7
- 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 (Port and Starboard).
- 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 AP47CR display position
- Connect rudder feedback cable to AP47CR 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

Figure 4: Rudder feedback unit.



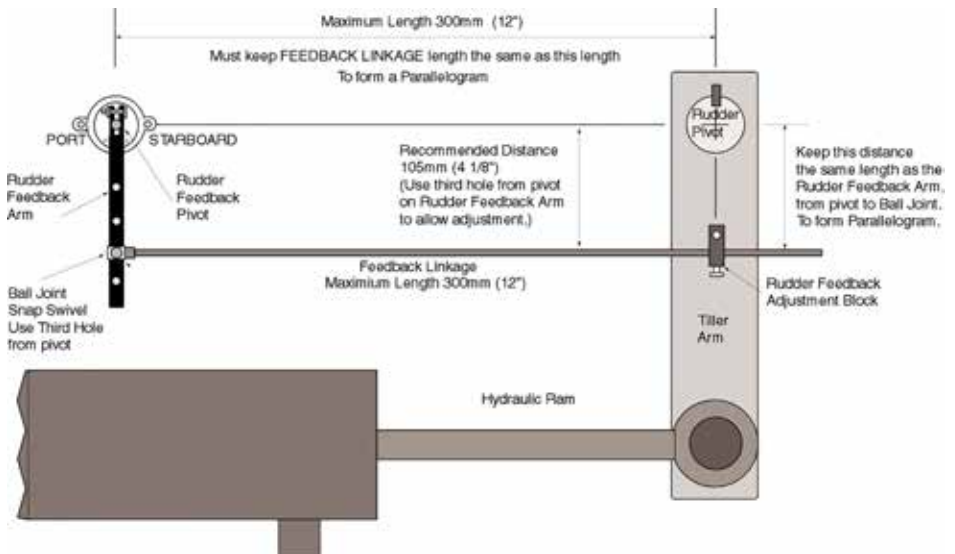
Note: The rudder feedback unit is water resistant. However, if it is to be mounted in a wet position, some protection should be provided to ensure the unit does not become excessively exposed or submersed in water.

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 Installation Diagram

Note: The rudder feedback is factory aligned. The arm should not be removed or loosened on the shaft as this will affect the "O" ring seal.

Figure 5:



Rudder Feedback / GPS Wiring Diagrams

Pin connections from rear of plug, solder connection side.
Pin 1 has adjacent dot. See Figure 6.

- 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)

Note: Pin locations are relative to pin 1 which always has a dot adjacent.



Figure 6: Pin Assignments
AP47C View

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 AP47C 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 AP47C display
- Connect motor cable to the yellow and yellow/black motor wires at AP47C

Notes:

Motor direction can be checked with AP47C in MANUAL by pressing ◀ or ▶ once power has been connected to the AP47C

Mechanical Reversing Motor Connection

- Route suitable four core cable (10 amp min) from motor to AP47C display
- Connect motor wires to the yellow and yellow/black motor wires at AP47C
- Connect one clutch wire to green wire at AP47C
- Connect second clutch wire to + 12 VDC voltage supply

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

Solenoid Connection

- Route suitable two core cable (5 Amp min.) from solenoids to AP47C
- Connect solenoid connection to either positive or negative supply.
- Fit diodes (eg 1N4007) to solenoids. Ensure the line on the diode is on the positive terminal on solenoid.

- Go to into Settings Page 2, and choose solenoid negative for common negative or solenoid positive for common positive

Initial Operational Settings (AP47CR) – With Rudder Feedback

The initial set up of the AP47C is done once the system installation is complete and power has been connected to the AP47C 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.

The installation procedure is designed to work on a rudder speed of approx. 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, motor direction and both rudder end limits must be set.

Compass Alignment

Your electronic compass may not be aligned correctly due to mounting etc. AP47C can adjust the heading reading from the compass to account for alignment error.

You will require an alternative heading reference to set the adjustment (eg. Magnetic compass / GPS plotter etc)

To commence:

- Switch power on to AP47C
- Wait until Main Screen is displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press MODE and AUTO buttons at the same time. Install Options 1 will appear (Figure 10)
- Scroll down to COMPASS ALIGNMENT using the ► Button
- Press AUTO button to edit
- The large Orange number is the raw heading reading from the electronic compass
- The large Green number is the Corrected Compass (Aligned) heading.
- Press ◀ or ▶ to change the Corrected Compass heading so it matches your alternative reference (Figure 7)
- Press MODE to exit back to Settings Page 1
- Press MODE to exit back to Main Screen
- The live compass reading on the main screen will be the Corrected Compass heading.
- All steering will use the Corrected Compass heading.

