



AP500 Display Head



OPERATION AND INSTALLATION MANUAL

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Warning!

Automatic pilots are designed to be a navigational aid. As an automatic steering aid, an autopilot can alleviate the boredom of hand steering.

This allows the operator of the vessel time to attend to other duties, keep a more accurate check of navigation duties or just relax and enjoy the trip.

HOWEVER, THE AUTOPILOT SHOULD NOT BE LEFT SOLELY IN CHARGE OF THE VESSEL AND AN ADEQUATE WATCH SHOULD BE MAINTAINED AT ALL TIMES.

IT IS STRONGLY RECOMMENDED THAT THE AUTOPILOT SHOULD NOT BE USED WHILE NAVIGATING IN RESTRICTED WATERWAYS AS WATER CURRENTS, WIND CHANGES OR RADIO TRANSMITTER INTERFERENCE CAN ENDANGER YOUR OWN OR OTHER VESSELS.

Introduction

Congratulations on your wise choice and purchase of the TMQ AP500 Autopilot Display Head we are sure that you will enjoy the benefits that it offers.

The minimum Autopilot system must comprise of the following units:-

Essential Electronics:

- Autopilot unit
- Rudder Feedback Unit (RFU)
- Display Head unit
or Computer operating software.
- Fluxgate compass
- Drive units, for example
 - Hydraulic system with solenoid valves.
 - Reversing hydraulic pump system.
 - Mechanical motor drive system.



The AP500 head provides full control of the autopilot, indicating both current course and course to steer along with rudder angle.

Note:

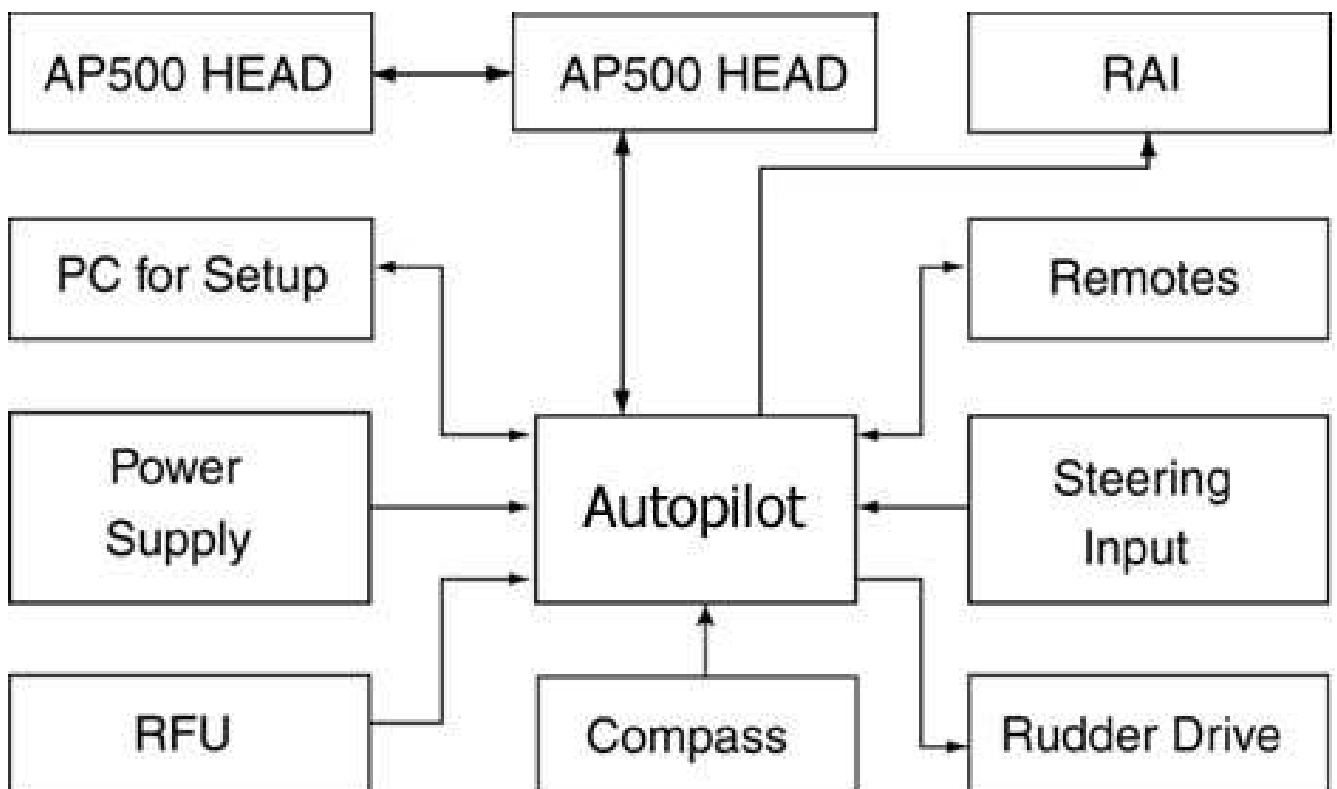
Additional AP500 Display units can also be fitted to operate the Autopilot from extra locations.

