AP55 Autopilot Display with C-Drive Motor Control Unit

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 AP55 Autopilot system. We are sure that you will enjoy the benefits that it offers.

The AP55 Autopilot system provides steering control from one main control panel and/or additional remote units.

The associated C-Drive can drive up to two independent steering units. The drives may be solenoid valves, mechanical motors or reversing pumps. The system facilitates a single or dual rudder system operating from a common input.

See the ***System configuration*** section.

AP55 Autopilot System

The minimum AP55 Autopilot system must comprise the following units: -

Essential Electronics:

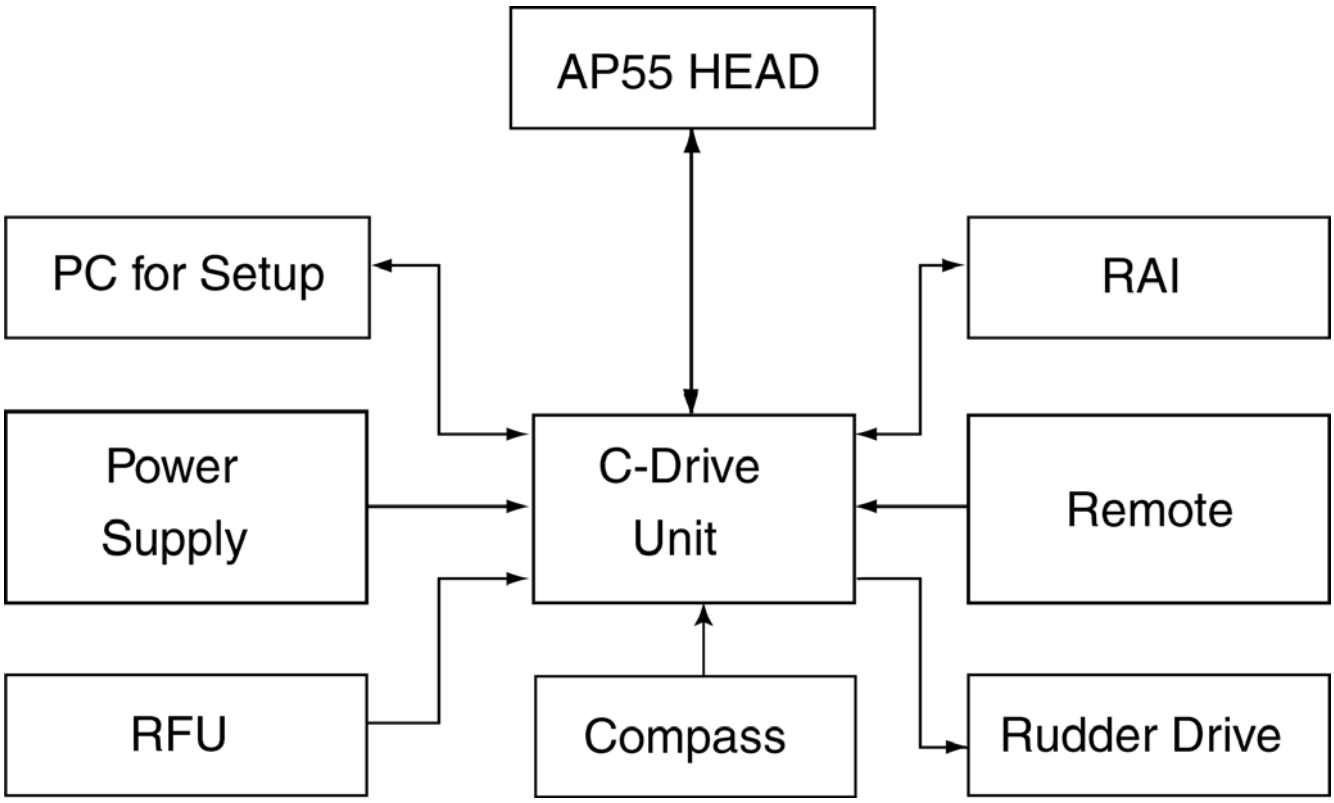
- AP55 Display head.
- C-Drive motor control unit
- Rudder feedback unit.
- Fluxgate compass
- Drive unit, for example
    - Hydraulic system with solenoid valves.
    - Reversing hydraulic pump system.
    - Mechanical motor drive system.

Options:

- Compass Top Sensor
- Heavy Duty Rudder Sensor
- 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



The AP55 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, which should be installed inside a dry locker or other protected position. Mounting position should be free of moisture and vibration. It requires a supply voltage of 12 or 24 volts DC.

The Rudder Feedback Unit (RFU) must be attached to the steering tiller device in such a way that it can accurately measure the movement of the ship's rudder (see Rudder Feedback Installation diagram page 14). The RFU must also be electrically connected to the C-Drive unit.

The compass (COMMAG) detects magnetic heading of the vessel and is connected to the C-Drive assembly. Mounting of the compass unit is very important (see pages 32 and 33).

Rudder drive system, this system provides the physical movement to the rudder responding to the direction control signals provided by the C-Drive system. Rudder Actuator Systems can comprise of the following: -

- Hydraulic Ram controlled by either: -
  1. Solenoid valves connected into an existing power steering system.
  2. Solenoid valves connected to a continuous running motor and pump unit.
  3. Reversing motor and pump unit, connected into an existing hydraulic steering system.

- Mechanical Drive, a reversing motor drive unit with reduction gears to drive the steering system.

Definition of Terms

AP55 Display:

The Operation unit, with LCD Display and pushbuttons.

C-Drive Assembly:

The Electric Steering control unit; 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)
  Two rudder feedbacks are required for an electrical tie bar system.
  (Either two RFUS or two RFUH.)

Remotes:

These provide additional steering input for the AP55 unit, Remotes include:

- Electric steering wheel
- Electric steering lever
- Steering lever, FFU or NFU
- Hand remote and or panel remotes

Steering Levers:

- Full Follow Up (FFU); this is a device that provides a proportional control input.
- Non Follow Up (NFU); this type of device does not provide a proportional control.

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.

Display Unit:

The unit with LCD digital display and keypad used to send commands to the C-Drive assembly.

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.

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 C-Drive unit. It is the C-Drive assembly, 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: "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.

- **REMOTE AUTO Mode: "A***"**

  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: "P***"**

  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 AP55 Autopilot for your vessel's steering. They may also be used to adjust for varying sea conditions.

- **Compass Calibration:**

  The AP55 compass can be calibrated on the vessel using a simple procedure.

- **Rudder Angle Displays:**

  The AP55 Display Unit LCD can be set to display the rudder angle as a numeric number.

- **Selectable backlighting:**

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

Turning the unit 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 AP55 Display Head.

If the display is disconnected when the C-Drive unit is in AUTO, POWER or GPS mode, the C-Drive unit will return to MANUAL mode after 10 seconds.

MANUAL Mode

In this mode

- The display screen shows "H***", *** being the current vessel magnetic heading in degrees.
- The drive unit clutch is disengaged,
- No steering control is generated.

Possible alarms

- No C-Drive alarm " nrd "

AUTO Mode

- Press the AUTO button. AUTO mode will be selected. A beep will sound and the text display will change to "A***". The Auto LED will light

  The autopilot will lock on the current heading.
  The course-to-steer is shown on the display.

Disengaging AUTO mode:

Press the AUTO 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:

Each press of the < or > buttons will cause a one degree per segment course change in the applicable direction. The display will change to indicate the new course-to-steer. By pressing and holding the buttons pressed will cause the change to be at 10 degrees per second for larger turns.

IMPORTANT!!

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

The AP55 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 or plotting system generating NMEA 0183 data output in the correct sentence format. GPS mode 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 and, while the MODE button is pressed, press the AUTO button.

A beep will sound and the GPS and AUTO LED will be illuminated.

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

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

If no GPS data is received by the AP55, 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 AP55 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 AP55 C-Drive 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 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 AP55 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 GPS and AUTO LED will flash. 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 AP55 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 theAP55 compass is correctly aligned and installed, and not subject to magnetic interference.

Rudder Sensitivity / Ratio

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

To adjust, press the MODE button. The display will show "S **" and the present sensitivity setting will be displayed (between 1 and 10).

- The sensitivity setting may be altered by the < - > Buttons. A low response value the drive will operate with minimum pulsing to the required rudder position and the autopilot system may work continuously.

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

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.

By pressing the MODE button a second time, the display will indicate "r **". This setting is used for adjusting the autopilot's rudder ratio setting to allow for varying vessel size and speed.

The display shall change to show "r **" and display shall show the current Rudder ratio (between 1 and 10).

The rudder setting may be altered by the < - > buttons.

- A value of 1 signifies the minimum amount of applied rudder. When the rudder setting is too low, vessel track will be a slow " S " ie: understeer through too little rudder applied.

- A value of 10 signifies the maximum amount of applied rudder. When the rudder setting is too high, vessel track will be a rapid " S " ie: oversteer through too much rudder applied.

Backlighting

Pressing the MODE button four times will display the message "LitE"
Pressing the < > buttons together will toggle the backlighting on and off.

The backlighting will always be off when the unit is powered up.

Rudder Angle Indicator

Pressing the MODE button three times will display the rudder position in numeric value Port or Starboard

- When the rudder is at centre it will display " 00"

- As port rudder angle is applied, the number will be "Pt**".

- As starboard rudder angle is applied, the numbers will be "St**".

Pressing MODE or AUTO will cancel the rudder display.

Initial Settings

Selecting the Initial settings of the Autopilot:

A number of system settings may need to be carried out prior to using the AP55 Autopilot. Two initial settings can be carried out from the Display Head.

- Rudder Limits
- Compass Calibration

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 AP55 if deemed necessary.

- Set the rudder to the desired Port position
- Select SET PORT LIMIT. By pressing the MODE button five times until "PL**" is displayed
- Press the < > buttons simultaneously to set the Port Limit.
- Set the rudder to the desired Starboard position
- Select SET STARBOARD LIMIT. By pressing the MODE button six times until "SL**" is displayed
- Press the < > buttons simultaneously to set the Starboard Limit

The number on the display will be between 0 and 31 to indicate the rudder position. “SL31” being fully to Starboard and “PL31” being fully to port.

If “ oor” (Out of range) is displayed it indicates the rudder is not in the correct position to set the rudder limit. I.e. **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.

Reset Rudder Limits

It is possible to reset the rudder limits to the factory settings if unsure of the settings.

Press the MODE Button 7 Times

“ rLr” will Display (Reset Limit Rudder).

Press < > both simultaneoualy to reset rudder limit.

Compass Calibration

The compass supplied with your AP55 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, 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 AP55 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 AP55 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 AP55 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 must not be selected to carry out the calibration.**

1. Press the MODE button 8 times to enter the compass calibrate mode "CCAL"

2. Press the < > buttons simultaneously to start the compass calibrate. The Display will change to "StrC"

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, press the < > buttons together to store the calibration setting into memory.

Check alignment of the AP55 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 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.