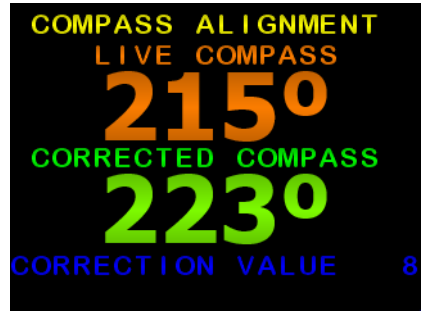


Figure 7: Press ◀ or ▶ to change the Corrected Compass heading so it matches your alternative reference

Rudder End Limits – Automatic Set up (Rudder Feedback required)

To commence:

- Switch power on to AP47C
- Wait until Main Screen is displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press MODE and AUTO buttons at the same time. Install Options 1 will appear (Figure 10)
- Press AUTO button to enter Steering Menu (Settings Page 2) Figure 11.
- Ensure USE RFU is set to YES
- Scroll down to END LIMIT AUTO using the ► Button
- Press AUTO button to start set up (Figure 12)
- Process will take between 20 and 60 seconds to complete depending on the speed of the motor
- If process is successful display will show CAL OK SAVING....
- Press either MODE to cancel the installation process, display will show ABORT CALIBRATION
- If CAL ERROR is displayed an error has occurred
- Check the drive output is connected and rudder feedback is moving
- Check rudder feedback installation
- To Exit menu, press MODE button

Figure 8: Example Main Screen (Manual Steer Mode)



Figure 9: Example Settings Page 1

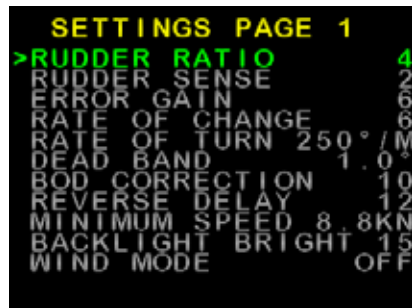


Figure 10: Example Install Options 1

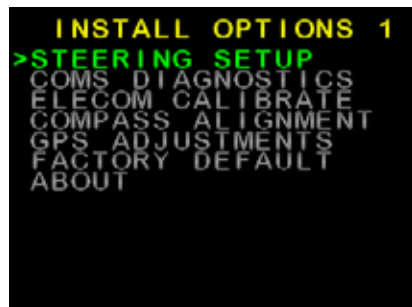
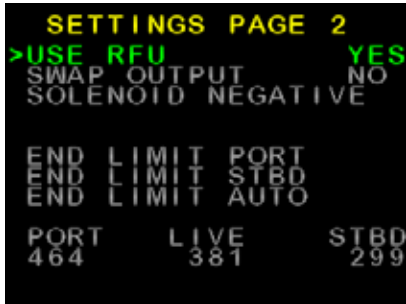


Figure 11: Example Settings Page 2



- Press AUTO again to save, or MODE to abort.
- Scroll down to END LIMIT STBD using the ► Button
- Press AUTO button to enter Starboard Adjustment
- Move to Starboard Limit, press AUTO button
- Press AUTO again to save, or MODE to abort.
- To Exit menu, press MODE button

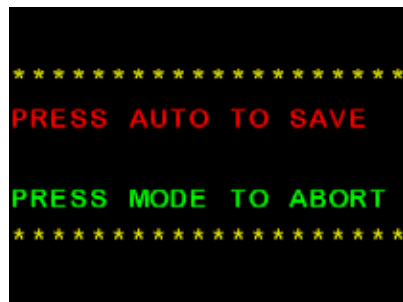
Figure 12: Port Limit Adjustment

Rudder End Limits – Manual Set up (Rudder Feedback required)

- Switch power on to AP47C
- Wait until Main Screen is displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press MODE and AUTO buttons at the same time. Install Options 1 will appear (Figure 10)
- Press AUTO button to enter Steering Menu (Settings Page 2) Figure 11.
- Ensure USE RFU is set to YES
- Scroll down to END LIMIT PORT using the ► Button
- Press AUTO button to enter Port Adjustment (Figure 12)
- Press ◀ to move rudder to Port
- Press ▶ to move rudder to starboard
- If direction is incorrect, reverse the yellow wires, or change SWAP OUTPUT in previous menu.
- Move to Port Limit, press AUTO button (Figure 13)



Figure 13: Save Limits Confirmation Screen



Rudder Ratio (Proportional Gain)

Factory default setting is 3 and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press AUTO to edit RUDDER RATIO
- Press ► to increase setting (larger rudder ratio)
- Press ◀ to decrease setting (smaller rudder ratio)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: A value of 1 signifies the minimum amount of applied rudder. When the rudder setting is too low, vessel track will be slow i.e.: understeer due to 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 rapid i.e.: oversteer due to too much rudder applied.