Options:

- Electric steering wheel or lever
- Remote Station Devices including:-
 1. Remote panel
 2. Hand remote
 3. Steering lever
 4. Steering wheel
 5. Rudder angle indicators (RAI), if desired

See Optional Extras at the rear of this manual for details.

Block Diagram of full system



Definition of Terms

Current Course:

The magnetic heading of the vessel at the current time.

Course-to-steer:

The magnetic heading which the autopilot is attempting to achieve.

Display Unit:

The unit with digital display and keypad which is used to send commands to the C-Drive unit. This is also referred to as a “steering station”.

Remote Unit:

This is a collective term for a “panel remote”, “hand remote”, “steering lever” or “steering wheel” station. Each of these function in similar ways, but differ in appearance.

AP500 Display



Overview of Operation

Operation of Display Unit buttons or mode selection on a remote unit will select one of the possible steering modes in the Autopilot unit. It is the Autopilot unit which generates signals to the steering motor (whether mechanical, hydraulic, or other type).

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

- **MANUAL Mode:**

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:**

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

- **GPS Mode:**

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.

- **POWER Mode:**

Moving the Dial on the AP500 controls the rudder of the vessel, the compass displays the compass heading.

- **REMOTE AUTO Mode:**

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:**

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

- **RUDDER and RESPONSE Settings:**

These customise the AP500 Autopilot for your vessel's steering. They may also be used to adjust for varying sea conditions.

- **Compass Calibration:**

The AP500 compass can be calibrated on the vessel using a simple procedure.

- **Rudder Angle Displays:**

The AP500 Display Unit will indicate rudder angle on the screen.

- **Selectable backlighting:**

When using the autopilot at night, 2 levels of backlighting are available.

Turning the unit ON / OFF

Press PWR/OFF to turn on the AP500 Display Unit

Press CLR/OFF and PWR/OFF simultaneously and hold for 10 seconds to turn off the unit.

NOTE:

The above only turns the power on in the Display Unit. Power should be connected to the Motor Control Unit (Autopilot unit) via an isolator circuit breaker. The AP500 Display Unit is powered from the Autopilot unit and the Autopilot unit must have power applied for the display to operate.

If the display is turned off when the Autopilot unit is in AUTO, POWER or GPS mode, the Autopilot unit will return to MANUAL mode after 10 seconds.

MANUAL Mode

In this mode

- The display screen shows “Manual”,
- The drive unit clutch is disengaged,
- No steering control is generated,
- The digital display shows the vessel’s current magnetic course.

Possible alarms

- “NO MCU” alarm

AUTO Mode

- Press the AUTO button. AUTO mode will be selected.

Or

- Press the MODE button. Select the mode required by turning the dial, press the dial to select the mode. A beep will sound and the text display will change to “AUTO”.

The autopilot will lock on the current heading.

The course-to-steer is shown on the display.

Disengaging AUTO mode:

Press the MANUAL button, a beep will sound and the vessel will return to manual steering.

Changing the position of the remote unit switch can select REMOTE AUTO, REMOTE POWER STEER, or MANUAL modes.

Course Adjustment:

Turning the dial will cause a one degree per segment course change in the applicable direction. The display will change to indicate the new course-to-steer.

IMPORTANT!!

Before entering AUTO mode, ensure that the rudder is in the centre position (ie: the vessel is steering approximately straight ahead). If you do not do this, the course steered will be different to that which is displayed.

