



TMQ – AP4



(AP4S7 Rev 1)

OPERATION AND INSTALLATION MANUAL

www.tmq.com.au

[This Page is Blank](#)

Contents

<i>Warning</i>	5
<i>Introduction</i>	6
Autopilot Operation.....	8
<i>Overview:</i>	8
<i>Set (Standby) Mode</i>	9
<i>Auto Mode</i>	10
<i>Power Steering Mode</i>	11
<i>GPS Mode</i>	12
<i>Watch Timer Mode</i>	16
To Enable The Commercial Watch Alarm	17
<i>Remote Auto Steer (Remote Unit Operation)</i>	18
<i>Remote Power Steer (Remote Unit Operation)</i>	19
<i>Rudder Response (Rudder Ratio) Control</i>	21
<i>Sensitivity</i>	23
<i>Angle Off Course Alarm</i>	24
<i>Alarms</i>	25
Autopilot Installation.....	26
<i>EMC Considerations</i>	26
Installation:-	26
Checking:-.....	27
Interconnection:-	27
<i>List of Components</i>	28
<i>Installation of Main Unit</i>	29

<i>Installation of Compass</i>	30
Interchanging Magnetic Sensor Unit & Compass Top Sensor	33
Heavy Duty Rudder Feedback Installation Diagram.....	36
Standard Rudder Feedback Installation Diagram	37
<i>Installation of Remote Units</i>	39
<i>Hydraulic Drive Installation</i>	40
<i>Mechanical Motor Installation</i>	41
Drive Connection Diagrams	43
<i>System Connection Diagram - Reversing Pump</i>	44
<i>System Connection Diagram – Mechanical Drive</i>	45
<i>System Connection Diagram – Solenoid Valves</i>	46
<i>NMEA Connection</i>	47
<i>External Alarm Installation</i>	49
<i>Commissioning Checks</i>	51
Connection Tests	51
Dockside Tests.....	51
<i>Rudder Limits Switch Setting</i>	53
<i>Compass Calibration</i>	54
<i>AP4 Special Modes</i>	56
<i>Optional Extras</i>	57
Remotes	58
Hydraulic Drives and Pump Units.....	59
<i>PCB Overlay</i>	61
<i>PCB Schematic</i>	62
<i>Warranty</i>	64

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 NOT RECOMMENDED THAT THE AUTOPILOT BE USED WHILE NAVIGATING IN RESTRICTED WATERWAYS AS WATER CURRENTS, WIND CHANGES OR RADIO TRANSMITTER INTERFERENCE MAY AFFECT VESSEL COURSE SUFFICIENTLY TO ENDANGER YOUR OWN OR OTHER VESSELS.

Introduction

The **AP4** autopilot is a rugged & reliable pilot for use on all sorts of vessels, motor or sail, commercial or pleasure. These pilots have been in production for many years and are widely used by professional fishermen because of their dependability. The front panel features large control knobs for ease of use in all sea conditions.

The **AP4** includes digital compass display, GPS interface, internal watch timer and much more, in a solid metal case.

An **AP4** system contains these Essential components:

- Autopilot Control Unit
- Compass or Compass-Top-Sensor
- Rudder Feedback Unit
- Rudder drive system

Optional Components:

- Hand remote
- Panel remote
- Second Display
- Active Remote
- Steering lever
- Rudder angle indicator
- External alarm

This autopilot can drive a mechanical drive motor, hydraulic pump or solenoid valves. The motor outputs have been carefully designed to work with a wide range of motors - for more information, consult your dealer or TMQ Electronics.

-
- The autopilot unit should be installed out of direct sunlight and protected from water and spray.
 - The compass must be installed in a place free of magnetic interference, and connected to the autopilot.
 - The rudder feedback must be attached to the rudder in such a way that it can accurately measure the position of the ships rudder. This must also be connected to the autopilot.

Provision has been made for a total of two standard remotes, of either **panel remote**, **hand remote** or **steering lever** station. Alternatively 1 Active remote can be used. Extra control devices may be connected internally via the special connection strip. These are very robust units, which will not be adversely affected by water. The abilities they provide are somewhat different from the main control panel. See the Operation section of this manual for details.

For more information on installation of your AP4 autopilot, see the Autopilot Installation section of this manual.

For more information on using your AP4 autopilot, see the Autopilot Operation section of this manual.

All control units operate on 12 or 24 volts DC. Electrical cables are supplied for interconnection of equipment. Hardware is supplied to mount and couple the mechanical drive unit into the steering system. Hydraulic installation kits can be supplied at an extra cost if the pipe size and brand of hydraulic system is specified.

Autopilot Operation

Overview:

The following is a brief list of the capabilities of the **AP4** autopilot. Each is described in more detail in a separate chapter.

- **Set/Standby Mode**
The digital display shows the current magnetic heading. The autopilot will not apply any steering control.
- **Auto Mode**
The autopilot will maintain your vessel on any selected magnetic course. This course can be set from the control panel by dialling up a course change with the course knob, or from a remote steering station.
- **Power Steer**
The rudder angle may be controlled by the course knob on the main panel, or from a remote steering station.
- **GPS Mode**
When receiving information from a GPS unit, the autopilot can steer a vessel to a precise latitude and longitude.
- **Watch Timer**
A timer can be set for 1 to 120 minutes. When the time expires, an alarm will sound. Uses include timing of trawling runs, or a reminder to check for anchor drag at set periods during a storm.
- **Remote steering stations**
One of these may be fitted (eg on flybridge), allowing adjustment of the autopilot course, or direct control of the rudder (**Power Steering**).

- **Rudder Response, Sensitivity**

These controls customise the **AP4** for your vessel. They may also be used to adjust steering for varying sea conditions.

- **Commercial Watch Timer**

For vessels under survey requirements. The timer can be set to give a warning alarm at a preset time and output for a loud external alarm after 6 minutes. Note: External alarm piezo siren must be fitted.

Set (Standby) Mode

In this mode

- The Auto light is off
- The motor clutch is disengaged
- No steering control output is generated
- The digital display shows the vessels current magnetic course.

- The **panel remote / hand remote / steering lever** (if installed) is ignored at first turn on.