Rudder Sensitivity (Rudder Tolerance)

Factory default setting is 4 and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to RUDDER SENSE
- Press AUTO to edit RUDDER SENSE
- Press ► to increase setting (more tolerance to the rudder position error)
- Press ◀ to decrease setting (less tolerance to the rudder position error)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: Increasing the Rudder Sensitivity too high can cause vessel wandering

Error Gain (Integral Control Gain)

Factory default setting is 5 and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to ERROR GAIN
- Press AUTO to edit ERROR GAIN

- Press ► to increase setting (more turn to target heading)
- Press ◀ to decrease setting (less turn to target heading)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: Increase Error Gain to get on track faster. If set too high, the vessel will overshoot the target heading.

Rate of Change (Derivative Gain Multiplier)

Factory default setting is 3 and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to RATE OF CHANGE
- Press AUTO to edit RATE OF CHANGE
- Press ► to increase setting (more dampening of error)
- Press ◀ to decrease setting (less dampening of error)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: Increasing Rate of Change can help dampen Error Gain. If set too high, vessel may never make it to target heading.

Rate of Turn (Max Turn Angle)

Factory default setting is 500°M and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to RATE OF TURN
- Press AUTO to edit RATE OF TURN
- Press ► to increase setting (more attack angle)
- Press ◀ to decrease setting (less attack angle)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This limits the max turn speed of the vessel. Reduce this to reduce the angle of attack for getting to target heading.

Dead Band

Factory default setting is 1.0° and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to DEAD BAND
- Press AUTO to edit DEAD BAND
- Press ► to increase setting (more allowance for error)
- Press ◀ to decrease setting (less allowance for error)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: Increase this to reduce rudder hunting.

BOD Correction (Applies to GPS Mode only)

Factory default setting is 15 and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to BOD CORRECTION
- Press AUTO to edit BOD CORRECTION
- Press ► to increase setting (more correction)
- Press ◀ to decrease setting (less correction)

- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This number increases or decreases the angle of attack from a GPS / PC supplied BOD (Bearing Origin to Destination) when in GPS mode.

Reverse Delay

Factory default setting is 15 and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 8)
- Press ► to scroll down to REVERSE DELAY
- Press AUTO to edit REVERSE DELAY
- Press ► to increase setting (more delay)
- Press ◀ to decrease setting (less delay)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This delay helps reduce shock load on the rudder drive train, as it controls the time between direction changes (eg. Port to Starboard or Starboard to Port changes)

Minimum Speed (Requires GPS)

Only used when no rudder feedback SOG installed

Factory default setting is 1.0km and should only be altered during sea trials

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to MINIMUM SPEED
- Press AUTO to edit MINIMUM SPEED
- Press ► to increase setting (higher minimum speed)
- Press ◀ to decrease setting (lower minimum speed)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: When the vessel is below this set speed and in Auto or GPS mode, the AP47C will revert back to Manual mode.

Backlight Bright

Factory default setting is 15 (Maximum Brightness)

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to BACKLIGHT BRIGHT
- Press AUTO to edit BACKLIGHT BRIGHT

- Press ► to increase setting (Brighter screen)
- Press ◀ to decrease setting (Darker screen)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This setting is useful for adjusting screen brightness for day / night or low lit areas.

Wind Mode (Requires MWV NMEA data input)

Factory default setting is OFF

- With Main Screen displayed (Figure 8)
- Hold MODE button, Settings Page 1 will appear (Figure 9)
- Press ► to scroll down to WIND MODE
- Press AUTO to edit WIND MODE
- Press ► to enable Wind Mode
- Press ◀ to disable Wind Mode
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: When Wind Mode is ON, the AP47C will attempt to correct for wind effects on vessel steering.

Initial Operational Settings (AP47C) – Without Rudder Feedback

The initial set up of the AP47C is done once the system installation is complete and power has been connected to the AP47C display control.