Press the MODE Button nine times and "rStC" is displayed

Press the < > buttons simultaneously to reset the compass calibration to factory settings.

Off Course Alarm

The AP55 allows for monitoring of the autopilot course holding ability by having the angle off-course measured and alarm sounding if greater than 45 degrees from the desired course.

If the difference is greater than 45 degrees between the heading and the course to steer, the alarm will sound and the Auto LED will flash

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 LED will indicate the mode used, i.e., REMOTE AUTO and the numeric display section will show the course-to-steer.

Engaging REMOTE AUTO Mode:

Select AUTO on the remote by the switch or button marked AUTO
The remote dial or lever now controls the course-to-steer.

For remote units with toggle switches, 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 MANUAL mode.

Remote 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 selection switch. The switch will be marked for the POWER MODE to be selected.

While the autopilot is in this mode, the Display Unit LEDs will indicate REMOTE POWER and the numeric display section will show the current magnetic heading.

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.
With remotes with toggle switches, 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 MANUAL mode.

Alarms

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

NO MCU Alarm " nrd"
This indicates that the Display Unit is not receiving data from the C-Drive assembly. 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 GPS and AUTO LEDs blink 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 AUTO LED blinks on and off.

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 hole of 70mm (2.5inches) is required for the rear of the unit.

Wiring:

Access for wiring must be provided from Display to C-Drive assembly. The Display cable plugs into the **NMEA** socket of the C-Drive, which provides power and data communications for the Display. 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. 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:

Provision for additional Display heads is not available at this time; please contact your dealer or reseller for further information.

Installation of Compass

The AP55 Autopilot is normally supplied with a standard Compass Sensor (COMMAG). For steel vessels with a good quality **flat-topped** ships compass, correctly compensated for the vessel, a Compass-Top Sensor (CTS) should be used.
The standard Compass Sensor should be treated with care, as the internal gimbals can be broken if the compass sensor is dropped. **Remove internal packing before installation.**

Position:

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.

As the compass has no moving card, it is not necessary for the compass to be mounted low in the vessel. This can be a place of high magnetic interference and should be avoided. However, **a position where excessive roll is experienced, such as the top of a mast, should not be used.**

In a steel vessel, if the standard Compass Sensor is selected instead of the Compass-Top Sensor, the compass sensor should be mounted **a minimum of 1 metre** above the steelwork.

The compass is weatherproof, not waterproof. A position not open to the elements should be selected. It can be mounted on top of a flat surface, on a bulkhead or from the deck head.

NOTE: Check other side of bulkhead for materials, which may cause magnetic interference.

Wiring:

The cable leading from the compass must be connected to the **COMPASS** socket on the C-Drive. Do not run the compass cable with other cables on the vessel. The compass is supplied with a standard 5 metre length cable but there is no restriction on cable length if it has to be extended.

Magnetic Effect:

Interference from any iron or steel can cause degraded operation of the compass unit. To prevent this occurring a minimum distance of 1 metre (3 feet) should be kept from any steel or other ferromagnetic materials. This includes speakers and radios with internal speakers.

Mounting:

Fasten the compass with the non-magnetic screws supplied. The compass must be mounted in an approximately vertical position. See also the diagram labelled “Compass Mounting Options”.

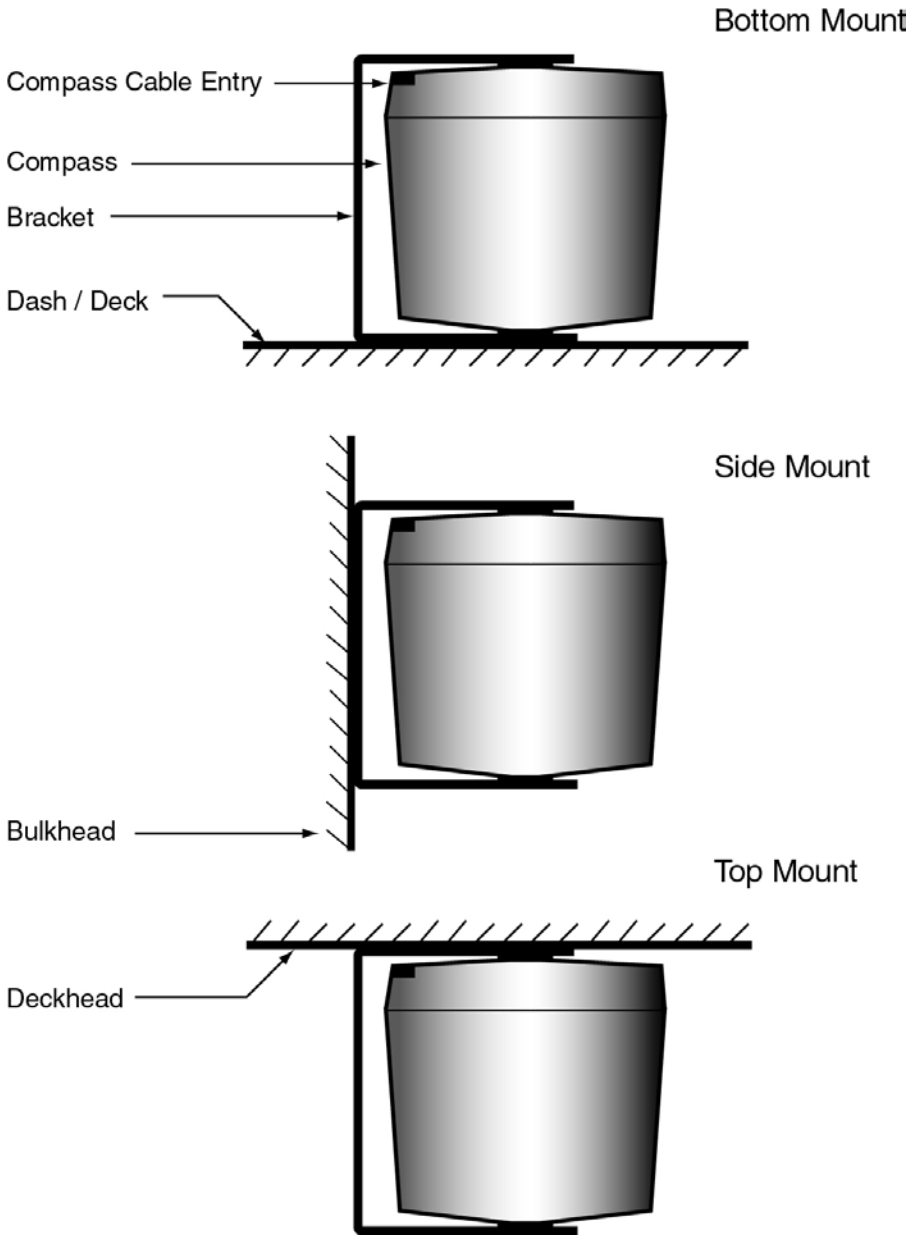
Calibration:

The compass unit will need to be rotated for the correct heading to be displayed. During sea trials further adjustment may be required to reduce any heading error displayed.

The compass is calibrated in the factory. This will certainly be good enough for sea trials and in most cases will be as good as or better than

the results of any auto-calibration on the vessel. Further calibration should not be necessary unless you find, **after sea trials**, that the autopilot compass readings have significant errors. If so, then follow the compass calibration section.

Compass Mounting Options

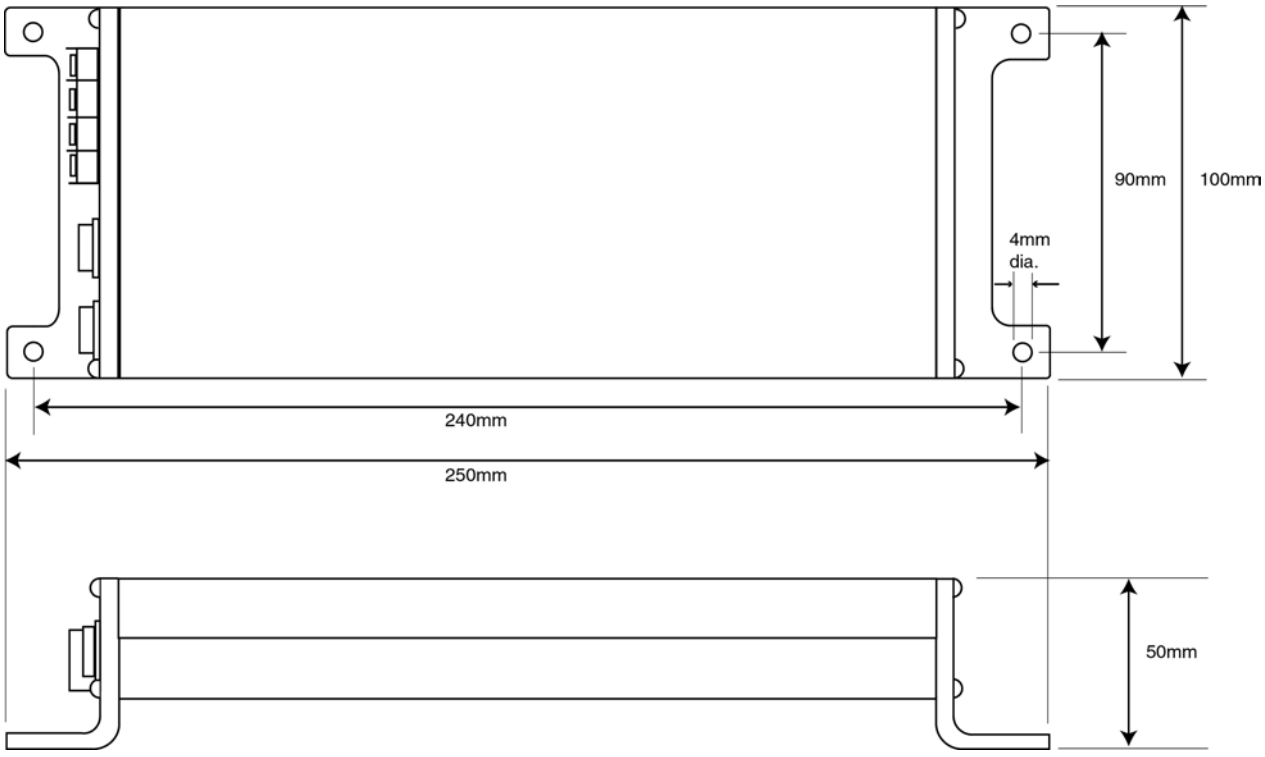


Installation of C-Drive unit

Position:

The C-Drive unit should be mounted in an easily accessible position so that it is possible for a technician to make adjustments to the unit. To access the internals of the unit, two screws at either end allow the top lid to be removed.
The unit should be protected from rain, salt water, condensation and vibration. Inside a locker or on a bulkhead below decks are suitable.

C-Drive Dimensions



Wiring:

Access for wiring must be provided. Cabling will have to be run to the Power Switchboard, rudder feedback unit, display head and drive unit. 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 C-Drive unit. Any remote unit has to be connected to a **REMOTE** socket of the C-Drive unit.