- Watch Alarm may be set (if required)
- Rudder Limit may be set
- Other special modes are accessible

Possible alarms

- Watch timer alarm

Auto Mode

Engaging Auto steering mode

When the mode switch is set to the **AUTO** position, the adjacent yellow light will be turned on and the autopilot will lock on to the heading indicated.

Disengaging the Autopilot

Rotate the mode switch to the **SET** position and the vessel will return to manual steering (set mode). The AUTO light will be turned off.

Course Adjustment

Rotating the large course control knob by one "click" will cause a one degree course change in that direction. The display will change to indicate the new **course to steer**. Each complete rotation of the course control knob gives 24 degrees of course change.

Note:

When the autopilot has been "turned off" using a remote unit (panel remote, hand remote, etc), the mode switch may be in the **auto** or **power** position but steering is under manual control (mode LED indicator would be off). To re-engage the autopilot, use the remote unit switch or move the mode switch to **SET** then back to **AUTO**.

Power Steering Mode

Engaging Power Steering Mode

Rotate the mode switch to the **PWR** position.

Setting the rudder angle

Rotating the course control knob clockwise will move the rudder to starboard. Rotating the course control knob anticlockwise will move the rudder to port.

The angle of rudder applied depends on the amount of rotation of the course knob.

The maximum angle of rudder is controlled by Rudder Limit setting (see installation section).

For information on Power Steering with a remote unit (eg steering levers), see the section on remote units.

GPS Mode

For use when interfaced to a GPS generating NMEA 0183 data output. While in auto 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

With the mode switch at the **AUTO** position, press the **GPS** button (labelled with a satellite dish symbol). The adjacent yellow light will be turned on.

The display will immediately indicate the course-to-steer, and the vessel will begin turning from its current course to the course requested by the **GPS unit**, at a maximum rate of 10 degrees per second.

If no GPS data is being received by the **AP4**, 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 sound.

Disengaging GPS Mode

Pressing the **GPS** button will set the **AP4** to **Auto Mode**. The light adjacent to the **GPS** button will go out.

Changing the mode switch to any position other than **AUTO** will cancel the **GPS** 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 pins 1 (RX +) and 2 (RX -) of the AP4 NMEA IN/OUT socket. A suitable cable to match your GPS can be prepared by the installer of your autopilot or the dealer from whom you purchased your autopilot.

The data from your GPS must include **at least one** of the following:

- The **APA** sentence.
- The **APB** sentence.
- The **BOD** and **XTE** sentences.

The GPS unit must be commanded to go to a waypoint, or to follow a line joining two or more waypoints (called a **route**). This unit will then send information to the autopilot from which can be calculated the **course to steer**. If several waypoints are linked together into a single route, and the GPS unit is set to "auto-sequence" between them and an "arrival zone" of more than 0.1 NM (nautical miles) is set so that the GPS can detect when the vessel has reached a waypoint, then the **AP4** will be able to steer from each waypoint to the next without intervention.

If only the **XTE** information is available from your GPS unit, the autopilot can only steer in a restricted manner. Your vessel **must be on track and heading in the correct direction BEFORE** engaging GPS mode; the auto sequencing feature is not available.

Remember: Prior to engaging GPS you must program a route into the GPS for the autopilot to follow

No GPS Data Alarm

If the autopilot is not receiving valid information while in GPS Mode, the **No GPS Data** alarm will sound. This could be caused by:

- Incorrect wiring of the GPS to the **AP4**.
- Incorrect data output from the GPS unit.
- No route set up or selected in the GPS unit.
- No location fix at the GPS unit.

See also Alarms in the Operation section of this manual.

The bearings generated by the GPS unit must correspond to the bearings the **AP4** is receiving from its magnetic compass. The greater the difference between these bearings, the less accurate will be the **GPS Mode** steering.

- Ensure that the GPS unit has the correct magnetic correction.
- Ensure that the **AP4** compass is correctly aligned and installed.

Watch Timer Mode

Pleasure Boat Watch Timer

The AP4 has an in-built timer, which can be set for any interval between 0 and 120 minutes. When the time expires, the internal alarm will beep. If an optional external alarm is fitted, one minute after the internal alarm begins the external alarm will sound. This can be used to time trawling runs, watch shifts, anchor checks during storms, etc.

To set the timer, press the timer button (labelled with a clock), and then rotate the course knob to set the number of minutes. When finished, wait for 3 seconds. The display will then revert to normal heading, the time value will be stored into the timer and it will begin counting down to zero. When the set time expires, an internal alarm will sound. If the timer is not reset within 1 minute, the external alarm (if fitted) will sound.

If the timer button is pressed while the alarm is sounding, the alarm will be cancelled and the timer will commence counting down again. The time delay set will NOT be displayed.

Pressing the timer button and selecting a watch time of zero will disable the timer.

Commercial Boat Watch Timer

In some states, survey regulations for commercial vessels require a watch timer (which includes an external alarm) fitted with every autopilot. The commercial watch timer feature is built in to the AP4 but is normally disabled and functions as for pleasure boat (see above). The external alarm unit is not supplied with the AP4 but is available as an option.

When the commercial timer is enabled and the autopilot is in control of the vessel (i.e.: in **AUTO**, **GPS** or **REMOTE AUTO** mode), the AP4 internal alarm sounds after completion of the selected interval (Note: 5 minute interval required for Queensland) and the louder external alarm one minute later - unless the timer is reset. Changing the autopilot mode will also reset the timer.

In **SET**, **POWER** and **REMOTE POWER** modes, the timer can be set to any required time as for a pleasure boat.

To Enable The Commercial Watch Alarm

1. Switch to **SET** mode.
2. Hold down the **GPS** button and press **TIMER** button, display shows [900]
3. Dial up [906] by COURSE knob then press the **TIMER** button, display shows [A-0]
4. Dial up [A-1] by COURSE knob then press the **TIMER** button display shows [A00]
5. Dial up Commercial Regulation Time, eg: for QLD dial [A05]
6. Press **TIMER** button, display then reverts to normal heading.

NOTE: Once the commercial watch alarm has been enabled, it cannot be disabled by the user.

To connect an external alarm to the AP4 refer to **Install Alarm Siren** on page 50.

Remote Auto Steer (Remote Unit Operation)

The following description applies to the **panel remote** and **hand remote**.