The AP500 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.

GPS Mode

For use when interfaced to a GPS generating NMEA 0183 data output in the correct sentence format. While in GPS mode this allows the autopilot to be directed by the GPS, enabling automatic heading changes and eliminating the effects of wind and tide.

The digital display indicates the **course-to-steer**, which will be the bearing between the origin and destination waypoints, plus a factor to correct for the current **cross track error (XTE)**.

Engaging GPS Mode:

Press the MODE button. Select the GPS mode with the dial, press the dial to select the mode.

A beep will sound and the text display will change to “GPS”.

The autopilot will lock on to the heading as requested by the GPS. The course-to-steer is shown on the display.

The vessel will begin turning from its current course to that requested by the GPS unit, at a maximum rate of 10 degrees per second.

If no GPS data is received by the AP500, 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.

Disengaging GPS Mode:

Pressing the AUTO button will return the AP500 to normal AUTO mode.

Pressing the MANUAL button will set the AP500 to MANUAL mode.

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 NMEA socket on the AP500 / Autopilot unit. 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 the course-to-steer can be calculated.

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 AP500 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.

No GPS Data Alarm:

If the autopilot is not receiving valid information while in GPS Mode, the alarm will sound, and the message “NO GPS DATA” will blink on the display. 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 AP500 is receiving from its magnetic compass. The greater the difference

between these headings, the less accurate will be the GPS Mode steering.

- Ensure that the GPS unit has the correct magnetic correction factor.
- Ensure that the AP500 compass is correctly aligned and installed, and not subject to magnetic interference.

POWER Mode

Engaging POWER mode:

Press the MODE button, select the POWER mode with the Dial, press the dial to select the mode. A beep will sound and the text display will change to “POWER”.

The vessel’s rudder position will be controlled by the autopilots’ dial.

The compass heading is shown on the display.

The required rudder position will be displayed on the lower section of the “RUDDER ANGLE” display. The upper section of the “RUDDER ANGLE” display will indicate the actual rudder position.

Disengaging POWER mode:

Press the “AUTO or MANUAL” button, a beep will sound and the vessel will return to selected mode.

Changing the position of the remote unit switch can select REMOTE AUTO, REMOTE POWER STEER, or MANUAL modes.

IMPORTANT!!

Before entering AUTO mode, ensure that the rudder is in the centre position (ie: the vessel is steering approximately straight ahead). If you do not do this, the course indicated would not be the actual course steered.

Rudder Ratio / Sensitivity

These settings are used to determine the amount of rudder the vessel requires for steering (actually, the amount of rudder angle applied for a given angle off-course), and how sensitive the Autopilot system is.

To adjust, press the SENS/RUD button. The display will show “RUDDER” and the present rudder ratio setting will be displayed (between 1 and 10).

The rudder setting may be altered by turning the dial.

- A value of one 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 ten 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.

By pressing the SENS/RUD button a second time, the display will indicate “SENS”. This setting is used for adjusting the autopilot’s response to varying sea conditions, and varying vessel capabilities.

The display shall change to show “SENS” and display shall show the current Sensitivity setting (between 1 and 10).

Turning the dial will alter the setting.

-
- A low response value, the drive will operate with minimum pulsing to the required rudder position and may overshoot.
 - A high response value, the drive will position the rudder with maximum pulsing and reduce the possibility of overshoot

NOTE: **Too low a setting may cause the steering motor to work continuously (hunting). The response setting should be increased from 1 until the rudder position is achieved with 1 or 2 motor pulses.**

Contrast and Backlighting

Pressing the “CONT/DIM” button will display the contrast setting of the LCD display. Adjust by turning the dial. The range of number can be between 1 and 24. If the display is not visible rotate the dial clockwise to increase contrast until the display is visible.

Pressing the “CONT/DIM” additional times will toggle the backlighting between “HI and LOW”

Rudder Angle Indicator

With the Normal display selected from the “MENU” button, the rudder angle will be displayed as graphic bars.

- When the rudder is at centre, there will be a single line in the centre of the display.
- As Port rudder angle is applied, the left bar will grow longer.
- As Starboard rudder angle is applied, the right bar will grow longer.

Autopilot Settings / Adjustments

Adjusting the settings of the Autopilot:

A number of system settings can be carried out for the Autopilot.