The C-Drive must have a direct connection to power supply via a 15 amp fused circuit and an isolating switch. A power cable rated at 15 amps should be connected between the power input switch and the **POWER** connector on the C-Drive unit.

DIP Switch Setting:

The DIP switch is located on the PCB. These switches are factory set to suit the configuration of the unit, but can be changed as required if the C-Drive system configuration is changed.

1 & 2 Set BOTH to ON for Rudder Feedback Unit Standard
Set BOTH to OFF for Rudder Feedback Unit Heavy Duty
(*Only on models with serial number greater than ES009)*

3 & 4 Set BOTH to ON for Compass Top Sensor (CTS)
Set BOTH to OFF for Fluxgate Sensor (FLUX)

Rudder Feedback Unit Standard (RFUS) provides an output voltage in the range of approximately 1.6v to 3.4v. This is due to the reduced angle of movement from the potentiometer.
Rudder Feedback Unit Heavy Duty (RFUH) provides an output voltage in the range of 0v to 5v as it can travel through the entire range of the potentiometer.

Installation of Rudder Feedback

Position:

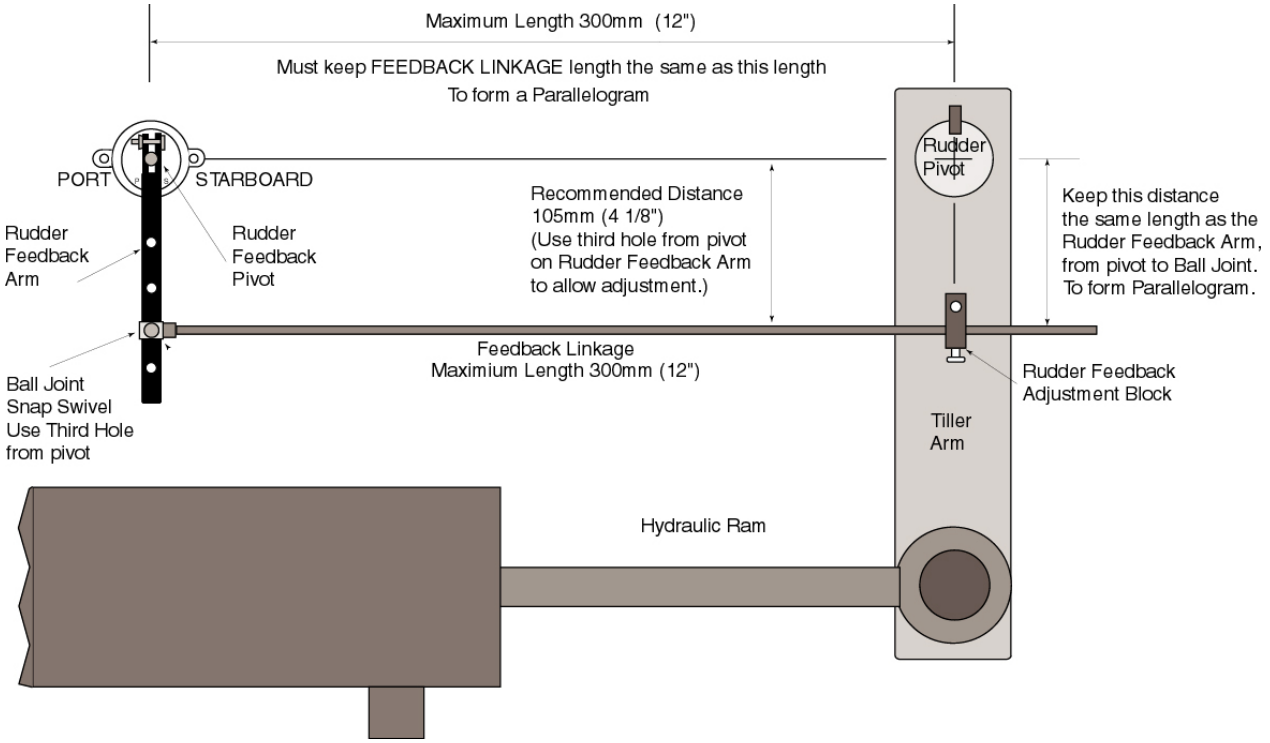
Install rudder feedback as shown in the diagram labelled "Rudder Feedback Unit Installation" (next page). The unit should be adjacent to the tiller and must copy the angular movement of the tiller. The markings on the rudder feedback unit indicate the required movement of the tiller for course correction. It should be installed with the shaft uppermost, mounted in such a way that the four points (tiller post, feedback shaft and the two adjustable linkage points) form the four corners of a parallelogram.

The rudder feedback unit is water resistant. However, **if it is to be mounted in a wet position, some protection should be provided to ensure the unit does not become excessively exposed to water.** If necessary, the rudder feedback unit may be mounted upside down, in which case the blue and red wires in the cable must be reversed. (Note: yellow wire in cable is not used in the RFU).

When installation of the feedback unit is complete and the linkage is fitted, have the steering of the vessel moved from lock to lock and ensure:

a) The direction indicated on the top of the RFU is correct.
b) No undue mechanical strain is placed on the rudder feedback or linkage.

Rudder Feedback Installation Diagram



Rudder Feedback Installation Notes

- When the rudder is central and the rudder feedback is central all angles should be 90 degrees.
- Use the snap swivel and ball joint on the rudder feedback arm
- Use the rudder feedback adjustment block on the tiller arm
- Hydraulic ram may be mounted on the other side of the tiller arm
- Ensure that when rudder turns to Port, Rudder Feedback turns to Port as indicated on the rudder feedback unit.
- Rudder feedback unit may be mounted upside down. This would require an electrical change. (Polarity of rudder feedback requires reversing)

RFU Wiring:

The cable from the RFU must be connected to the **RUDDER** socket on the C-Drive unit. The RFU is supplied with a standard 14-metre cable but can be extended if required during installation.
See Rudder feedback wiring diagram, page 16.

NOTE 1: THE RUDDER FEEDBACK UNIT IS FACTORY ALIGNED.
THE ARM SHOULD NOT BE REMOVED OR LOOSENED AS THE FEEDBACK ARM HOLDS AN O-RING AGAINST THE FEEDBACK BODY TO FORM PART OF THE WATER RESISTANT SEAL.

NOTE 2: IF USING RFUH CONNECT TO THE TERMINAL STRIP RFUH 2 AND SIGNAL POSITIONS. SET THE C-DRIVE INTERNAL DIP SWITCHES TO RFUH.

RFUH Internal Terminal Strip.

RFUS 1	RFUH 2	SIGNAL	RFUH 2	RFUS 1

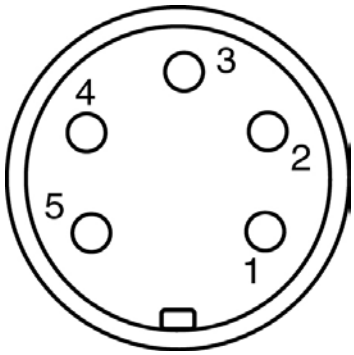
NOTE 3: ENSURE RUBBER GASKET IN RFUH IS PROPERLY FITTED TO PREVENT MOISTURE OR WATER INGRESS.

<u>If the Autopilot is the only means of steering it is recommended that some form of emergency steering is also fitted.</u>

Rudder Feedback Wiring Diagrams

Pin connections from rear of plug, solder connection side.

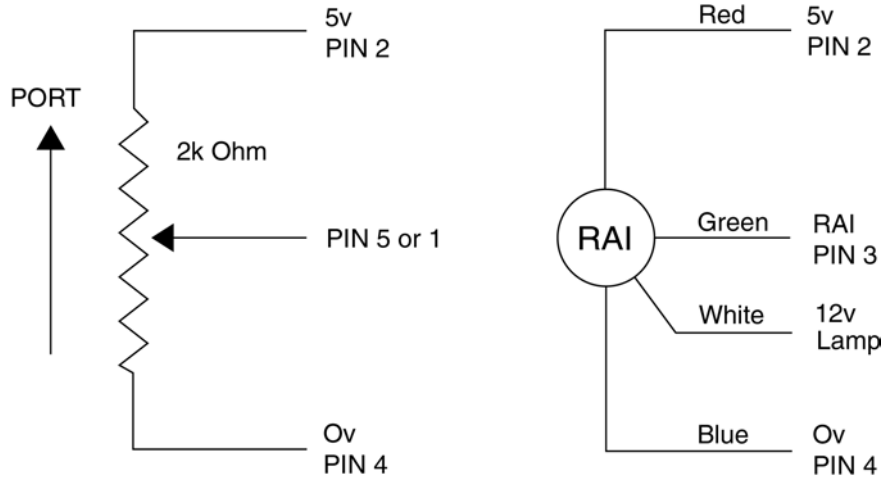
Figure 1 Rudder Feedback Connection Diagram



Pin1 Motor Two Feedback (Green)
Pin2 +5v Rudder Feedback supply (Red)
Pin3 Rudder Angle Indicator (Green)
Pin4 0v Rudder Feedback Supply (Blue)
Pin5 Motor One Feedback (Green)
(See NOTE Below)

NOTE: When C-Drive is used in a single rudder feedback installation, Pin 1 and Pin 5 should be connected together.

Figure 2 Rudder Feedback and Rudder Angle Indicator Wiring Diagram



GPS Connection

Data In and Out:

For GPS navigation, connect the GPS unit via the two wires coming from the back of the 6-pin DIN socket connecting the AP55 Display Unit to the C-Drive unit. The connections on the plug are:

Pin 1	DATA IN+	White
Pin 2	DATA COM	Green

Data In Connection Examples:

For any GPS unit, which has a BNC type output plug (a bayonet plug, with a core and shield), connect the core to DATA IN+ and shield to DATA COM.

For any GPS having open wires connect TX + to DATA IN+ and TX – to DATA COM.