Engaging Auto Steer Mode

The AP4 mode must be Set, Auto or PWR for the remote to operate. Change the switch on the remote unit to the **AUTO STEER** position. If the switch is already in the **AUTO STEER** position, move switch to **OFF** and then back to **AUTO STEER**.

Disengaging Auto Steer Mode

Changing the mode switch setting on main unit will disable the remote.

By switching the remote to OFF the autopilot will be disengaged. It will behave as in **set** mode, i.e. steering is under manual control.

Course Adjustment

Turning the remote unit course knob will alter the **course-to- steer**. This change will be reflected on the digital display.

From the central position of the remote unit course knob, the course may be changed to port or stbd by 90 degrees.

GPS Operation

GPS operation can be selected whilst in the auto steer mode on the active remote unit only. This selection disables the course change knob of the remote. Selection of any other mode will disengage the GPS selection.

Remote Power Steer (Remote Unit Operation)

The following description applies to the **panel remote** or a **hand remote**.

Engaging Remote Power Steer Mode

The AP4 mode must be Set, Auto or PWR for the remote to operate, centre the remote unit course knob and switch the remote unit to the **POWER STEER** position. If the switch is already at the **POWER STEER** position, move switch to **OFF** and then back to **POWER STEER**.

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

Disengaging Remote Power Steer Mode

Return the remote unit course knob to centre before switching to **OFF**.

The autopilot will return to **SET** mode.

Important!!

The remote unit course knob (or steering lever) must be returned to centre before leaving **remote power steer mode**. If not, **auto mode** or **GPS mode** will not steer accurately.

If the centre position of the remote unit course knob does not cause the vessel to steer straight ahead, you may need to realign your rudder feedback. The above does not apply if the vessel is carrying temporary "weather helm" (eg sailing, net drag, etc).

A function in the AP4 S7 version allows for a steering wheel input on pin 5 of the remote socket. Selection of this mode in the software allows for full electric steering on the vessel. (See section ‘AP4 Special modes’).

Rudder Response (Rudder Ratio) Control

The control in the centre of the autopilot control unit panel adjusts the **rudder response** and **sensitivity**.

With the **knob pushed in**, this control governs **rudder response** and is used to determine the amount of rudder the vessel requires for steering (i.e.: the amount of rudder angle applied for a given angle off course). The display will display in two digits [******] when adjusted, and indicates the desired setting between [**01**] and [**10**].

The centre position is usually suitable for most vessels, but should the vessel's steering be sensitive or slow, adjustment maybe required.

In general, a vessel with fast turning rate will require a small rudder response setting. A large, slow vessel may require a higher value for the rudder response.

This may also be adjusted according to speed - low speeds may require more rudder angle for steering than high speeds.

- The rudder response knob set fully anticlockwise signifies the minimum amount of applied rudder (for sensitive steering or large rudders). Setting of [**01**]
- The rudder response knob set fully clockwise signifies the maximum amount of applied rudder (for vessels with slow steering or small rudders). Setting of [**10**].

When the **rudder response** setting is too low, turns will take an excessive amount of time, and the vessel may "wander".

When the **rudder response** setting is too high, turns will be rapid and the vessel will oversteer.

**Experiment to find the best settings for your particular vessel.
Only make small changes at a time.**

The control unit remembers the response setting when the unit is turned off.

Sensitivity

The control in the centre of the autopilot control unit panel adjusts the **rudder response and sensitivity**.

With the knob pulled out, this control governs the sensitivity and is used to determine the amount of "wander" in the vessel steering. A high value for the sensitivity will allow the vessel to drift off course before correcting. A low value for sensitivity will attempt to keep the vessel more precisely on course.

Set the lowest sensitivity value that you can, without having the steering motor continuously "hunting" from side to side. This minimum setting depends upon the amount of slack in your steering, vibration around the rudder feedback mounting position, characteristics of the steering drive system and the weather conditions.

While the centre knob is pulled out, the current sensitivity setting is displayed on the front panel - [01] to [10]. Pushing the centre knob back in will store the new setting, and return to heading information shown on the display. **The knob must then be reset to the desired rudder response setting**. The sensitivity setting is remembered when the unit is turned off and on.

Lower numbers are most sensitive and will give a straighter course steered. **Do not set this so low that your steering equipment is continually working** or "hunting", i.e.: drive lights on front panel flicker continuously, as this will cause premature wear on your system and, in severe cases, may cause malfunction.

For more information, see the installation section of this manual.

Note: The autopilot should be operated with the centre knob pushed in.

Angle Off Course Alarm

An alarm will sound if the vessel has deviated from its desired course by more than 45 degrees. This rare alarm can be caused by a number of steering faults, any of which require attention by the crew.

When the allowable angle is exceeded, the off-course alarm will sound. When the vessel is brought to within the bounds set the alarm will cease.

Changing to **power-steer** or **set/standby** modes will cancel the alarm.

Note that the alarm will sound if a large course change is entered (eg from course change knob or remote unit). This alarm will cease as soon as the vessel completes its course change. The alarm may also sound when changing from one section of a GPS route to another, and will cancel itself when the course change is completed.

See also the **Alarms** section of this manual.

Alarms

A number of conditions will cause alarms to sound. Each alarm has a different "beep pattern" (except watch timer and commercial watch alarm). The external alarm output may also be turned on by some of these alarms; this does not have a "beep pattern", instead sounding continually.

Watch Timer Alarm

This alarm indicates that the time set by the user has expired. Alarm pattern is 1 second on, 1 second off until reset.

Commercial Watch Alarm (Option)

This alarm indicates that the autopilot is in control of the vessel but timer key has not been pressed within the last five minutes. Alarm pattern is 1 second on then 1 second off until reset.

The external alarm output is turned on 1 minute after the internal alarm begins to sound.

Angle Off Course Alarm

The alarm pattern is 0.2 seconds on, 0.2 seconds off when vessel is more than 45 degrees from **course-to-steer**.

No GPS Data Alarm

The alarm sounds 0.5 seconds on, 0.5 seconds off if the autopilot is not receiving valid information from the GPS.

Autopilot Installation

EMC Considerations

All TMQ equipment and accessories are designed to the best industry standard for use in the marine environment. Their design and manufacture conforms to the appropriate Electromagnetic Compatibility (EMC) standards, but good installation is required to ensure that performance is not compromised.