Figure 14: Example Main Screen (Manual Steer Mode)

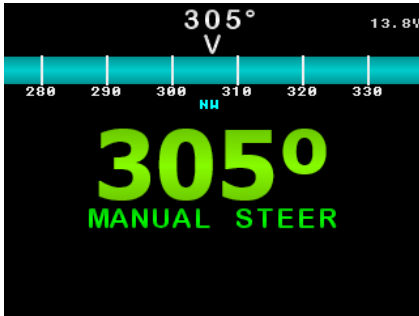


Figure 15: Example Settings Page 1

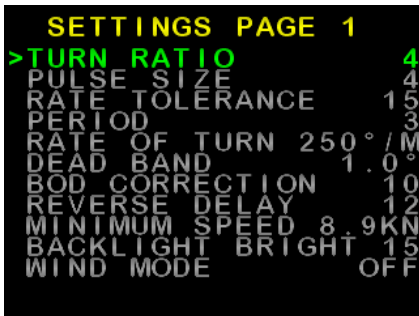


Figure 16: Example Install Options 1

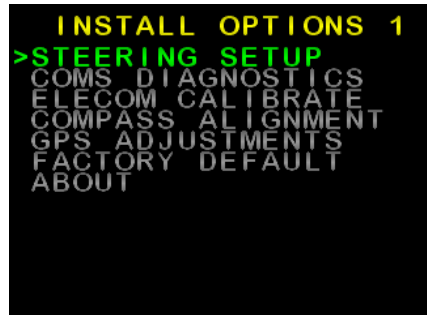
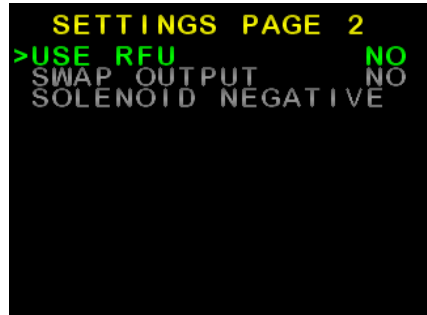


Figure 17: Example Settings Page 2



Turn Ratio

Factory default setting is 3 and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press AUTO to edit TURN RATIO
- Press ► to increase setting (larger turn ratio)
- Press ◀ to decrease setting (smaller turn ratio)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: A value of 1 signifies the minimum amount of applied rudder. When the rudder setting is too low, vessel track will be slow i.e.: understeer due to too little rudder applied.

Pulse Size

Factory default setting is 3 and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to PULSE SIZE
- Press AUTO to edit PULSE SIZE
- Press ► to increase setting (longer pulses)
- Press ◀ to decrease setting (shorter pulses)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This sets the minimum solenoid / motor pulse length when hunting for the heading track.

Rate Tolerance

Factory default setting is 15 and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to RATE TOLERANCE
- Press AUTO to edit RATE TOLERANCE
- Press ► to increase setting (more tolerance to the rate of turn error)
- Press ◀ to decrease setting (less tolerance to the rate of turn error)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: Increasing the Rate Tolerance too high can cause vessel wandering

Period

Factory default setting is 4 and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to PERIOD
- Press AUTO to edit PERIOD
- Press ► to increase setting (longer delay between rudder pulses)
- Press ◀ to decrease setting (shorter delay between rudder pulses)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Rate of Turn (Max Rudder Angle)

Factory default setting is 500°M and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to RATE OF TURN
- Press AUTO to edit RATE OF TURN
- Press ► to increase setting (more attack angle)
- Press ◀ to decrease setting (less attack angle)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This limits the max turn speed of the vessel. Reduce this to reduce the angle of attack for getting to target heading.

Dead Band

Factory default setting is 1.0° and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to DEAD BAND
- Press AUTO to edit DEAD BAND
- Press ► to increase setting (more allowance for error)
- Press ◀ to decrease setting (less allowance for error)

- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: Increase this to reduce rudder hunting.

BOD Correction (Applies to GPS Mode only)

Factory default setting is 15 and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to BOD CORRECTION
- Press AUTO to edit BOD CORRECTION
- Press ► to increase setting (more correction)
- Press ◀ to decrease setting (less correction)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This number increases or decreases the angle of attack from a GPS / PC supplied BOD (Bearing Origin to Destination) when in GPS mode.

Reverse Delay

Factory default setting is 15 and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to REVERSE DELAY
- Press AUTO to edit REVERSE DELAY
- Press ► to increase setting (more delay)
- Press ◀ to decrease setting (less delay)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This delay helps reduce shock load on the rudder drive train, as it controls the time between direction changes (eg. Port to Starboard or Starboard to Port changes)

Minimum Speed (Requires GPS SOG)

Only used when no rudder feedback installed

Factory default setting is 1.0kn and should only be altered during sea trials

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to MINIMUM SPEED
- Press AUTO to edit MINIMUM SPEED
- Press ► to increase setting (higher minimum speed)
- Press ◀ to decrease setting (lower minimum speed)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: When the vessel is below this set speed and in Auto or GPS mode, the AP47C will revert back to Manual mode.

Backlight Bright

Factory default setting is 15 (Maximum Brightness)

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to BACKLIGHT BRIGHT
- Press AUTO to edit BACKLIGHT BRIGHT
- Press ► to increase setting (Brighter screen)

- Press ◀ to decrease setting (Darker screen)
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: This setting is useful for adjusting screen brightness for day / night or low lit areas.

