

AP56

AUTOPILOT

Installation and Service Manual



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IMPORTANT: PLEASE RETAIN ON BOARD

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Introduction

This manual should only be read in conjunction with the associated electric amplifier (C-Drive MCU) or autopilot control unit (AP4/AP9).

The AP56 Display is the main control panel used in conjunction with a C-Drive Steering amplifier to form an AP56 Autopilot System. It provides the means to fully control the autopilot system, indicating in different modes heading, course to steer and rudder angle.

When factory configured as a remote display (Part # AP56REM), it can be used as a second control station for the AP56 Autopilot only.

In addition the standard display (Part # AP56HEAD) can be used as a second station control for TMQ autopilot models AP4 and AP9.

System configuration

An AP56 Autopilot system comprises the following minimum units:

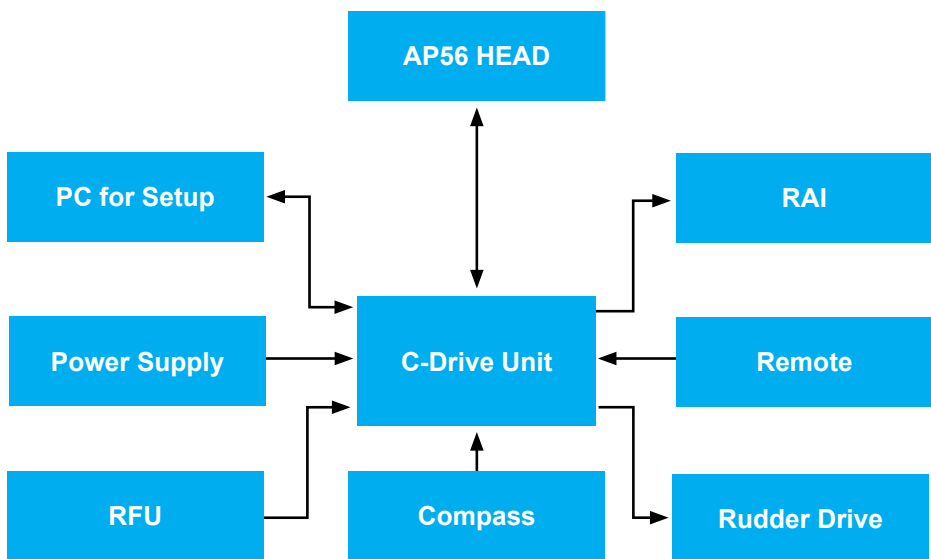
Essential Electronics:

- AP56 Display.
- C-Drive motor control unit
- Rudder feedback unit.
- Fluxgate compass or E-compass
- Drive unit, for example:
 - Hydraulic system with solenoid valves.
 - Reversing hydraulic pump system.
 - Mechanical motor drive system.

Options:

- Compass Top Sensor
- Heavy Duty Rudder Sensor
- Second Station Display Unit
- Remote Station Devices including:
 1. Active remote
 2. Hand remote
 3. Steering lever (full follow up)
 4. Electric helm (full follow up)
 5. Rudder angle indicator (RAI)

System Block Diagram



System Overview

The AP56 Display head utilises the C-Drive assembly and provides full control of the autopilot, indicating in different modes heading, course to steer and rudder angle.

The C-Drive assembly is housed in a rugged black aluminium case and requires a supply voltage of 12 or 24 volts DC.

The rudder feedback unit (RFU) is attached by linkage to the steering tiller device in such a way that it can accurately measure the movement of the ship's rudder and is also electrically connected to the C-Drive unit.

The compass detects magnetic heading of the vessel and is connected to the C-Drive assembly.

The rudder actuator (drive) system provides the physical movement to the rudder responding to the direction control signals provided by the C-Drive system.

Rudder actuator systems may comprise any of the following:

1. Hydraulic ram controlled by either:
 - Solenoid valves fitted to an existing power steering system.
 - Solenoid valves connected to a continuous running pump set.
 - Hydraulic reversing pump unit connected into an existing hydraulic steering system.
2. Mechanical reversing drive unit with reduction gears to drive the steering system.
3. Linear actuator either hydraulic or mechanical connected to a steering tiller (or quadrant).

Definition of Terms

AP56 Display:

The Operation unit, with LCD Display and pushbuttons.

C-Drive Assembly:

The Electric Steering control amplifier; this houses the main processor and steering circuitry.