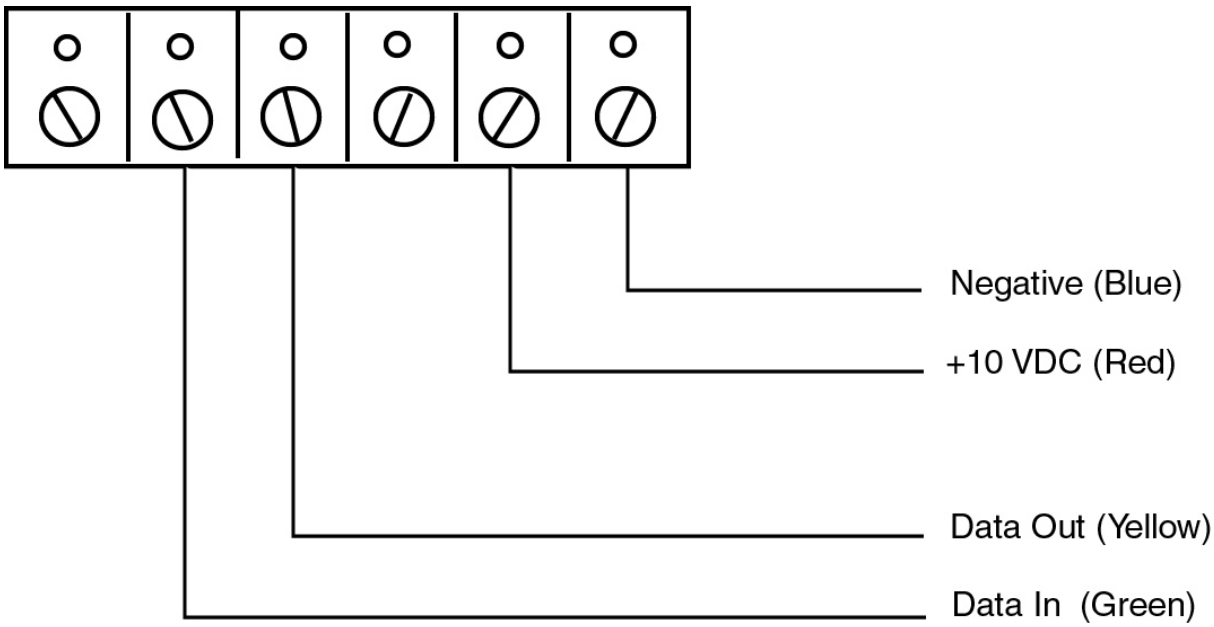
For a GPS with the following marking connect Data Out + to DATA IN+ and Common to DATA COM.

For information on connecting other types of GPS units, refer to the owners manual.

***Connections for AP55 Display Unit / C-Drive cable*:**

C-Drive NMEA Socket	Function	AP55 Display Cable Colour Code	
Pin 1	GPS In + White wire		
Pin 2	GPS In – Green wire		
Pin 3	Data Tx +	Pin 5	Green
Pin 4	Negative	Pin 1	Blue
Pin 5	Data Rx +	Pin 4	Yellow
Pin 6	+10 volt	Pin 2	Red

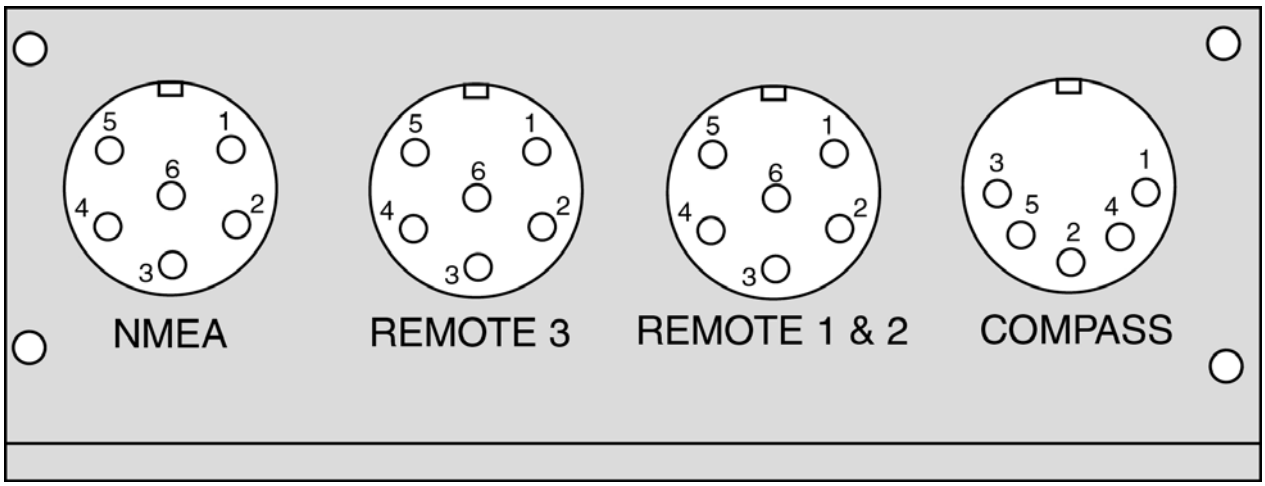
Power for the AP55 Display Unit is from the MCU



AP55 Display Unit Connections

C-Drive unit Connection Layout

Figure 3 Input Connections Panel



NOTE: Pin identification from end of C-Drive unit
(Also solder side of plug pins.)

Compass

Pin 1 White
Pin 2 Blue (Square wave drive)
Pin 3 Red
Pin 4 Yellow
Pin 5 Green

Remotes 1& 2 (connections shown for remotes 1 and 2)

Pin 1 +5v Power Out (Red)
Pin 2 Remote 1 Wiper Return Signal (Green)
Pin 3 0v, Common Ground (Blue)
Pin 4 Remote 1 Auto / Manual Select (Yellow)
Pin 5 Remote 2 Wiper Return Signal (Green)
Pin 6 Remote 2 Auto / Manual Select (Yellow)

Remote 3

Pin 1 +5v Power Out (Red)
Pin 2 Remote 3 Wiper Return Signal (Green)
Pin 3 0v, Common Ground (Blue)
Pin 4 Power steer / Auto select (White)
Pin 5 GPS / Standby select (Black)
Pin 6 Rudder / Response select (Yellow)

NMEA In / Out (AP55 Display)

Pin 1	NMEA One	Input +	GPS
Pin 2	NMEA One	Input –	GPS
Pin 3	TMQ Data TX	Data +	TMQ Data
Pin 4	Negative	Common	Display Negative
Pin 5	TMQ Data RX	Input +	TMQ Data
Pin 6	+10v Power		Display Power

NMEA Heading Data, Internal Connector Strip

A screw terminal connector strip within the C-Drive unit is available for sending NMEA Heading Data to other equipment if required.

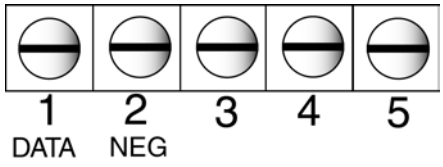
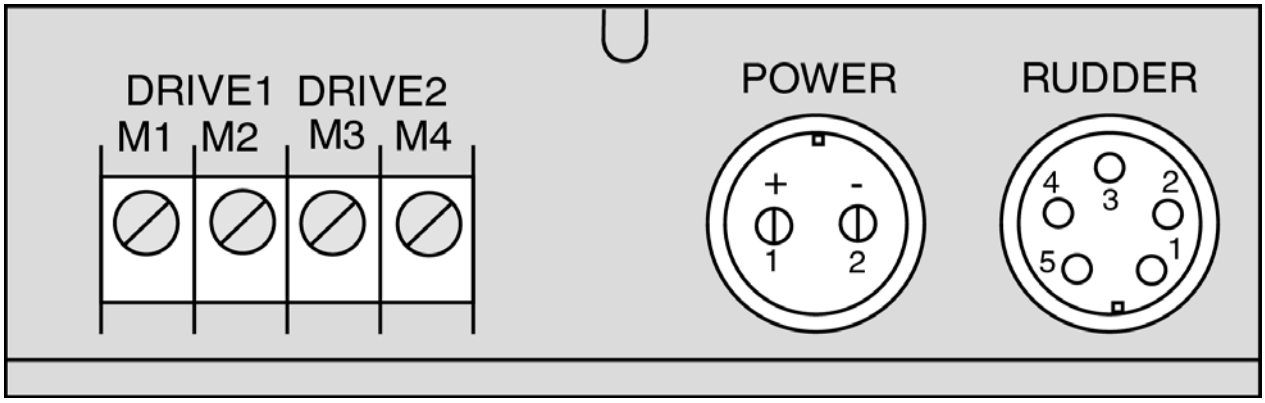


Figure 4 Output Connections Panel



Drive1 and Drive 2

Output terminals for connection to rudder position actuators.
Can be connected directly to reversing hydraulic pump motors or to reversing mechanical drive motors, with a maximum current rating of 15 Amps. If solenoid valves are implemented the addition of diodes can remove the need for a positive supply to the solenoid valves as shown in Figure 7.

NOTE: The motor wires may require reversing to provide the correct rudder direction movement.

For constant running pump sets Drive 2 can be used to power constant running pump. (Contact TMQ for special set up requirements)