- Compass Calibration
- Rudder Limits
- Off Course Alarm
- Remote Selection

To adjust one of these setting, select MANUAL Mode, press MODE button and select “INITIAL” and push the dial.

Select the required special function with the DIAL and push to select.

Compass Calibration

The compass supplied with your AP500 autopilot has been calibrated after manufacture, and this calibration will be satisfactory for almost all installations. If you have a steel vessel, or some other factor that 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 AP500 compass 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 AP500 compass sensor to align the displayed headings with the ships compass, **it is not necessary to re-calibrate the compass as described below.**

If the AP500 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.**

1. Use the dial to select “START CAL”
2. Push the dial and “START” will display
3. Start turning the vessel slowly in one direction. Turn vessel slowly through two complete circles from this point. Each complete turn should take at least 60 seconds.
4. On completion of circles, dial up “STORE CAL” to store calibration setting into memory.

Check alignment of the AP500 compass by steering the vessel due North (000 on ships compass) and, if necessary, rotate the compass sensor until display 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, do not carry out Step 3 but press MODE to return to MANUAL.

It is important to realise that on any vessel the ships compass can have heading errors as a result of the vessels magnetic signature. These errors can be minimised by having the ships compass swung and compensated by a licensed compass adjuster. In any case it is highly unlikely that the ships 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:

Select :- MANUAL / MODE / INITIAL / COMPASS CAL / RESET CAL

To exit “INITIAL” mode at any time press CLR/OFF

Rudder Limits

The rudder limits prevent the steering motor driving the rudder beyond its physical (mechanical) stops. The limits are factory set and should not need altering. However, the limit setting can be set from the display of the AP500 if deemed necessary.

- From the MANUAL mode select INITIAL then RUDDER LIMITS
- Select SET PORT LIMIT. Mechanically move the steering to the required maximum PORT position via the steering wheel. When the desired position is reached, push the DIAL to select.
- Select SET STBD LIMIT. Mechanically move the steering to the required starboard position via the steering wheel. When the desired position is reached, push the DIAL to select.
- Press CLR/OFF to return to the normal pilot display.
- To cancel the LIMIT settings, select RESET LIMITS and push dial to return to factory settings.

The number on the display between 0 and 256 indicate the rudder position. 000 being fully to Starboard, 128 being the centre and 256 being fully to port.

It is recommended that the rudder limits are set between 1 and 254.

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.

Remote selection

Provision is included for 2 different remote input selections :

R-1:- Provision for 1 or 2 hand/panel remotes (Default condition)

R-4:- Basic remote plus power steer input on REMOTE connector pin 5 in MANUAL mode. (Electric steering vessel).

To select the required remote style, selecting REMOTE via the INITIAL Mode allows the selection via the dial and push to accept.

Off Course Alarm

The AP500 allows for monitoring of the Autopilot course holding ability by having the angle off-course measured and alarm sounding if greater than the preset angle.

To set, select INITIAL Mode, select OFF COURSE ALARM, push dial, adjust value with the DIAL and push to accept.

CLR/OFF to exit

REMOTE AUTO Mode (Remote Unit Operation)

Hand remotes, panel remotes and steering lever stations all come with a dial or lever and switch.

While the autopilot is in this mode, the display will show “RAUTO” and the numeric display section will show the course-to-steer.

Engaging REMOTE AUTO Mode:

Move the remote unit switch to AUTO.

The remote dial or lever now controls the course-to-steer.

If the switch has been left at AUTO and the autopilot turned OFF, or the AUTO or MANUAL button pressed on the Display Unit, you will need to move the switch to centre (OFF), then back to AUTO to re-engage REMOTE AUTO Mode.

Disengaging REMOTE AUTO Mode:

Setting remote switch to OFF will select MANUAL mode.

Or

Pressing the AUTO button on the Display Unit will select AUTO mode.

Pressing the MANUAL button on the Display Unit will select MANUAL mode.

Course Adjustment:

Turning the remote dial will alter the course-to-steer. This change will be reflected on the Display Unit. From the central position of the remote dial, the course may be changed to PORT or STARBOARD by 90 degrees. The vessel will steer the new adjusted heading.

REMOTE POWER STEER (Remote Unit Operation)

Hand remotes, panel remotes and steering lever stations all come with a dial or lever and a 3-way switch. The switch is labelled PWR, OFF and AUTO.