Rudder Feedback Unit (RFU):

This provides the required rudder position information for steering control.

- Rudder Feedback Unit Standard (RFUS)
- Rudder Feedback Unit Heavy Duty (RFUH)

Remotes:

This is a collective term for a control device which are normally mounted in a position remote from the main control display. Each of these function in similar ways, but differ in appearance.

Remotes include:

- Electric helm
- Steering lever (FFU)
- Jog lever (NFU)
- Hand remote
- Active remote

Rudder Angle Indicator (RAI):

Displays the current rudder position.

Heading:

The magnetic heading of the vessel at the current time.

Course-to-steer:

The magnetic heading which the autopilot is attempting to achieve.

Waypoint Steering.

When interfaced to a GPS the autopilot is able to steering along a route pre programmed into the GPS.

NMEA Heading

The autopilot is able to accept heading data from an external source (eg: GPS compass or E-Compass) in NMEA 0183 format

Overview of Operation

Operation of the display unit buttons or mode selection on a remote unit will select one of the possible steering modes in the C-Drive amplifier. It is the C-Drive, which generates signals to the steering motor.

The following is a brief list of the capabilities of the autopilot. Each is described in more detail in a separate chapter.

MANUAL Mode: “H**”**

The autopilot Display Unit shows the current magnetic heading.

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

AUTO Mode: “A**”**

The autopilot will maintain your vessel on any desired magnetic course. This course can be set from the Display Unit.

GPS Mode: “A**”**

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

RUDDER and RESPONSE Settings:

These customise the AP56 Autopilot for your vessel's steering. They may also be used to adjust for varying sea conditions.

COMPASS CALIBRATION:

The AP56 compass can be calibrated on the vessel using a simple procedure.

RUDDER ANGLE DISPLAY:

The AP56 Display Unit LCD can be set to display the rudder angle as a numeric number.

BACKLIGHTING:

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

REMOTE AUTO Mode: “ r * ”**

With a hand remote, panel remote, steering lever or steering wheel station installed, this will allow steering by compass with the desired course adjustable from the remote station.

REMOTE POWER STEER Mode: “ r * ”**

With a hand remote, panel remote, steering lever or steering wheel station installed, this will allow control of rudder position from the remote station.

POWER ON/OFF

The power to the C-Drive motor control unit should be via a suitable circuit breaker. Turning this on will provide power for the C-Drive unit and the AP56 Display Head.

Initial Settings

Selecting the Initial settings of the Autopilot:

A number of system settings may need to be carried out prior to using the AP56 Autopilot. Two initial settings can be carried out using the display controls; other settings include special remote mode or C-Drive parameters which are set using a computer with Hyperterm (or another type of COMS Terminal) program.

The display adjusted settings are:

- Rudder Limits
- Compass Calibration

Rudder Limit Set

The rudder limits prevent the steering motor driving the rudder beyond its physical (mechanical) stops. The limits are factory set to 30° and should not need changing. However, the limit setting can be set from the display if deemed necessary.

Setting limits:

- Move the rudder to the required port limit position
- Press MODE button five times
- Display will read PL - - (- - is the port rudder angle °)
- Press ◀ and ▶ buttons together
- Port limit is now set
- Move rudder to the required starboard limit position
- Press MODE button
- Display will read SL - - (- - is the starboard rudder angle °)
- Press ◀ and ▶ buttons together
- Starboard limit is now set
- Press AUTO
- Display should now revert to read heading (H***)

NOTE:

- *If "oor" (out of range) is displayed, it indicates the rudder is not in the correct position to set the rudder limit. ie: Rudder is to port when setting the Starboard limit.*
- *If at any time during testing the motor runs under load and the rudder does not move, checks should be carried out to confirm the limit switches are operating prior to the rudder running into the stops.*

Rudder Limit Reset

It is possible to reset the rudder limits to the factory settings if unsure of the settings when adjustments are carried out.

To reset rudder limit to factory default:

- Press the MODE button seven times
- Display will read r L r
- Press ◀ and ▶ buttons together
- Rudder limits are now reset to factory default setting

Compass Calibration

The standard TMQ compass (COMMAG or E-Compass) supplied as part of the AP56 autopilot system has been calibrated after manufacture and this calibration will be satisfactory for most installations. If you have a steel vessel, or some other factor which causes the compass to perform poorly, the calibration procedure will adjust compass characteristics to compensate.