Although every effort has been taken to ensure that they will perform under all conditions, it is important to understand that some factors could affect the operation of the product.

Complete installation instructions are provided in this manual. Some preliminary suggestions follow:

Installation:-

To reduce the risk of operating problems, all TMQ equipment and cables connected to it should be at least 1 metre (3 feet) from any equipment transmitting or cables carrying radio signals, eg: VHF radios, cables and antennas. In the case of SSB radios, the distance should be increased to 2 metres (7 feet).

Genuine TMQ cables should be used at all times. Cutting and rejoining these cables could compromise EMC performance and should be avoided unless doing so is suggested in the installation instructions.

Checking:-

Always check the installation before going to sea to make sure that it is not affected by radio transmissions, engine starting, low battery voltage or other problems.

In some installations it may not be possible to prevent the equipment from being affected by external influences. Usually this will not damage the equipment but may lead to resetting or momentary incorrect operation.

Interconnection:-

If your TMQ equipment is going to be connected to other equipment using a cable not supplied by TMQ, a suppression ferrite **MUST** always be fitted to the cable close to the TMQ unit.

List of Components

BEFORE INSTALLATION, ENSURE YOU HAVE PURCHASED THE CORRECT PARTS FOR YOUR VESSEL.

TMQ Electronics Autopilots are intended for use in three (3) basic systems:

1. The control unit can be used to drive most brands of Slave Units or Oil Control Valves (power steering).
2. The control unit and mechanical drive system is used to drive most hand-operated mechanical steering systems being rod & chain, push-pull or pull-pull systems. Some hand operated hydraulic systems ("helm pumps") can also be used with mechanical drive units to provide an installation, which requires no additional hydraulic pump.
3. The control unit and hydraulic pump system is used with hand operated hydraulic steering systems. Different pump units are used to cater for a wide range of systems. Correct installation is required and pump size and voltage should be considered BEFORE installing the system.

Installation of Main Unit

Position

The **AP4** should be mounted in an accessible position, protected from rain or salt water. If autopilot control is required from an exposed steering position, fit an additional remote steering panel.

Wiring

Access for wiring must be provided. Cabling will have to be run to the **rudder feedback unit, compass unit and steering drive system**.

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 pilot.

The cables selected for the steering drive connections must be sufficiently large to prevent voltage drop.

Magnetic Effect

As a minimum amount of steel is used in the control unit, there is negligible effect on a steering compass. Some radio interference may be caused.

Mounting

The unit may be:

- (a) mounted by using the bracket supplied to fix the control unit on the dash or suspended from an overhead beam.

- (b) flush-mounted into the dash.

Installation of Compass

There are two types of compass suitable for this autopilot - a **magnetic sensor unit** (fluxgate compass), which is a complete compass, and the **compass-top sensor**, which is used together with a standard flat top ships magnetic compass. Note: The CTS is not suitable for a dome top compass.

Installing a Compass-Top Sensor

Before attaching the CTS to the top of the compass, ensure there are no defects in the compass, eg: sticking card, as this will affect the operation of the autopilot.

The sensor unit is placed on the glass plate of the ships compass, in the exact centre of the compass card and secured with adhesive double-sided tape. Before fixing the sensor in place, align it carefully so that the AP4 compass displays the same bearing as the ships compass. A compass top sensor is recommended for steel vessels provided a suitably compensated steel boat compass is fitted to the vessel.

Installing a Magnetic Sensor Unit (Fluxgate Compass)

Where there is magnetic interference on a vessel, the magnetic sensor unit may have to be tried in several positions to obtain the best operating results before final installation.

The compass unit should be treated with care, as the internal gimbals can be broken if dropped. Remove any internal packing before use.

The position of this type of compass is the most important item in the installation of the autopilot. Good course holding is dependent on the compass being **free from magnetic interference**.

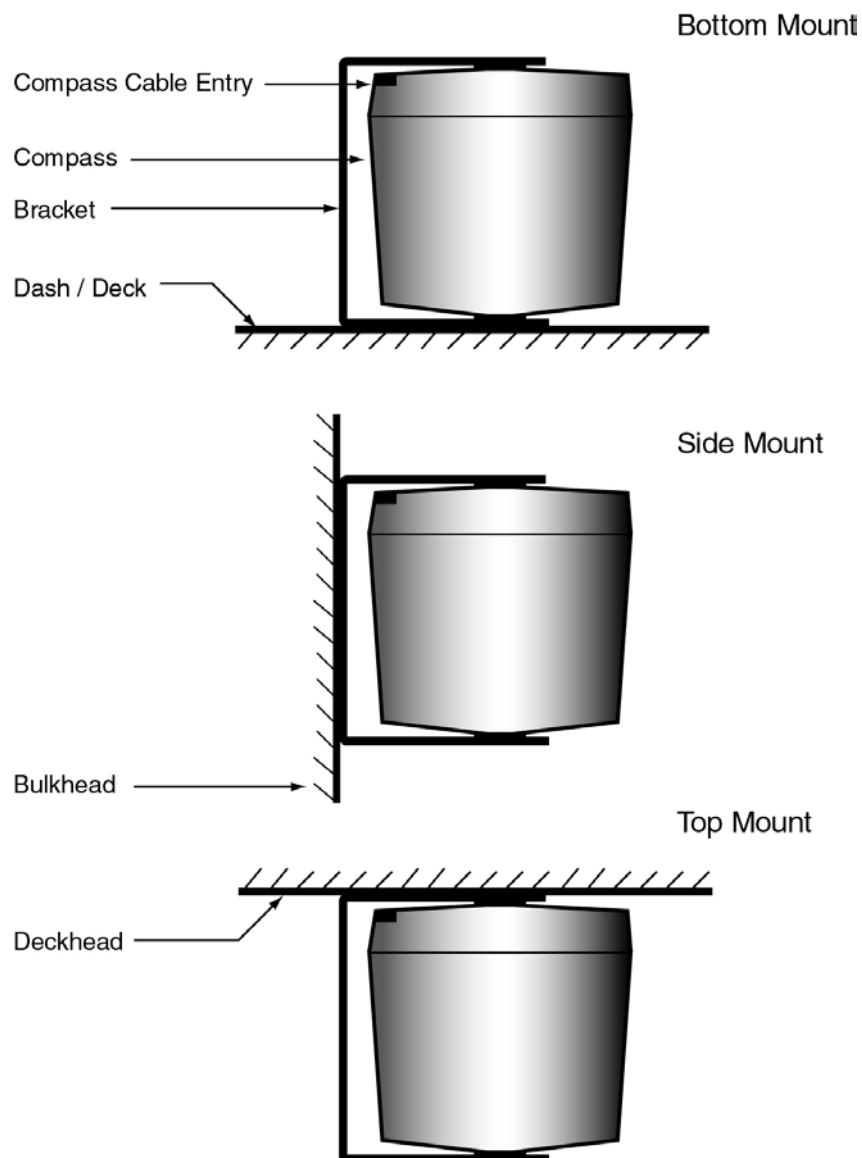
As this compass has no moving card, it is not necessary for the compass to be mounted low in the vessel. This is usually a place of high magnetic interference and should be avoided. However, a position of severe roll such as the top of a mast should also be avoided.