While the autopilot is in this mode, the Display Unit display will show “RPWR” and the numeric display section will show the current course.

Engaging POWER STEER Mode:

Move the remote switch to the PWR position.

The remote dial or lever now acts as the helm, giving control over the angle of the rudder.

If the switch has been left at PWR and the autopilot turned OFF, or the AUTO or MANUAL button pressed on the Display Unit, you will need to move the switch to centre (OFF), then back to PWR to re-engage Remote POWER STEER mode.

Disengaging POWER STEER Mode:

Return the remote dial or lever to centre before switching to OFF.

The autopilot will return to MANUAL mode.

Or

Pressing the AUTO button on the Display Unit will return the autopilot to AUTO mode.

Pressing the MANUAL button on the Display Unit will return the autopilot to MANUAL mode.

Alarms

A number of conditions will cause alarms to sound and an alarm message to blink on display.

NO MCU Alarm

This indicates that the Display Unit is not receiving data from the C-Drive unit. Check that all plugs are secure and the interconnecting cable is not damaged.

NO GPS DATA Alarm

The alarm sounds if the autopilot is not receiving valid information from the GPS. The message “NO GPS DATA” blinks on and off at the same time.

OFF COURSE Alarm

The alarm sounds when vessel is more than the preset amount (default 45 degrees) from the selected course-to-steer. The message “OFF COURSE” blinks on and off at the same time.

Installation of Display Unit

Position:

The Display Unit should be mounted in a position accessible to the steering position and protected from direct rain or salt water. A mounting bracket is supplied with the AP500 Display Unit. For security, the Display Unit cable can be easily disconnected and the unit removed from its bracket for safe storage.

Wiring:

Access for wiring must be provided. Cabling will have to be run to the Autopilot. The power for the AP500 display is from the Autopilot unit. Wiring should be kept as far as possible from radio aerials and aerial cables to prevent interference to the radio and transmitted signals from the radio influencing the autopilot. The cable should also be run separately (if practical) from other current-carrying cables. There is no restriction on cable length.

Magnetic Effect:

As no steel is used in the Display Unit, there is negligible effect on a steering compass. Some radio interference may be caused by the internal electronics.

Additional Display Units:

Additional Display Units can be fitted if required. Connection is by 5-core cable between the “To Remotes” connector on the AP500 Display Head (connected to the Autopilot unit) and the “To MCU” connector

on the additional Display Unit. A third Display “To MCU” would be connected to the “To Remotes” connector of the second Display Unit etc.

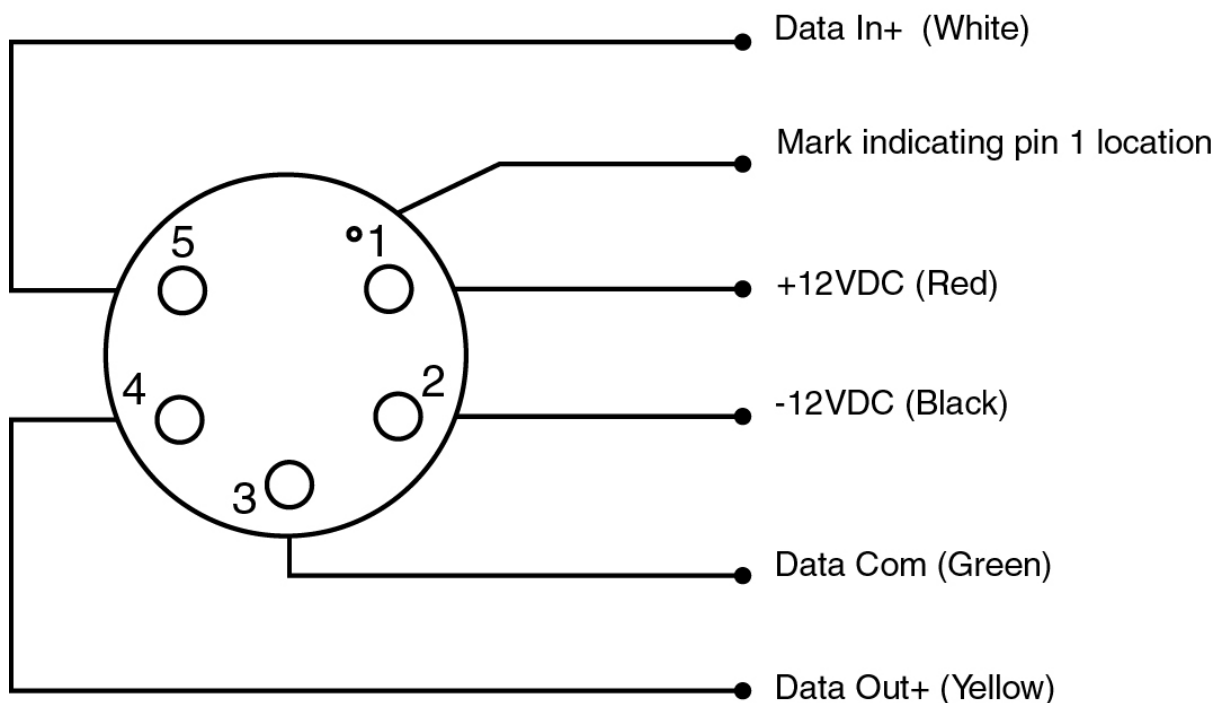
Operation of a function on one Display Unit will indicate on other Display Units.