NOTE: *The calibration should only be done if the compass is known to be inaccurate when compared to a chart bearing.*

If the AP56 compass heading displays a constant offset when compared to a correctly calibrated ships compass (eg: the autopilot compass reads 3 degrees high on all headings), simply rotate the compass sensor to align the displayed headings with the ships compass.

In this case it is not necessary to re-calibrate the compass as described below.

If the AP56 has inconsistent variation on different headings, the following calibration procedure can be carried out. This procedure should only be done in calm waters with adequate sea room. AUTO mode must not be selected to carry out the calibration.

To calibrate compass:

- Press MODE button eight times
- Display will read CCAL
- Press ◀ and ▶ together to start calibration
- Display will read StrC
- Commence turning the boat slowly in one direction for two full circles (720°). Each circle should take a minimum of 1 minute.
- On completion of the turns press ◀ and ▶ together to store the calibration.
- Display will revert to read heading
- Check the compass alignment by steering boat due north 000° by boat's compass
- Rotate autopilot compass (if necessary) so that display also reads 000

NOTE: *The effectiveness of the compass calibration is dependent upon all steps being completed. Should you wish to abort the calibration procedure at any time during the process, simply press MODE button to return the pilot to MANUAL.*

It is important to realise that on any vessel the ship's compass can have heading errors as a result of the vessel's magnetic signature. These errors can be minimised by having the ship's compass swung and compensated by a licensed compass adjuster. In any case it is highly unlikely that the ship's compass and autopilot compass will be congruent for every heading.

If you are unsure of the success of the calibration, you may return to the factory calibration setting by doing the following:

Auto must not be selected to reset the compass calibration.

To reset calibration to factory default:

- Press MODE button nine times
- Display will read rStC
- Press ◀ and ▶ together to reset calibration to factory setting

Heading Sensitivity

The heading sensitivity adjusts the angle the boat is allowed to move off course before the autopilot reacts to correct. This is sometimes referred to as dead band.

A low sensitivity value will cause the drive to operate with minimum pulsing to position the rudder position and the autopilot system may work continuously (hunt).

A high sensitivity value the drive will position the rudder with maximum pulsing. The vessel's course will wander slightly.

To adjust sensitivity:

- Press MODE button
- Display will read S * * - present setting (**) will be between 1 and 10
- Press ▶ to increase setting
- Press ◀ to decrease setting
- Display will revert to heading after 3 seconds has elapsed

Rudder Ratio

The rudder ratio varies the amount of rudder angle which can be applied for a given course error. This is sometimes referred to as rudder response.

A low rudder setting which is too low will cause the boat to track in a slow " S " motion, ie: understeer through too little rudder applied.

When the rudder setting is too high, vessel track will be a rapid " S " ie: oversteer through too much rudder applied.

To adjust rudder ratio:

- Press MODE button twice
- Display will read r * * - present setting (**) will be between 1 and 10
- Press ▶ to increase setting
- Press ◀ to decrease setting
- Display will revert to heading after 3 seconds has elapsed.

Operation of Autopilot

Manual Mode

- Display reads “H***”, *** being the current magnetic heading
- Drive unit is disengaged,
- No steering control is generated.

Possible alarms:

- No C-Drive alarm “ n r d “

Auto Mode

IMPORTANT!

Before entering AUTO mode, rudder should be in the centre position (i.e.: the vessel is steering approximately straight ahead). If not done, the course steered will be different to what is displayed.

The AP56 Autopilot will select the position of the rudder when AUTO is selected as the position of the rudder to allow the vessel to steer straight ahead. This can be an advantage in most vessels when a slight amount of helm from the physical centre position is required for the vessel to go straight.

Engage AUTO Mode:

- Press the AUTO button
- Beep will sound
- AUTO LED will light
- Autopilot locks on to current heading
- Display reads “A***” – course to steer

Disengage AUTO mode:

- Press the AUTO button
- Beep will sound
- AUTO LED goes off
- Boat is steered by hand (helm)

Course Adjustment in Auto:

- Press ◀ button
- Course will alter by 1° port
- Press ▶ button
- Course will alter by 1° starboard
- Display will indicate new course to steer
- Press and hold pressed ◀
- Course will alter by 10° increments to port
- Press and hold pressed ▶
- Course will alter by 10° increments to starboard
- Display will indicate new course to steer on completion

Possible alarms:

- No C-Drive data
- Display reads n r d
- Off course – by more than 045°
- Alarm sounds and LED flashes

Power Steer Mode

The rudder angle may be controlled by the buttons ◀ and ▶ on the AP56 panel or from one of the remote steering stations.