The compass need not be mounted in a weatherproof position. The compass can be mounted on top of a flat surface, on a bulkhead or from the deck head. Check other side of bulkhead for materials which may cause magnetic interference.

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

Fasten the compass bracket with non-magnetic screws. The compass must be mounted in a near **vertical** position.

Fluxgate Compass Mounting Options

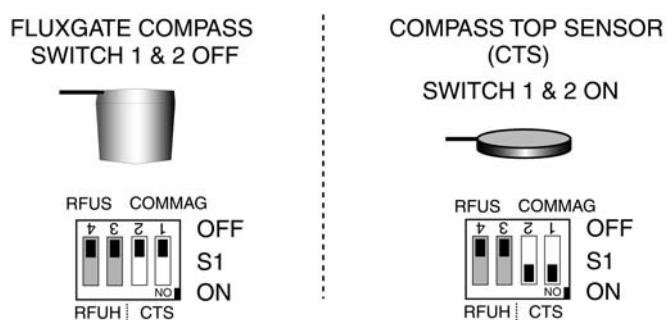


Calibration

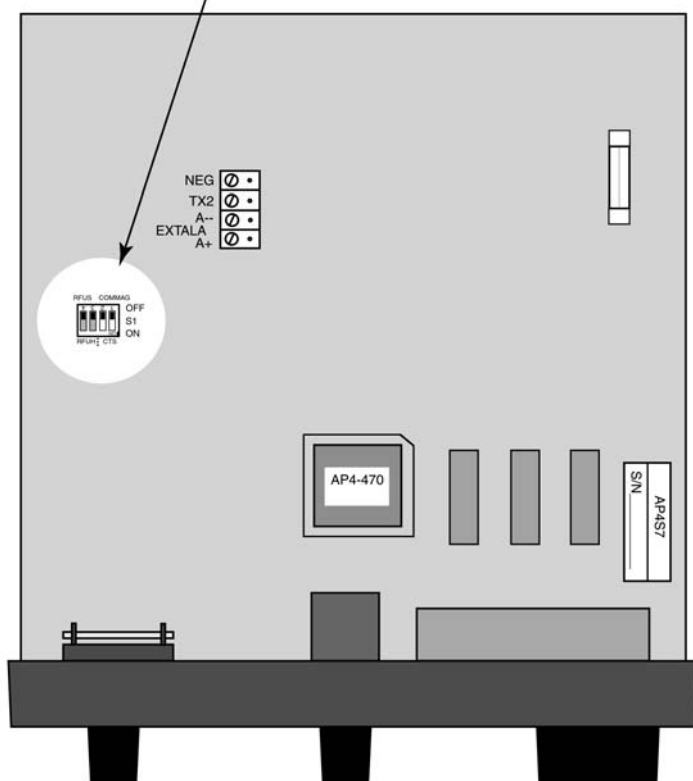
The compass unit will need to be rotated in its bracket for the correct heading to be displayed, lock the compass in position using the 'Locking Screw' on the Bracket. The compass is calibrated before leaving the factory and will be accurate enough for sea trials. After initial sea trials, you **may** wish to recalibrate the compass, although in most cases the factory calibration will be as good as or better than calibration achieved on the vessel. See the Compass Calibration Section.

Interchanging Magnetic Sensor Unit & Compass Top Sensor

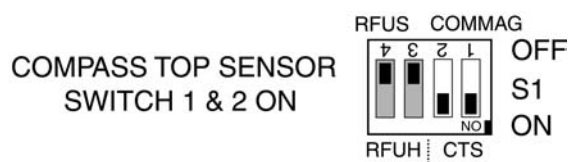
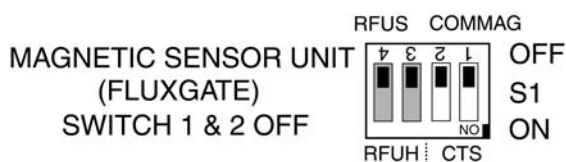
The magnetic sensor unit (fluxgate compass) can be interchanged with a compass top sensor. This is desirable when the autopilot is to be fitted to a steel hulled vessel or vessel containing large amounts of steel.



Location of DIP Switch on PCB



If the magnetic sensor unit and compass top sensor are interchanged, the compass detector DIP switches must be altered. The Top cover of the AP4 has to be removed. The DIP switch is identified as component **S1** on the PCB and as SWDIP-4 on the component overlay diagram at the rear of this manual. **Switch 1 and 2 OFF** - for magnetic sensor unit (fluxgate)
Switch 1 and 2 ON - for compass top sensor



Wiring

The magnetic sensor unit or compass-top-sensor, which comes with your **AP4** autopilot is fitted with a plug, which fits into the socket, labelled "compass" on the rear of the autopilot. If the cable must be extended, we recommend that a good quality 5-core shielded extension cable be used. This is available from your supplier or TMQ Electronics.

Refer to the drawings section of this manual for details of fitment of EMC suppression ferrite to compass cable.

Calibration

The compass unit will need to be rotated in its holder after installation for the correct heading to be displayed. After initial testing, further adjustment may be required to reduce any heading error displayed. If the **AP4** compass does not adequately match your ships compass then you may need to re-calibrate the **AP4** compass. See the Compass Calibration section of this manual.