Connections for AP500 Display Unit / C-Drive cable:

When connecting to a TMQ C-Drive using the NMEA socket.

C-Drive NMEA Socket	Function	AP500 Display	Colour (To C-Drive)
Pin 1	GPS In +		
Pin 2	GPS In -		
Pin 3	Data Tx +	Pin 5	White
Pin 4	Negative	Pin 2 & Pin 3	Black/Green
Pin 5	Data Rx +	Pin 4	Yellow
Pin 6	+10 volt	Pin 1	Red

Power for the AP500 Display Unit is fed from the Autopilot



AP500 Display Unit Connections (display end of cable)

Optional Extras

There are a range of optional extras available from TMQ.

Further information can be obtained from the TMQ website at www.tmq.com.au

Rudder Angle Indicator



The rudder angle indicator is a flush mounted instrument providing a clear indication of rudder position, which is critical when docking or manoeuvring in close quarters.

Electric Wheel



The TMQ Electric steering wheel provides precise, light steering on any vessel with a power steering system installed. It simplifies vessel fit out by eliminating long hydraulic lines to the helm position.

Panel Remote



The TMQ panel remote provides basic autopilot control providing course changes from a second station such as a fly bridge.

Hand Remote



Hand remotes and Active remotes provide the freedom to maintain full control of the autopilot and steering while moving around the vessel.

Active Remote



AP500 Head



The AP500 head provides full control of the autopilot, indicates both current course and course to steer along with rudder angle.

Steering Lever



These levers allow single handed control of any size vessel with power steering. Movement to port or starboard causes the rudder to follow proportionally.

Full Follow Up lever



Hydraulic Drives and Pump Units

Reversible pumps



Hydraulic pumps available in either 12 or 24 volts DC.

Continuous pumps



Constant running pumps available in 2 or 3 litre for 24 volt DC systems. Accurate flow adjustment is provided to set lock to lock time.

Linear drives



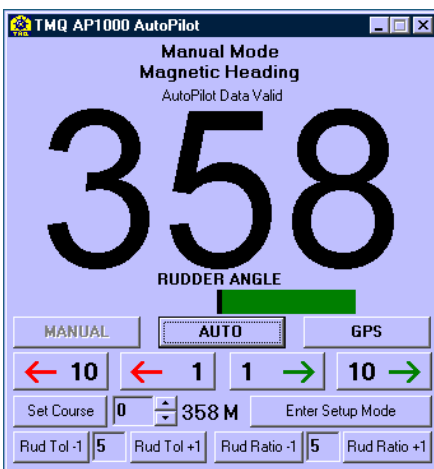
Single rod linear drives can be fitted to a wide variety of vessels. May be attached directly to the tiller or rudder quadrant.

Mechanical drives



Mechanical drive units in 12 or 24 volt DC to suit vessels with existing mechanical steering. Supplied with standard chain and socket.

Computer Software



TMQ AP1000 Autopilot Operating Software.

Computer control program enabling autopilot control from a standard PC with serial com ports. (Cable required)