Figure 5 Single rudder motor and clutch configuration

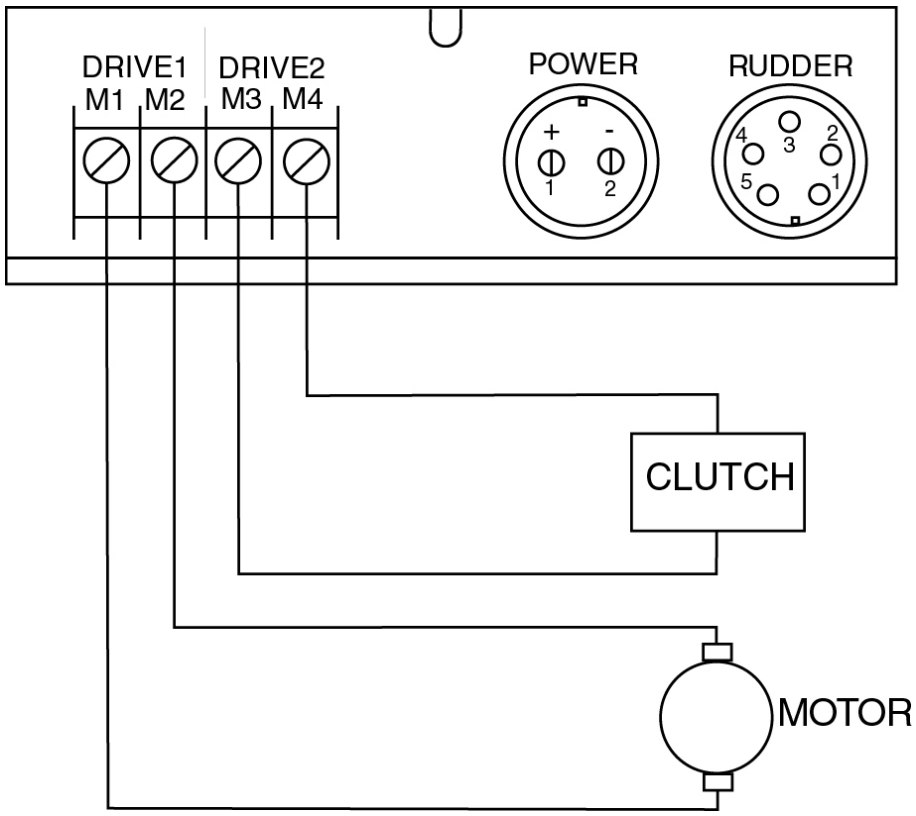


Figure 6 Solenoid Valve Connection Diagram

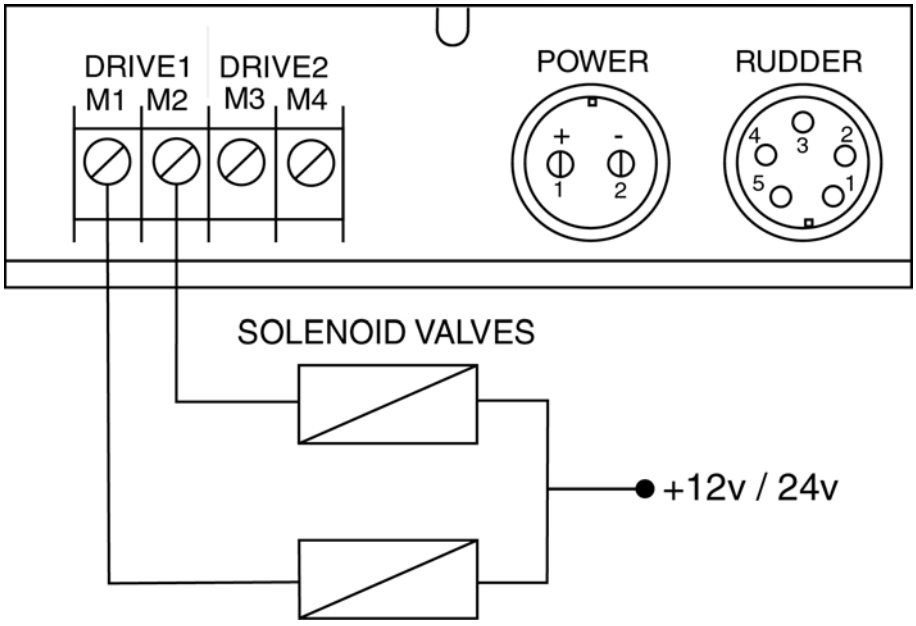
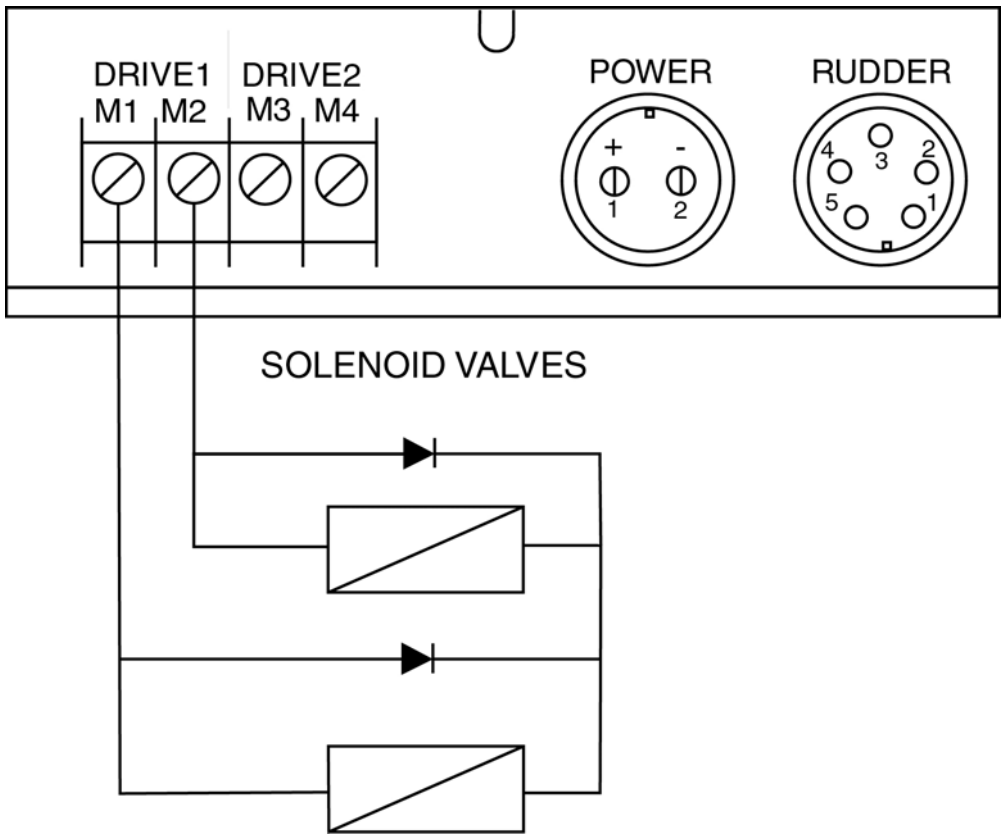


Figure 7 Without using a positive supply to the solenoid valves



Use the diodes available from TMQ or a high current rated device, 2 Amp rating minimum recommended.

The above circuit should be replicated for Drive 2 if solenoid valves are used with the addition of diodes.

Figure 8 Dual rudder system using solenoid valve and external power supply

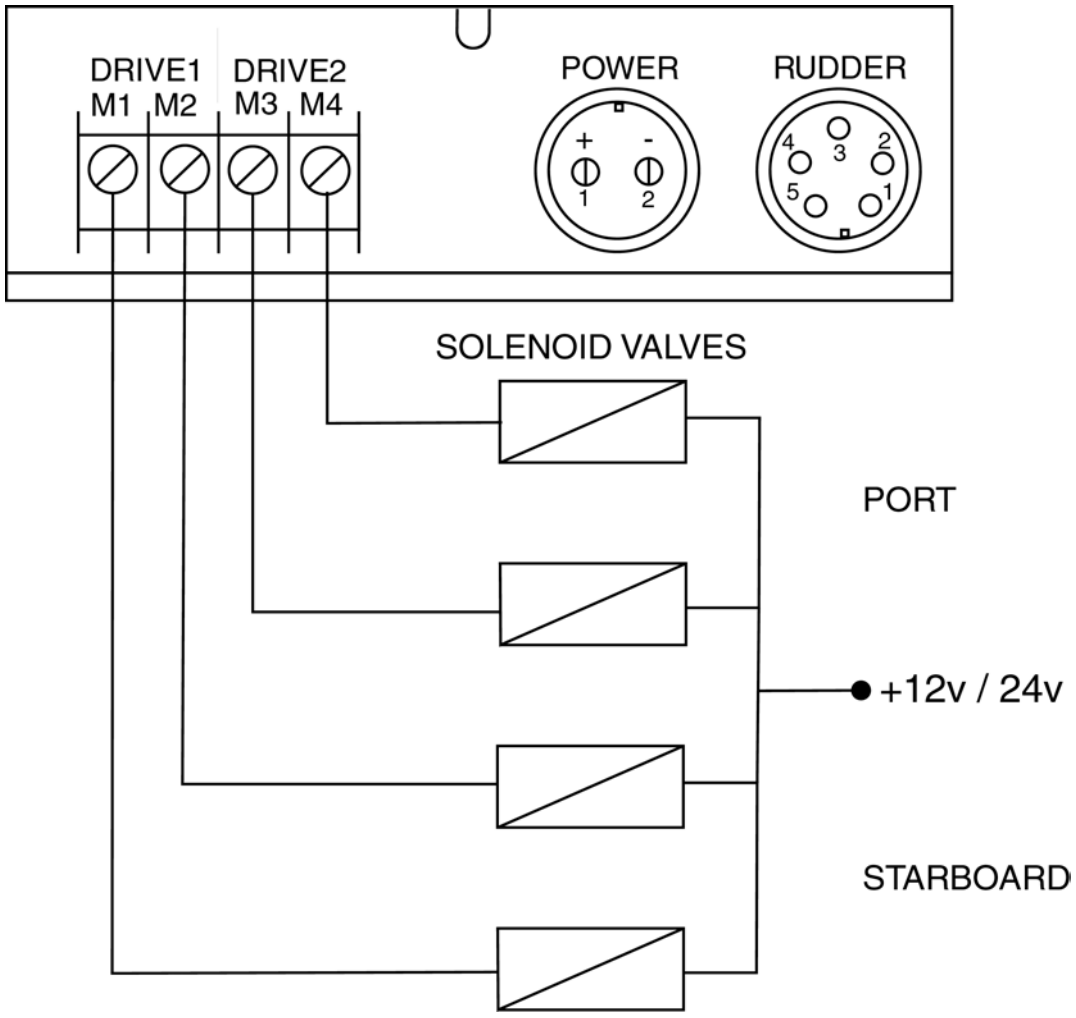
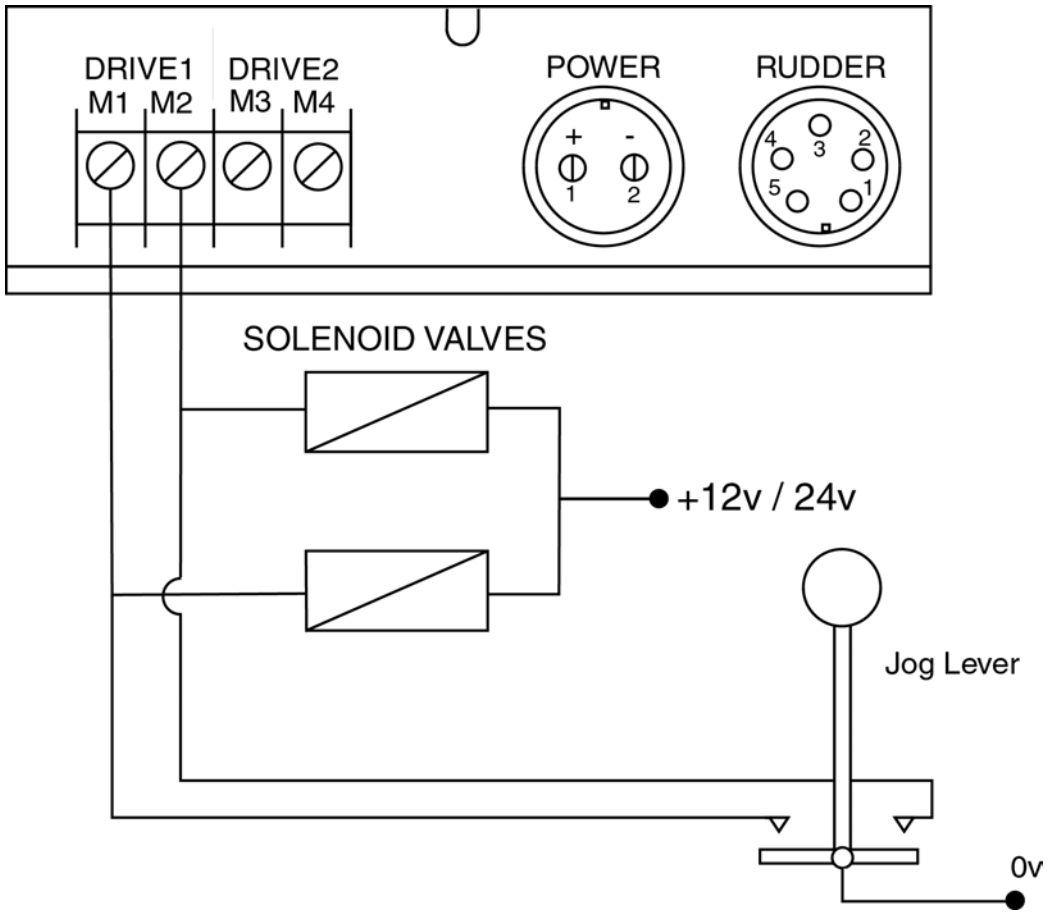