Installation of Rudder Feedback

Position

Install rudder feedback as shown in the diagrams labelled either "Heavy Duty Rudder Feedback Installation Diagram" or "Standard Rudder Feedback Installation Diagram" depending on the type of Rudder Feedback to be fitted. 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 and linked in such a way that the four pivot points (tiller post, feedback shaft and the 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 effort is necessary to ensure the unit does not become immersed in water.

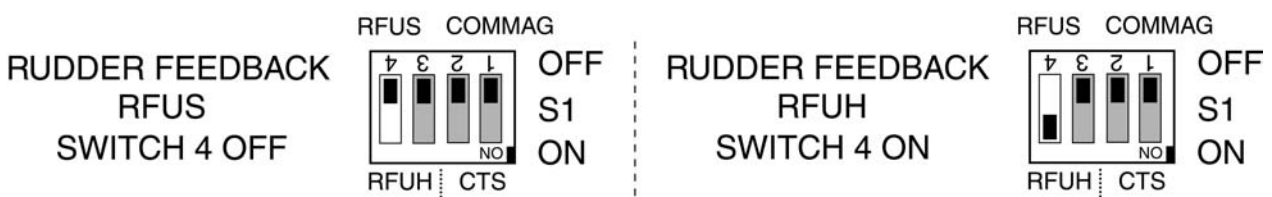
After installation of the feedback unit is complete, turn the rudder from lock to lock by hand, ensuring:

- (a) No undue mechanical strain is placed on the linkage
- (b) There is no excessive "slack" in the steering.

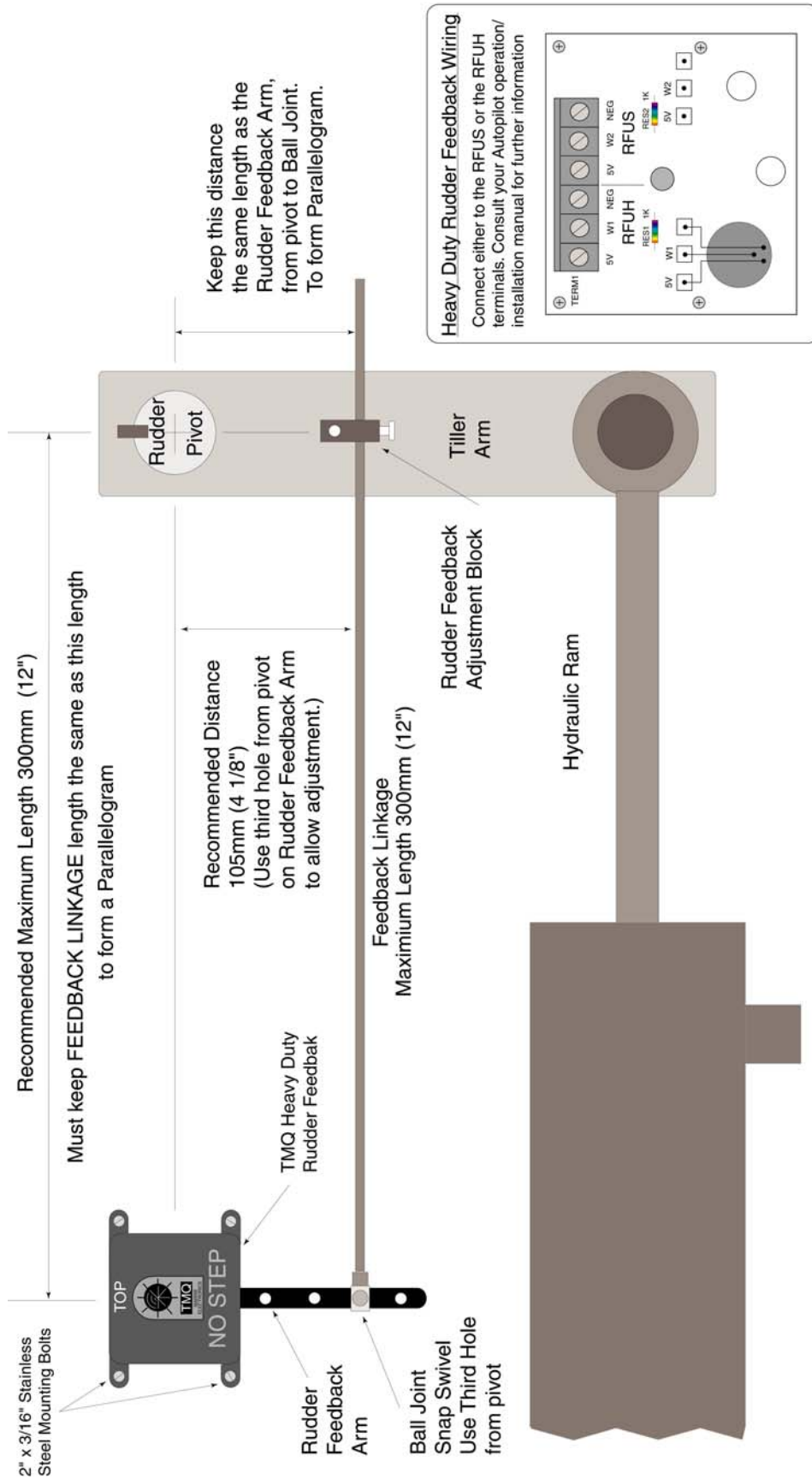
For vessels where extreme hard wear is expected, a **heavy duty rudder feedback unit** can be supplied which gives full voltage back to the autopilot. This must be specified when ordering the autopilot control unit.

If a RFUS is used S1 (Dip switch) switch 4 should be set to OFF.