Wind Mode (Requires MWV NMEA data input)

Factory default setting is OFF

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press ► to scroll down to WIND MODE
- Press AUTO to edit WIND MODE
- Press ► to enable Wind Mode
- Press ◀ to disable Wind Mode
- Press MODE to return to Settings Page 1
- Press MODE to return to Main Screen

Note: When Wind Mode is ON, the AP47C will attempt to correct for wind effects on vessel steering.

Main Screen Explained

Manual Steer Mode

The live compass heading is displayed in the top center, as a bar-graph below it, and in large green numbers near the middle of the screen.

Below the large numbers is the current steering mode (MANUAL STEER), or an error in red.

The live supply voltage is displayed top right side.

If Latitude is received via NMEA input, it will be displayed top left

If Longitude is received via NMEA input, it will be displayed top right

If vessel speed is received via NMEA (SOG), it will be displayed top left.

Rudder Angle is indicated by a bar and number. The number and bar will be red when Port side, Green when Starboard side, and yellow when in center at 0°



Figure 18: Example Manual Steer Mode Main Screen. Live Compass heading is 185°, Rudder is at center.

Press ◀ or ▶ buttons to move the rudder.

Hold MODE to enter Settings Page 1

Press AUTO to enter Auto Steer Mode

Hold MODE and press AUTO to enter GPS steer mode.

Auto Steer Mode

The current target heading is in large yellow numbers near the middle of the screen.

If a yellow bar appears within the compass bar, it indicates current deviation from target heading.

Target Heading is 315°, Deviation is shown as a yellow bar within the compass bar.

Press ◀ or ▶ buttons to change the target heading.

Hold MODE to enter Settings Page 1.

Press AUTO to enter manual steer mode.

Briefly press MODE to toggle target heading step size between 1° and 10° (indicated in yellow brackets).

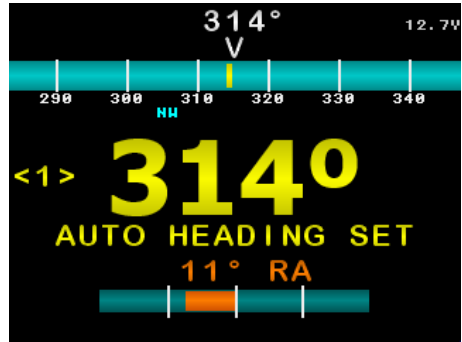


Figure 19: Example Auto Steer Mode Main Screen. Live Compass heading is 314°, Target Heading is 314° Deviation is shown as a yellow bar within the compass bar.

GPS Steer Mode

The live compass heading is displayed in the top center, as a bar-graph below it.

If a yellow bar appears within the compass bar, it indicates current deviation from target heading.

The current target heading received via NMEA is in large blue numbers near the middle of the screen. If no NMEA heading is received, it will display the current compass heading.

Below the large numbers is the current steering mode (GPS HEADING), or an error in red.

The live supply voltage is displayed top right side.

If Latitude is received via NMEA input, it will be displayed top left

If Longitude is received via NMEA input, it will be displayed top right

If vessel speed is received via NMEA (SOG), it will be displayed top left.

Rudder Angle is indicated by a bar and number. The number and bar will be red when Port side, Green when Starboard side, and yellow when in center at 0°.

Hold MODE to enter Settings Page 1.

Press AUTO to enter Manual Steer Mode.

Press ◀ or ▶ to adjust BOD correction.



Figure 20: Example GPS Steer Mode Main Screen. Live Compass heading is 314°, Target Heading is 313°, Deviation is shown as a yellow bar within the compass bar.

Error Messages

There are a number of possible error messages that can be displayed on screen, in place of the current Steer Mode text.

Examples are:

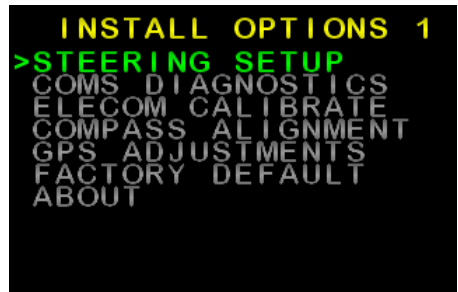
MOTOR SHORT	- Over current detected on motor wires
CLUTCH SHORT	- Over current detected on clutch wire
ANGLE OFF COURSE	- Vessel is more than 45° from Target Heading.
RUDDER AT LIMIT	- Rudder has reached the set end stop
RFU DISCONNECTED	- Cannot detect the rudder feedback unit
GPS – NO GPS DATA	- No NMEA XTE and no BOD received
GPS – NO GPS XTE	- No NMEA XTE or APB XTE or RMB XTE received
GPS – NO GPS BOD	- No NMEA BOD or APB BOD received
NO XTE – SET DEST	- User needs to set a destination waypoint in GPS / PC
VESSEL TOO SLOW	- Vessel is too slow to maintain steering without rudder feedback.