Figure 9 Incorporating a Jog Lever



NOTE:

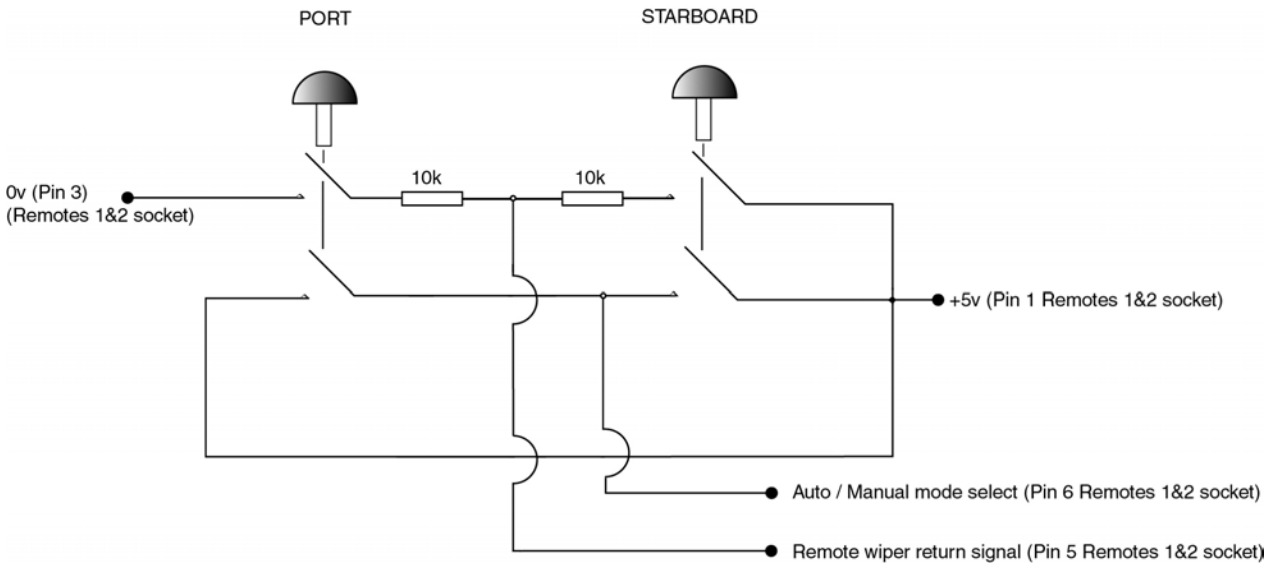
- Jog levers are an easy method to fit extra steering stations to the AP55.

- The internal links Link 1 and Link 2 must be cut in the C-Drive unit.

- Manual must be selected for the jog lever to operate correctly.

Figure 10 Jog lever system as Remote 2

USES REMOTE MODE 1 ON THE C-DRIVE.



The jog lever or press buttons switch the C-Drive into Power during operation and return the C-Drive to Manual after operation.

NOTE:

- Jog levers are an easy method to fit extra steering stations to the AP55 Autopilot system.
- Allows Jog Levers to operate on reversing pumps or mechanical drives.
- Two 10k Ohm resistors as shown above are required to prevent the possibility of a short circuit.
- An FFU lever or Electric Wheel can still be used as Remote 1 or Remote 3.

Installation of Remote Units

Hand Remotes, Panel Remotes, Steering Levers and Steering Wheels:

These units are robust and any of these may be mounted where it is subjected to occasional splashes of water. If mounted in direct sunlight, the unit may fade. The cable leading from the remote unit is connected to the REMOTE socket of the C-Drive assembly.

Remote unit configuration options

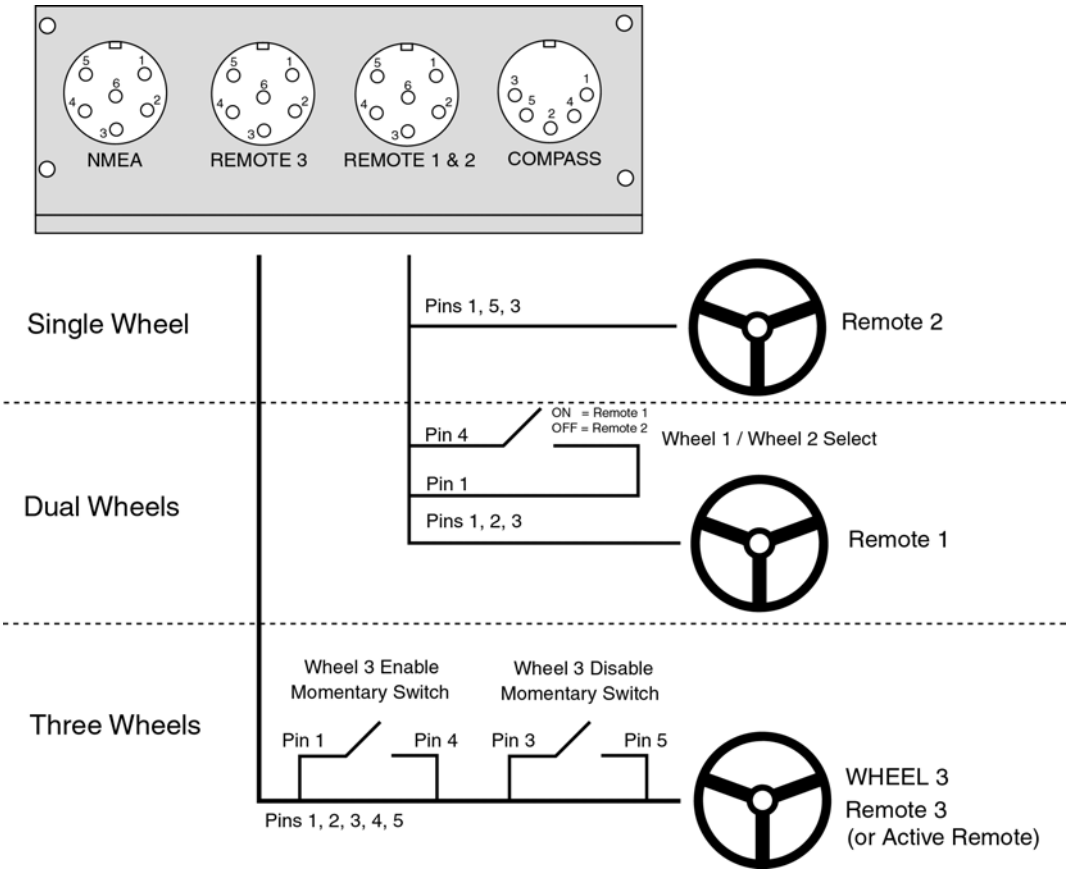
The C-Drive system allows for many configuration options, such as follows:

- 1 Electric wheel with single rudder.
- 1 Electric wheel with dual rudder.
- 1 Electric wheel and 1 remote with single or dual rudder.
- 1 Electric wheel and 2 remotes with single or dual rudder.
- Multiple combinations of the above to suit.

See *C-Drive unit Connection Layout for connection information.*

There are two setting options for the C-Drive, Mode 1 and Mode 4. These provide different steering input configurations as required, see Figure 10 and Figure 11.
The Mode can be altered via the Computer lead and a computer running a serial program.

Figure 11 Remote Mode 4



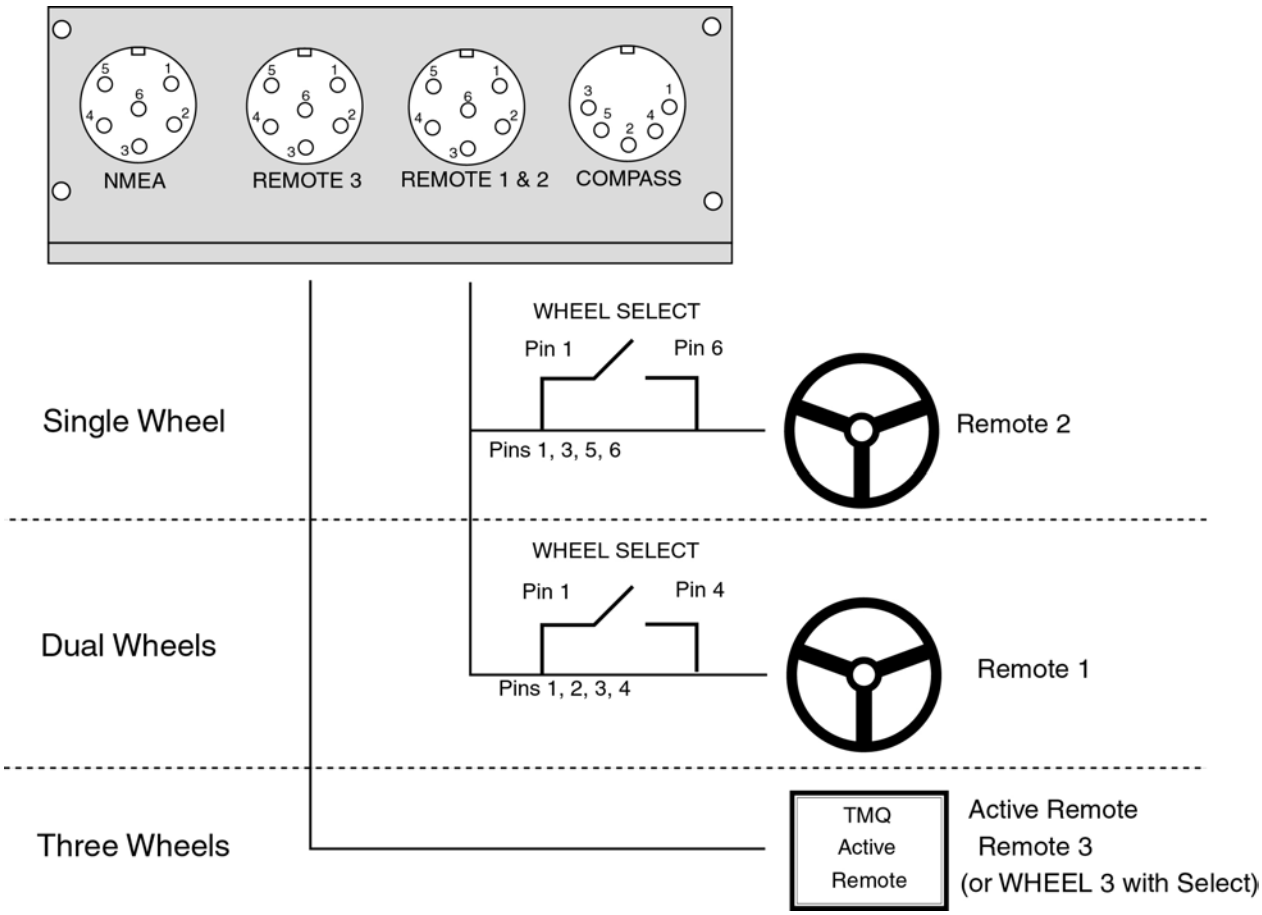
Remote 1 & 2

Pin 1 +5v Power Out (Red)
Pin 2 Remote 1 Wiper Return Signal (Green)
Pin 3 0v, Common Ground (Blue)
Pin 4 Remote 1 Auto / Manual Select (Yellow)
Pin 5 Remote 2 Wiper Return Signal (Green)
Pin 6 Remote 2 Auto / Manual Select (Yellow)