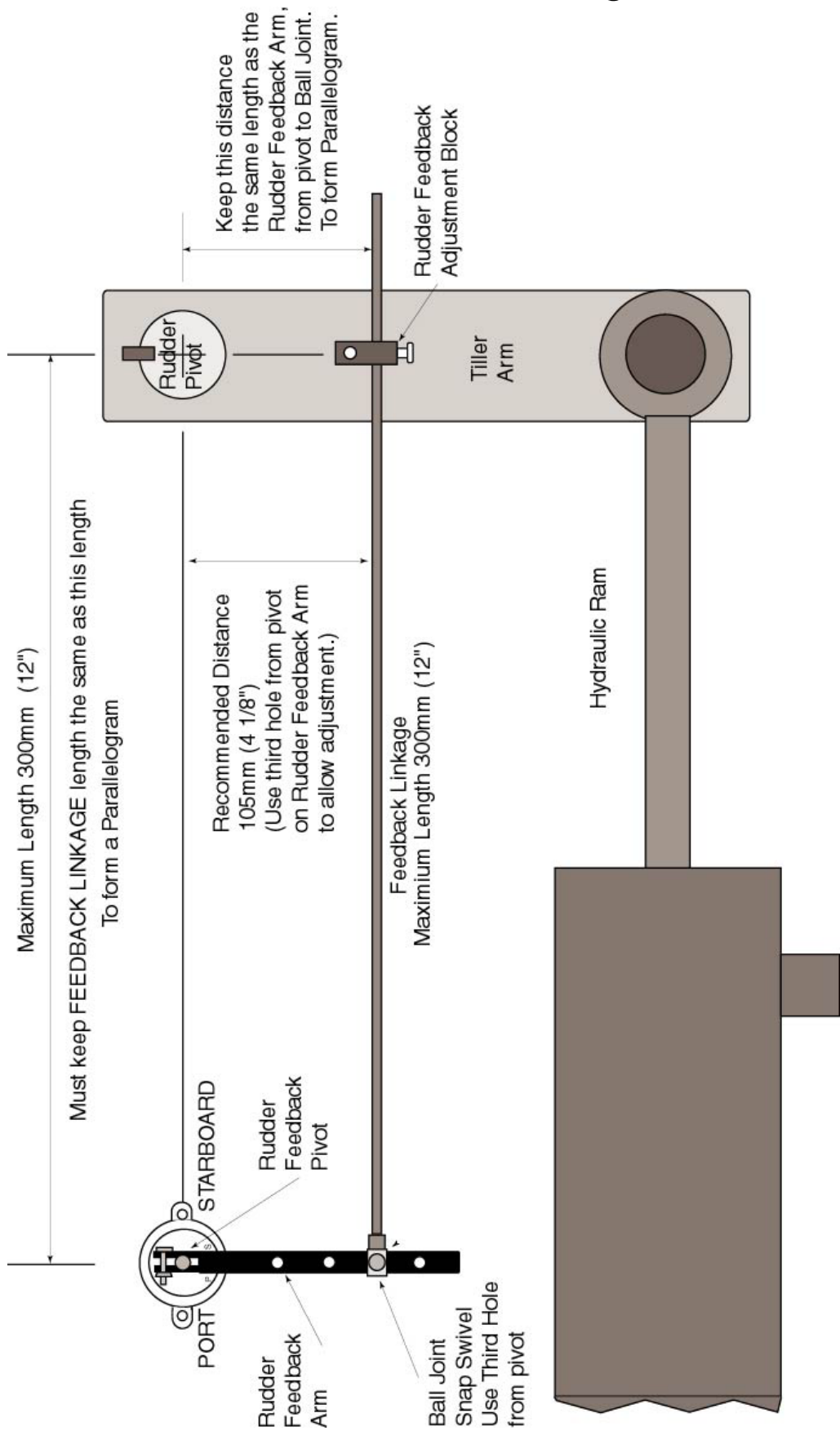
Note:- Switch 3 is not used.



Heavy Duty Rudder Feedback Installation Diagram



Standard Rudder Feedback Installation Diagram



The rudder feedback unit is water resistant. However, if it is to be mounted in a wet position, some effort is necessary to ensure the unit does not become immersed in water. If necessary the standard rudder feedback unit may be mounted upside down, in which case the feedback cable may be cut in a suitably dry position, and the blue and red wires swapped.

DO NOT MOUNT THE HEAVY DUTY RUDDER FEEDBACK UNIT UPSIDE DOWN

NOTE: THE AUTOPILOT WILL NOT FUNCTION CORRECTLY IF A RUDDER FEEDBACK IS NOT FITTED, OR IF THE FEEDBACK IS FAULTY OR INCORRECTLY ADJUSTED.

NOTE: THE RUDDER FEEDBACK UNIT IS FACTORY ALIGNED. THE ARM SHOULD NOT BE REMOVED OR LOOSENED UNNECESSARILY. IF ARM IS LOOSENED OR REMOVED, VOLTAGE ALIGNMENT SHOULD BE CHECKED BEFORE USING THE AUTOPILOT. THIS MUST BE DONE BY A COMPETENT TECHNICIAN.

Installation of Remote Units

Hand Remotes and Steering Levers

These units are very robust and either of these may be mounted where it is subject to occasional splashes of water. If mounted in direct sunlight, the decal may fade.

The cable leading from the unit should be connected to the **remote** socket of the AP4, as shown in the connection diagram.

Panel Remote

This unit is very robust and may be mounted where it is subject to occasional splashes of water. If mounted in direct sunlight, the decal may fade.

The control cable leading from the unit should be connected to the **remote** socket of the AP4.

NMEA Data Remotes - (Future option)

Remotes Calibration

The remotes can be calibrated if required, this will provide the full range of the steering input to be used, set up procedure.

1. In **SET** mode, hold down **GPS** button and press the **TIMER** button, **[900]** will show on the display. Release buttons, rotate course knob until display shows **[911]**. Press the **TIMER** button. The display show **[rCL]**.
2. Rotate each of the remote units through their full travel range (Full Port to full Starboard),
3. Press the Timer button to save the settings and exit the set up procedure.

Hydraulic Drive Installation

The AP4 autopilot can drive spool valves, relays or hydraulic pumps. TMQ can supply the following pump units:

1. A constant running pump set (including spool valves) for 24V DC operation with flow rate up to 4000cc per minute.
2. A constant running pump set (including spool valves) for 240V AC or 415V AC 3-phase operation with flow rate up to 5000cc per minute.
3. Reversing pumps with adjustable (or fixed) flow rate to 1200cc per minute (specify 12 or 24 volts).

Position

All pump units should be mounted horizontally, in a **dry position**, lower than the highest Helm Pump on the vessel. Hydraulic lines must be used to connect the pump to the steering lines of the vessel.

Precautions

The balance line must be connected back to the helm reservoir.

Some brands of Helm Pumps will require lock valves fitted to prevent the helm from turning when the autopilot is operating. Consult your steering supplier for this information.