If the Compass is disconnected or faulty, NO COMPASS will be displayed in place of the compass heading, and the compass bar will disappear.

Advanced Options (Recommended for installers only)

There are a number of Advanced Options, recommended for installers only.

- With Main Screen displayed (Figure 14)
- Hold MODE button, Settings Page 1 will appear (Figure 15)
- Press MODE and AUTO buttons at the same time, INSTALL OPTIONS 1 should appear (see Figure 21).
- Press ► to scroll down to desired menu, press AUTO to enter the menu



*Figure 21: Advanced Settings
(Install Options 1)*

Steering Menu (Recommended for installers only)

For setup of Rudder output and Rudder end limits (Figure 22 and figure 23)

- USE RFU – Choose to use Rudder Feedback or not.
- SWAP OUTPUT – Choose to reverse the rudder output
- SOLENOID – Choose common connection polarity when used with solenoids.
- END LIMIT PORT – Manually set the Port rudder limit
- END LIMIT STBD – Manually set the Starboard rudder limit
- END LIMIT AUTO – Automatically set rudder limits and rudder output direction

Note: The set Port and Starboard rudder limits, and live rudder position is displayed at the bottom of the screen (When USE RFU set to YES)

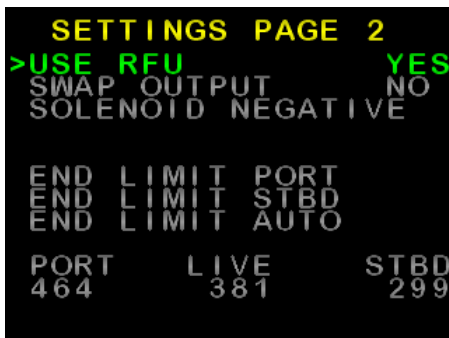


Figure 22: Advanced Steering Menu (Settings Page 2), with USE RFU enabled

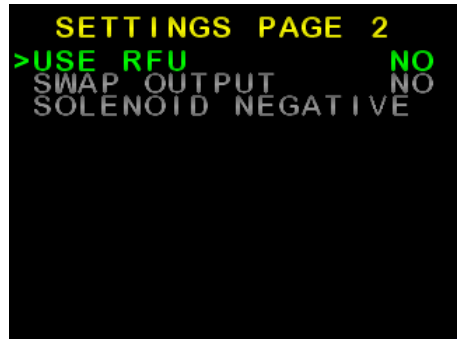


Figure 23: Advanced Steering Menu (Settings Page 2), with USE RFU disabled

Coms Menu (Recommended for installers only)

This menu is used to monitor live incoming NMEA data.

- A list of NMEA data headers is displayed. Headers in White are being received (Figure 24).
- Press ► to scroll down to desired header, press AUTO to view the data.
- Press MODE to return to list screen.
- Press MODE again to return to Install Options 1 menu.
- Press MODE to return to Main Screen

(See images next page)



Figure 24: Example Coms Menu (COMS DIAGNOSTICS)



Figure 25: Example live HDT (Heading True) compass data

Elecom Menu (Compass Calibration)

To carry out this procedure the boat must be in open waters and be able to safely turn clockwise through 360°. The purpose of this is to compensate for local magnetic influences of the vessel.

- From the Install Options 1 menu, use ► to scroll down to ELECOM MENU and press AUTO button. Press ► to confirm or MODE to exit (Figure 26)
- When the screen prompts to TURN THE BOAT, Start turning the boat clockwise at low speed, hold the turn constant.
- When calibration is complete, the screen returns to Install Options 1 menu.

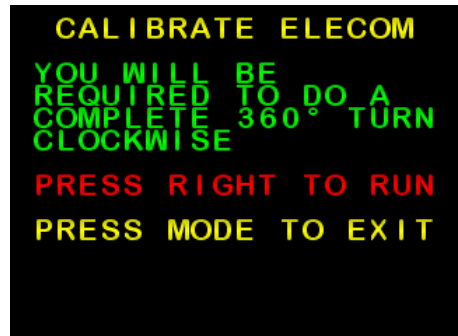


Figure 26: Confirmation screen

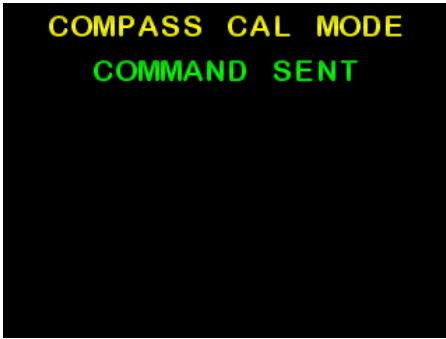


Figure 27: AP47C sending calibration command to Elecom, and waiting for a response