Remote 3

Pin 1 +5v Power Out (Red)
Pin 2 Remote 3 Wiper Return Signal (Green)
Pin 3 0v, Common Ground (Blue)
Pin 4 Power steer / Auto select (White)
Pin 5 GPS / Standby select (Black)
Pin 6 Rudder / Response select (Yellow)

Figure 12 Remote Mode 1



Remote 1 & 2

Pin 1 +5v Power Out (Red)
Pin 2 Remote 1 Wiper Return Signal (Green)
Pin 3 0v, Common Ground (Blue)
Pin 4 Remote 1 Auto / Manual Select (Yellow)
Pin 5 Remote 2 Wiper Return Signal (Green)
Pin 6 Remote 2 Auto / Manual Select (Yellow)

Remote 3

Pin 1 +5v Power Out (Red)
Pin 2 Remote 3 Wiper Return Signal (Green)
Pin 3 0v, Common Ground (Blue)
Pin 4 Power steer / Auto select (White)
Pin 5 GPS / Standby select (Black)
Pin 6 Rudder / Response select (Yellow)

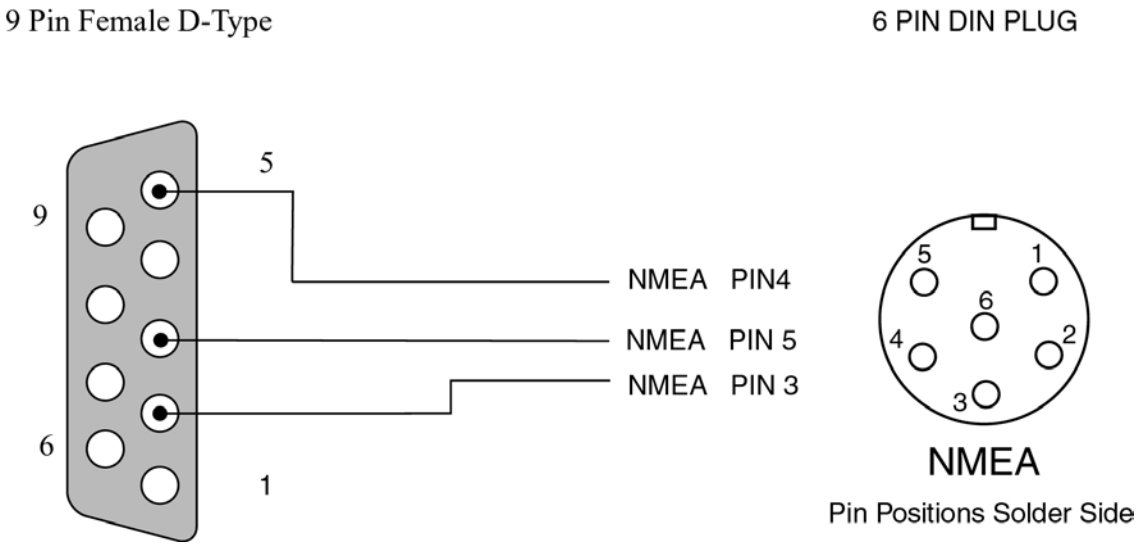
System Configuration

Operational settings and Rudder Limits are factory set and will suit most operating situations, the settings are as follows:-

Function	Factory Setting	Range
Rudder Limit Settings:	+-30 Degrees.	Adjustable +- 10 to 35 Degrees.
Remotes Mode	1	1 or 4
Steering Types	S	S or D (Single or Dual)
Reverse Delay	m	a to z (50mS to 1.2 Seconds)
Pulse Delay	d	a to z (50mS to 1.2 Seconds)

See Recommended System configuration.

The above settings can be altered depending on the specific requirement of the installation. This can be carried out by the TMQ dealer or by using a computer and the computer lead with the connections detailed below. (Lead not supplied)



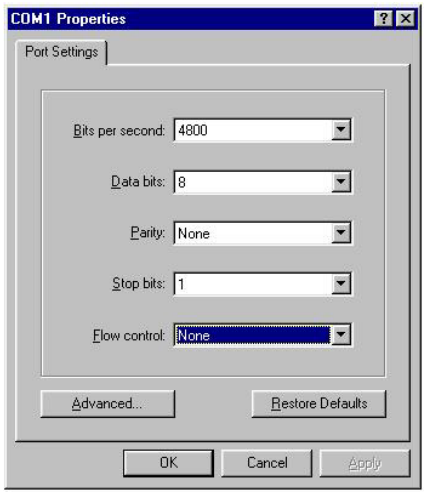
Computer lead.

Setup Procedure

Adjustment of the installation settings can be made using the following procedure.

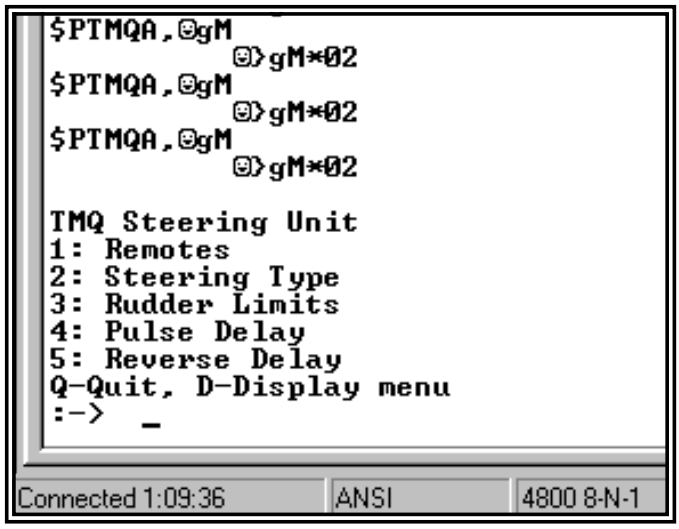
1. Connect the programming lead to the NMEA Port on the C-Drive unit and your Computer's Communication (com.) port; this requires to be an unused port for the duration of the system configuration.
2. Run a com. Server program such as HyperTerminal which is included on the installation disks for Windows 95, Windows 98, Windows 98SE etc.
3. Start a new connection and name it Electric Steering. For example in Hyper Terminal.

4. Select connection to the Com port that the programming lead is connected to, for example, connect using: Direct to COM1



5. Set the baud rate to 4800,
   Data Bits = 8,
   Parity = None,
   Stop Bits = 1,
   Flow Control = None.

6. Switch on the C-Drive system, using the Hyper Terminal Program connect to the com. port. Data should now be visible in the text editor window.
7. In that window enter the text '@cal ' The text is not visible as it is typed. The 'TMQ Steering Unit' configuration option menu will now be displayed.
8. Following the instruction in the Menu to alter the configuration settings as required, save and exit the configuration menu.
9. These settings will be retained in the C-Drive memory.



TMQ Setup Option Menu

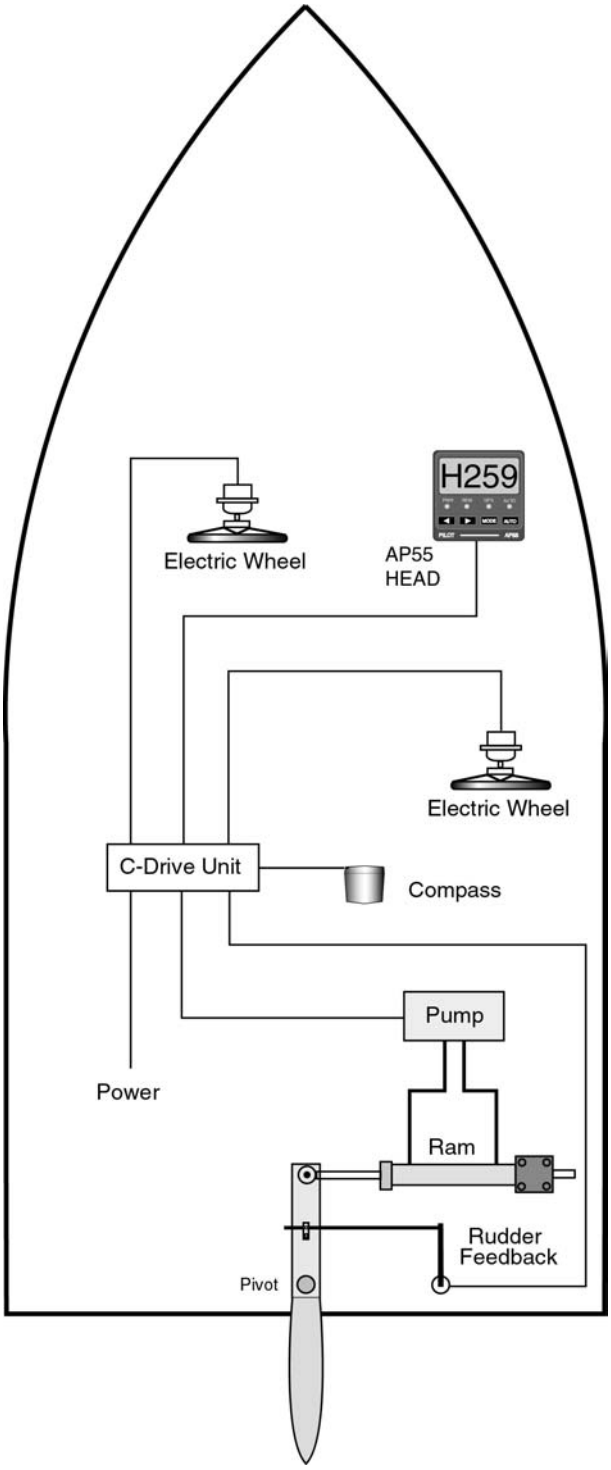
Recommended System configuration

For solenoid valve applications it is recommended that for option **4: Pulse Delay** a value of between 'd ' and 'z' is implemented This is due to the pulse length possibly not being long enough if a value between 'a' and 'd' is used. This would therefore not activate the solenoid valves.

For option **5: Reverse Delay** it is not recommended that a setting between 'a' and 'h' is implemented as this will increase the possibility of 'hunting' in the steering system causing undue noise and wear. A reverse delay set to mid range 'm' would suit most applications.