For engaging this mode, when in MANUAL mode press the buttons AUTO and MODE at the same time. Once in power steer mode, press ◀ for moving the vessel to port, or ▶ for moving to starboard.

GPS Mode – Waypoint Steering

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.

Setting up your GPS unit:

The GPS unit must be set up to output NMEA 0183 and programmed to navigate to a waypoint, or to follow a line joining two or more waypoints (called a route). The output data generated must include at least one of the following sentences:

- (i) APA
- (ii) APB
- (iii) BOD and XTE

NOTE: *If only the XTE data sentence is available, the pilot can steer in a restricted manner only.*

The AP56 will be able to steer from each waypoint to the next without intervention under the following conditions:

- (i) several waypoints are linked together into a single route,
- (ii) the GPS unit is set and capable of “auto-sequence” between them,
- (iii) 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,

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.

Engage GPS Mode:

- Press AUTO Button
- Then press the MODE and AUTO buttons together
- GPS and AUTO LED's will light
- Beep will sound
- Display reads course to steer (BTW as displayed by GPS)
- Boat will turn (if necessary) to take up new course

Disengage GPS Mode:

- Press AUTO
- Beep will sound
- AUTO & GPS LED's will be off
- Display reads magnetic heading (H ***)
- Boat is steered by helm

Possible alarm:

- No GPS data

When GPS mode is selected boat will turn to take up new course at a rate of 10° / second

If no GPS data is received by the AP56, the autopilot will lock onto the course of the vessel at the time that GPS Mode was engaged, and the "NO GPS DATA" alarm will function. Both AUTO and GPS LED's will flash.

Backlighting

The backlight may be switched on to provide the LCD display with a back lit screen for night viewing or switched off for day time viewing.

To switch back light on or off:

- Press MODE button four times
- Display will read LitE
- Press ◀ and ▶ together to turn light on
- Press ◀ and ▶ together to turn light off again
- Press AUTO button to return display to read heading

Rudder Angle Indicator

The display may be used to show rudder angle when in MANUAL or AUTO modes.

To view rudder angle:

- Press MODE button three times lay the rudder position in numeric value Port or Starboard
- Display will read either Pt ** or St ** where ** is the angle of rudder in degrees. If the rudder was centred, the display would read 00

To exit rudder angle display:

- Press MODE or AUTO button

Remote Operation

The AP56 autopilot can use the following remote control devices:

- Hand remote
- Active remote
- Steering lever
- Electric helm

These devices are connected directly to the C-Drive amplifier via the REMOTE 1&2 socket or REMOTE 3 socket.

NOTE: *Special remote modes have to be selected in the C-Drive amplifier in order to use some of the remote control devices. Refer to the C-Drive manual for more information.*

Display indication for remote auto control:

- AUTO selected by remote control
- AUTO and REM LED's on main display will be lit
- Autopilot is under autopilot control
- Display reads course to steer
- Course changes can be made by remote control

To revert to main control:

- Press AUTO on main display to assume main control
- Autopilot is in AUTO control
- Boat is under autopilot control
- Press AUTO again to revert to MANUAL control
- AUTO LED will now be off on main display
- Display shows magnetic heading (H ***)

Display indication for remote power steer control:

- Select POWER STEER by remote control
- PWR and REM LED's on main display will be lit
- Display reads boat heading
- Boat is under remote power steer control
- Course changes are made by remote control

To revert to main display control:

- Press AUTO on main control
- AUTO LED will be lit on main control
- Boat is under autopilot control
- Press AUTO again to revert to MANUAL
- AUTO LED will now be off on main display
- Display shows magnetic heading (H ***)

Where a steering lever or electric helm is used, remote power steer is the only selectable function.

Alarms

There are several alarms associated with the autopilot system which are a function of and controlled by the C-drive amplifier. However the display is the medium through which these alarms are heard and displayed.

Off Course

In AUTO mode the off course will activate when the boat is more than 45° off the required course.

- Audible alarm will sound
- AUTO LED will flash

When the boat heading comes back within 45° of the course heading the alarm will deactivate.