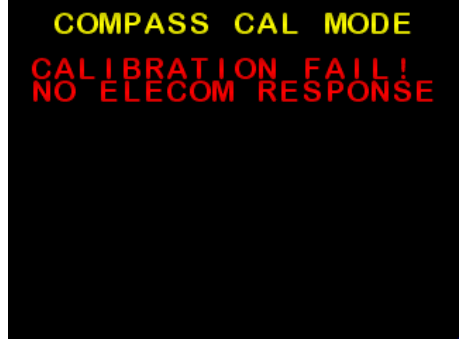


Figure 30: Elecom not communicating, or does not support Calibration mode.

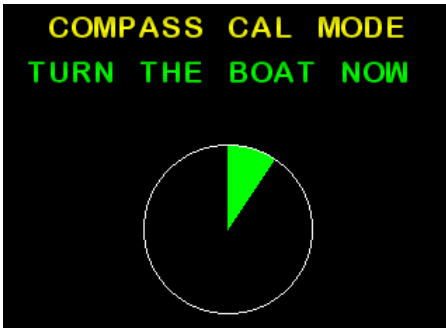


Figure 28: Start turning the boat clockwise at low speed, hold the turn.

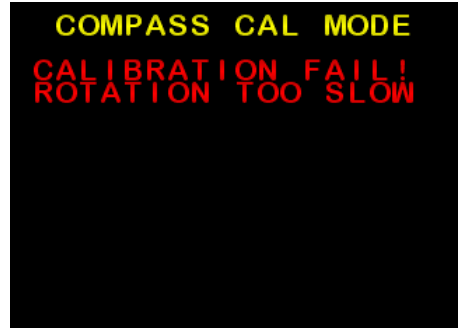


Figure 31: Calibration failed, vessel rotation too slow

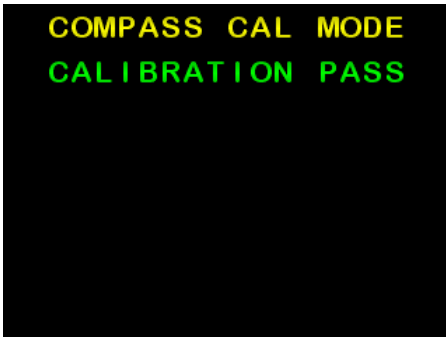


Figure 29: Elecom calibration successful

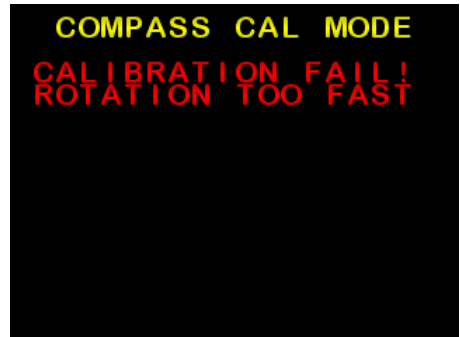


Figure 32: Calibration failed, vessel turning too slow turning too fast.

GPS Menu (NMEA corrections)

These adjustments can be used to improve tracking when in GPS mode.

- From the Install Options 1 menu, use ► to scroll down to GPS MENU and press AUTO button to enter (Figure 33)
- Scroll to desired setting using ◀ or ►, and press AUTO to modify setting
- Modify setting using ◀ or ►, and press MODE to return to list of settings.



Figure 33: Example GPS Menu (Track Settings)

Factory Default

This will reset all settings to default values,

- From the Install Options 1 menu, use ► to scroll down to FACTORY DEFAULT, press AUTO button to enter (Figure 34)
- Follow on-screen instructions