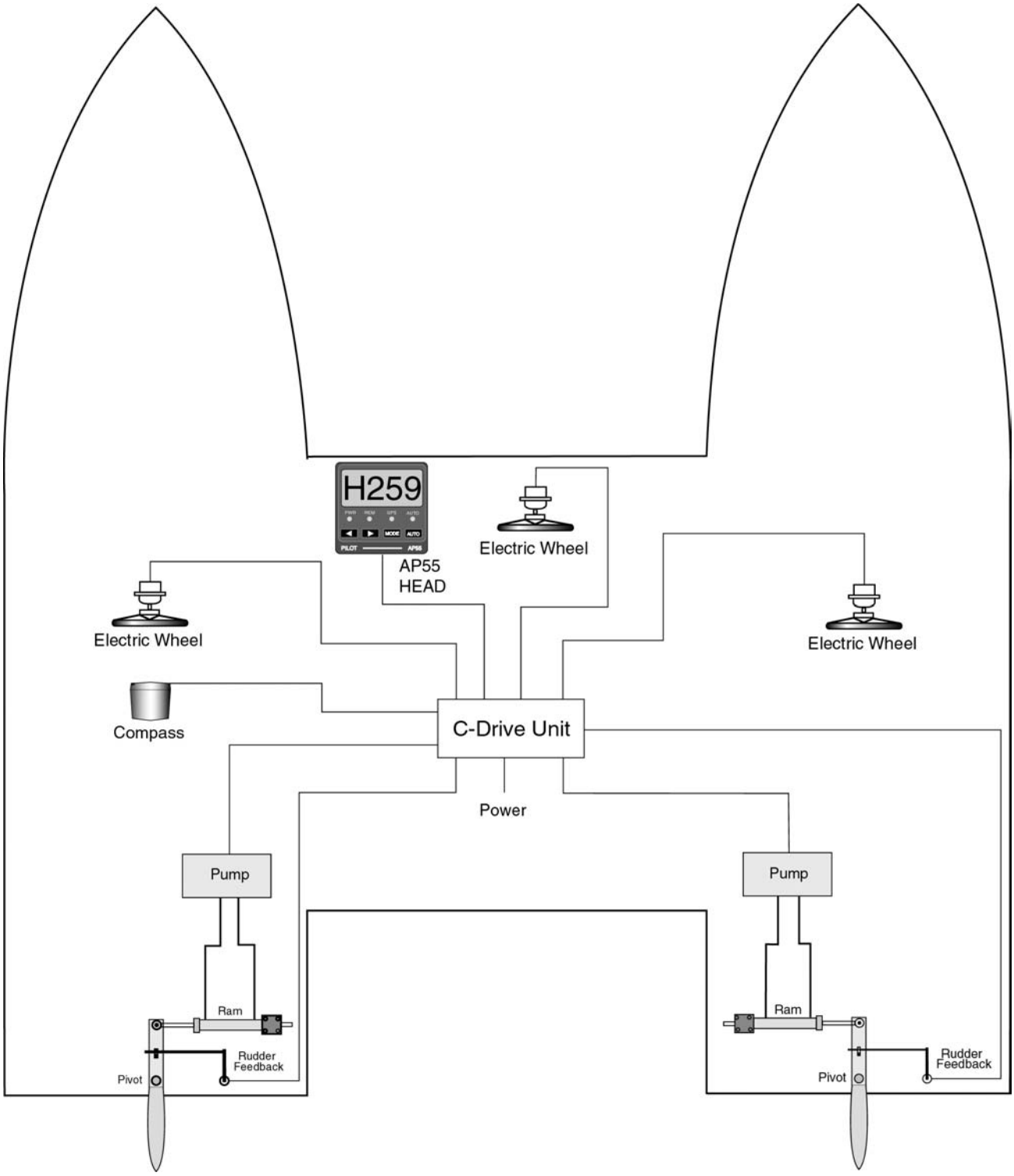
Electric steering connection examples.

Dual Station Electric Steering *(C-Drive unit set to Remote Mode 4)*



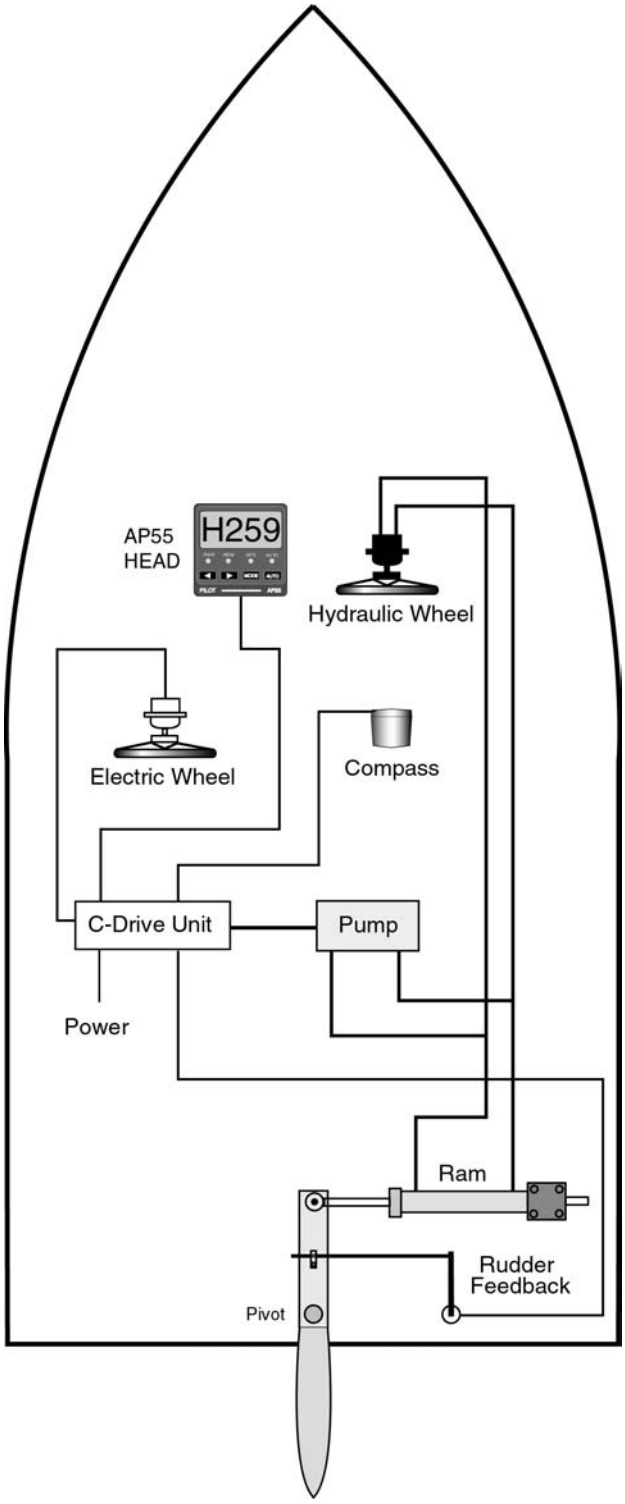
Three Station Electric Steering

C-Drive unit set to Remote Mode 4



Hydraulic Steering System with Electric Wheel

C-Drive unit set to Remote Mode 1



Testing Procedure

Initial Inspection and Testing

1. Confirm power to be connected is the required DC voltage.	
2. Power Supply 12v DC.	
3. Power Supply 24v DC	
4. Ensure polarity of the voltage supply is correct.	
5. All electrical connections are correct.	
6. 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; visually check that RFU has moved in correct direction as indicated on the RFU label on top.	
2. Repeat step 1 for anti-clockwise.	
3. Return Steering to centre and Ensure RFU is at centre.	
4. Centre any electric steering wheel or lever	
5. Switch on C-Drive Autopilot system Select Auto	
6. If drive goes hard over to mechanical stop change motor connection wiring. (See Trouble Shooting Section)	
7. Check Rudder direction follows Course change request	
8. Check Course change provides sufficient Rudder movement	
9. Adjust Rudder Limits with display if required	
10. Check magnetic heading display on AP55	

Trouble Shooting

Unit does not move rudder

- Check voltage is present at the C-Drive assembly power plug.
- Confirm that the supply voltage is within the range or 12-24 volts dc.
- Check and replace the C-Drive assembly 15A internal fuse if necessary.
- If using solenoid valves with an external power supply check if it is present.
- Check all motor and / or solenoid valve wiring.
- If using a 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.
- Reset rudder limit switches to factory settings. (see rudder limits section) Note: L1 should only be on if either rudder limit is reached.
- After ensuring all the above check that the internal LED, L2 is flashing when the unit is powered. If not, the C-Drive unit requires replacing.

Rudder(s) drive hard over

- After installation of the autopilot System if either of the rudders drive hard over to their mechanical stops in the wrong direction, the solenoid valves may be wired incorrectly (the wrong way around) or the motor connections may need reversing.

- Rudder drives hard over to the mechanical stops in the correct direction;

1. Check rudder feedback unit(s) is/are connected to the rudder arm
2. Check rudder feedback cable(s) for damage.
3. Ensure the rudder feedback plug is firmly connected to the electric steering unit.

Solenoid valves do not operate

- Check the motor connections on the electric steering unit
- Check connections on solenoid valves and the required diodes (see: Solenoid valve connection diagram)
- Test coil resistance of solenoid valves
- Confirm that the value for Pulse Delay on the electric steering unit is set between ‘d’ and ‘z’ (see: System configuration)

Motor unit does not operate

- If using a continuous running pump check the power supply to the pump
- If using a reversible pump
  Check the connections to the pump
  Check the internal 15A fuse, replace if necessary

Quick check if AP55 Autopilot does not Operate

- Reset Rudder Limits.
- Reset Compass Calibration.
- Ensure L2 in C-Drive is flashing.
- Ensure L1 in C-Drive is off. (wheel is in centre)
- Check Wiring for Power and Motor.
- Check Fuse. (Powers motor circuit only)
- Check DIP Switch settings for Compass and Rudder fitted.

Optional Extras

There is a range of optional extras that can be connected to the C-Drive system as the need or circumstances require. The C-Drive system can be adapted to suit many applications.
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

Active Remote

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

AP500 Head

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

Steering Lever **Full Follow Up 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.

Hydraulic Drives and Pump Units

Reversible pumps

Hydraulic pumps available in either 12 or 24 volts DC with 1, 2 or 3-litre capacity to suit recreational, work boat or fishing applications.

Continuous pumps

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

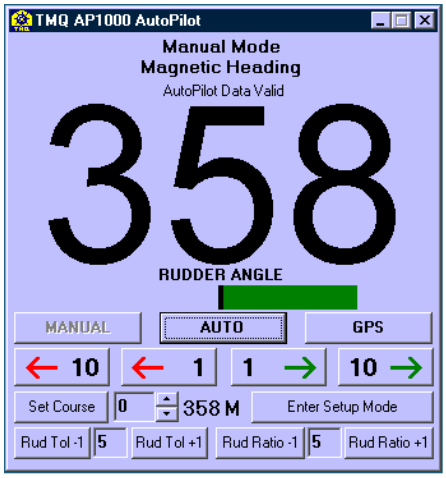
Linear drives

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)