No GPS Data

This alarm is activated when the autopilot is not receiving valid information while in GPS mode. This could be caused by:

- Incorrect wiring of the GPS to the C-Drive unit.
- Incorrect data output (wrong sentence) from the GPS unit.
- No route set up or selected in the GPS unit
- No location fix at the GPS unit.

The course over ground information generated by the GPS unit should closely correspond to the magnetic heading signal the AP56 is receiving from its magnetic compass. The greater the difference between these headings, the less accurate will be the GPS Mode steering.

Two areas which should be carefully checked are:

- Ensure the GPS unit has the correct magnetic correction factor
- Ensure that the AP56 compass is correctly installed, aligned, and not subject to magnetic interference.

When the pilot is in waypoint steering mode (AUTO / GPS) and the No GPS data alarm is activated:

- Audible alarm will sound
- AUTO LED will flash
- GPS LED will flash
- Press AUTO to stop the alarm and revert to normal autopilot steering

No MCU

This alarm is activated when the display unit does not receive communication data from the C-Drive assembly.

- Audible alarm will sound rapidly
- Display will scroll **n r d** across the screen
- Check that all plugs are secure and the interconnecting cable is not damaged.

No Heading Data

The autopilot C-Drive amplifier is able to accept NMEA heading data from an external device (e.g.: NMEA heading from a GPS compass). This data can arrive directly to C- Drive connecting the external device to C-Drive, or via AP56. For receiving NMEA data via AP56, the external device has to be attached to the AP56, and the AP56 will forward the incoming data automatically to its other port, which is connected to C- Drive.

When in AUTO mode if the data stream to the C-Drive is interrupted, the alarm is activated.

- Audible alarm will sound
- AUTO LED will flash
- Alarm can only be silenced by switching autopilot system off

Installation

Main Display Unit

Position:

The Display Unit is water resistant but not waterproof.

- Select a dry position with access to the steering position
- Ensure this position is not affected by water
- Cut a 75mm diameter hole (2.5 inches) in the panel where the display is to be mounted
- Mount display and fasten with four corner screws, DO NOT over tighten screws as this may damage the display
- Route display cable to C-Drive amplifier
- Connect cable to NMEA socket on C-drive
- For feeding C-Drive with NMEA data via AP56 head, connect an external device which provides this data, such as an electronic compass, to the other available connector of AP56 head. Does not matter to which connector the C- Drive and the external NMEA device are connected to.

NOTE: *When routing cable keep as far away as possible from radio aerial and aerial cables to prevent interference to the autopilot. Cables should also be kept clear of heavy current carrying cables.*

Second Station Display Unit

It is important to note that displays are connected in series (daisy chain) format.

Connect the displays in series choosing one of the two connectors in each one.

The remaining connector of one of them must be connected to the NMEA port of C-Drive, then, the remaining connector of the other head can be connected to an NMEA data device, such as a GPS, or a electronic compass.

The data provided by this last device will be forwarded to C-Drive module via the AP56 heads.

AP56 Display Connections

NOTE: *Both connector sockets of the AP56 have the same functions, i.e., the power supply and the communication pins.*

Once a power supply is connected to one connector, it can't be connect another power supply to the other, as the pins for the power are connected internally between the two connectors.

Connection to C-Drive Unit

AP56 socket	Function	Display Colour	DIN Plug	
	GPS In +	White	Pin 1	White
	GPS In –	Green	Pin 2	Green
Pin 1	+10 V.....		Pin 6	Red
Pin 2	Negative		Pin 4	Blue
Pin 3	Not connected			
Pin 4	TMQ Data Tx +		Pin 5	Yellow
Pin 5	TMQ Data Rx +		Pin 3	Green
Pin 6	Not connected			

Connection to a NMEA Device

AP56 socket	Function
Pin 1	+10 V
Pin 2	Negative
Pin 3	NMEA data Rx –
Pin 4	NMEA data Tx +
Pin 5	NMEA data Rx +
Pin 6	Not connected

Declaration of Conformity

(MANUFACTURERS DECLARATION)

Manufacturer: TMQ Electronics
PO BOX 3348
Tingalpa, QLD 4173
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Declares under our sole responsibility
that the products:

AP47 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.



1st August 2020
Dale Sinclair, Manager

Warranty

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

TMQ 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

Email: tmq@tmq.com.au

Visit the website: www.tmq.com.au

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