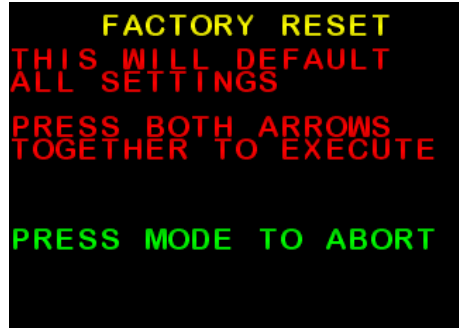


Figure 34: Factory Default (Factory Reset) warning screen

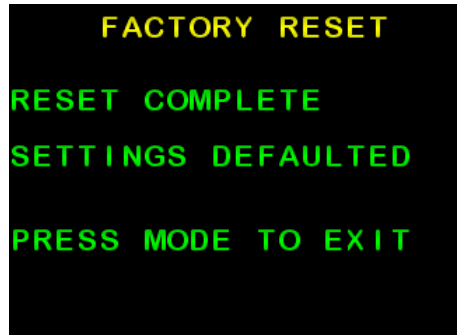
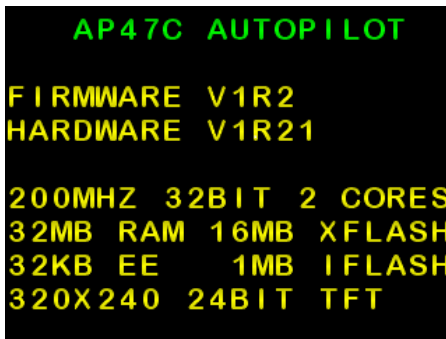


Figure 35: Factory Default complete.

About

This displays information about the build of the AP47C,

- From the Install Options 1 menu, use ► to scroll down to ABOUT, press AUTO button to enter (Figure 36)
- Press any button to exit back to Install Options 1 menu.



```
AP47C AUTOPILOT
FIRMWARE V1R2
HARDWARE V1R21
200MHZ 32BIT 2 CORES
32MB RAM 16MB XFLASH
32KB EE 1MB IFLASH
320X240 24BIT TFT
```

Figure 36: About screen example.

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 at 4800 baud on a pair of wires, which are connected to the AP47C 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 AP47C 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.

AP47C 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. A red message will also be displayed on the screen

GPS Alarm

In GPS steering mode an audible alarm of 1 “beep” per second will sound when no GPS data is received by the AP47C. A red message will also be displayed on the screen.

Compass Alarm

If there is no reading from a compass, or no HDM / HDT data incoming, an audible alarm of 1 “beep” per half-second will sound. A red message will also be displayed on the screen.

Low Speed Alarm

When used without a rudder feedback (RFU), if the vessel speed goes below the low speed threshold set in the settings, an audible alarm of 1 “beep” per second will sound. A red message will also be displayed on the screen.

Definition of Terms

AP47C Display: The operational control unit with colour 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.

Testing Procedure

Initial Inspection and Testing



1. Confirm power to be connected is the required DC voltage.

2. Power Supply 12V-24V 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 AP47C 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 compass heading display on AP47C.

10. Return steering to centre.

Trouble Shooting

AP47C 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 AP47C red wire
- Check all wiring connections

AP47C Does not move rudder when AUTO is selected

- Confirm AP47C display is showing compass heading information.
- Check voltage is present at the AP47C motor connections (Yellow and yellow with black stripe) when AUTO is selected and a course change applied.
- Confirm that the supply voltage is 12V-24VDC (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.

AP47C Display will not change from MANUAL STEER mode.

- Vessel speed may be below the set threshold, and USE RFU set to NO.
- Check speed setting in settings page 1 is greater than one
- Vessel must be moving forward at or higher than that set speed.

AP47C Does not follow waypoint route

- Check GPS plotter waypoint setting
- Check GPS HEADING mode selected on AP47C
- Check alarm status of AP47C
- Ensure that the GPS unit has the correct magnetic correction factor.
- Check AP47C compass alignment and possible magnetic interference

No GPS Data Alarm

- Check wiring of the GPS to the AP47C 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.

Declaration of Conformity

(MANUFACTURERS DECLARATION)

Manufacturer:

TMQ Electronics

PO BOX 3348

Tingalpa, QLD 4173, Australia

Tel: +61 7 3640 5600

Fax: +61 7 3640 5699

Declares under our sole responsibility
that the products:

AP47C Display, Rudder Feedback
Unit, Compass, all units
interconnected with necessary cables
and external connections as a system
to which this declaration relates, is in
conformity with Standard(s):

EN60945/1997

CEI IEC945/1996

For TMQ International Pty. Ltd.
Murarrie Queensland Australia.



12th October 2017

Ken Brown, Manager

Warranty

TMQ Electronics products are thoroughly inspected and tested before shipment from the factory and are warranted being free of defects in workmanship and materials for a period of one year from the date of shipment from the factory. **By returning the enclosed questionnaire and registering the product**, the warranty will be extended to a total of **3 years** from the date of leaving 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 TMQ Electronics, whose address is Unit 18, 17 Rivergate Place, Murarrie QLD 4172.
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.

TMQ Electronics shall not be liable for damage or loss incurred resulting from the use and operation of this product. TMQ Electronics 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 TMQ website:
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