All air must be purged from the steering system before commencing sea trials with the autopilot. Also, care must be exercised when dual rams are connected in series because of differential pressure within the system. Consult your hydraulics manual.

Wiring

Refer to relevant connection diagrams.

All constant running pumps should be connected to the supply via an isolating switch and suitable protection circuit (eg: fuse or circuit

breaker). **Cables must be sufficiently large to carry the required motor current with minimum voltage drop.**

Solenoid Valves

Links are provided to allow jog lever operation in conjunction with AP4 S7 Autopilot. When cut (open circuit) the Autopilot only pulls the outputs low. Positive being supplied to the Solenoid common. Links are marked J1 and J2 on the PCB.

As preventative measure to ensure voltage spikes do not interfere with the Autopilot or other equipment, spike suppression diodes should be fitted on solenoid valves.

Mechanical Motor Installation

Motor Gearing Ratio

Mechanical drive motors supplied by TMQ Electronics have a nominal output speed of 30 RPM. They are fitted with a 16 tooth 3/8 pitch sprocket to suit BS chain 06B-1R. 1.5 meters of chain, a 38 tooth sprocket and mounting bolts are supplied in the installation kit.

Due to wide variation of mechanical steering systems and the turning speed of vessels, this ratio has proved the most effective in regard to helm speed and the required torque. If steering problems are encountered with the TMQ mechanical units, different sized sprockets can be fitted on the motor drive shaft; variations normally available from the factory are 10 or 24 tooth.

Position

The motor should be mounted in a **dry position** on a flat base and fasteners with sufficient strength to withstand in excess of 150kg pull.

The output shaft should always be parallel with the shaft to be driven although the motor can hang down or be mounted on the side.

When a sprocket is fitted on the back of a hydraulic helm pump, ensure that the helm pump does not twist in its mounting under full load.

Wiring

Refer to Drive Connection Diagrams.

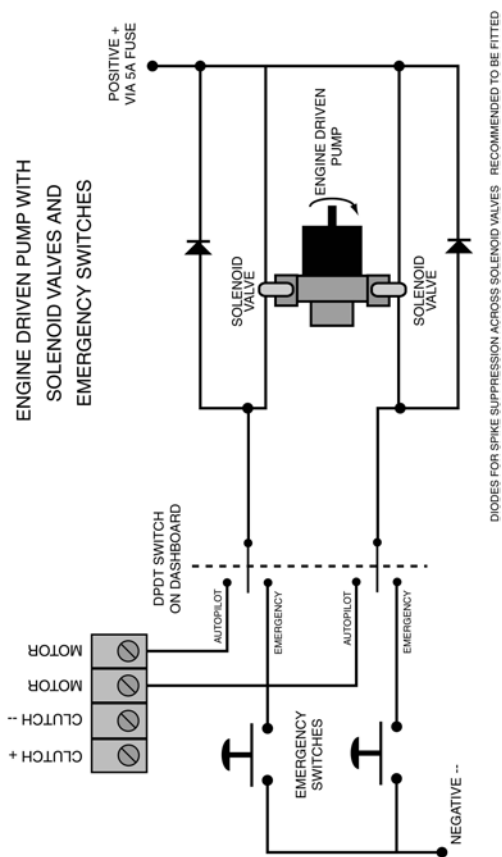
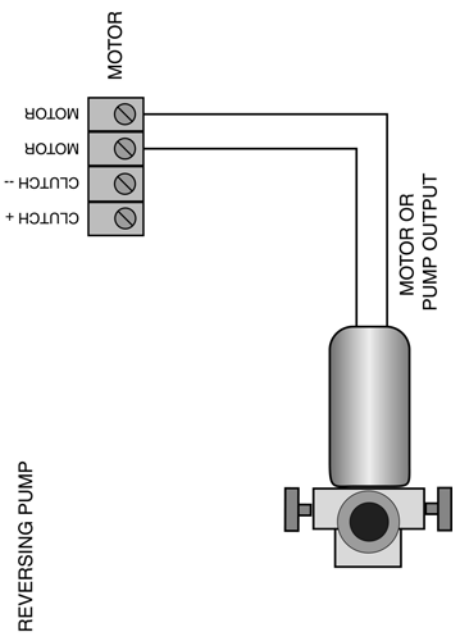
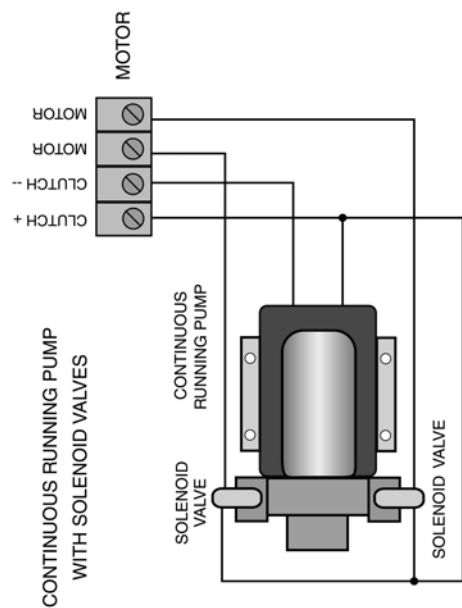
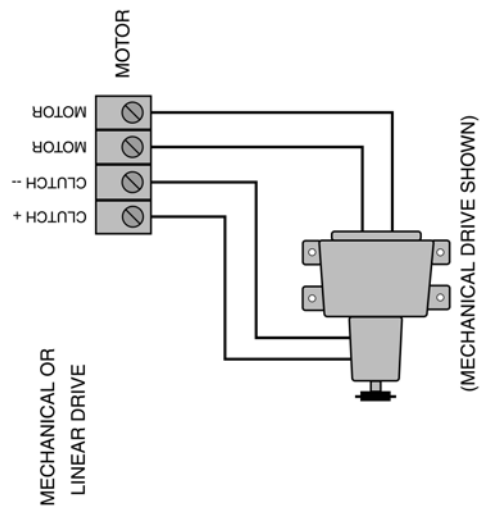
Connect the motor unit to the **MOTOR** and **CLUTCH** terminals.

Note: To extend motor cable use large enough cable to keep voltage drop less than 0.5 volts on full load of 10 amps. If the motor runs in the wrong direction when the autopilot is turned on, switch off and reverse the **MOTOR** connections (see section on dockside checks).

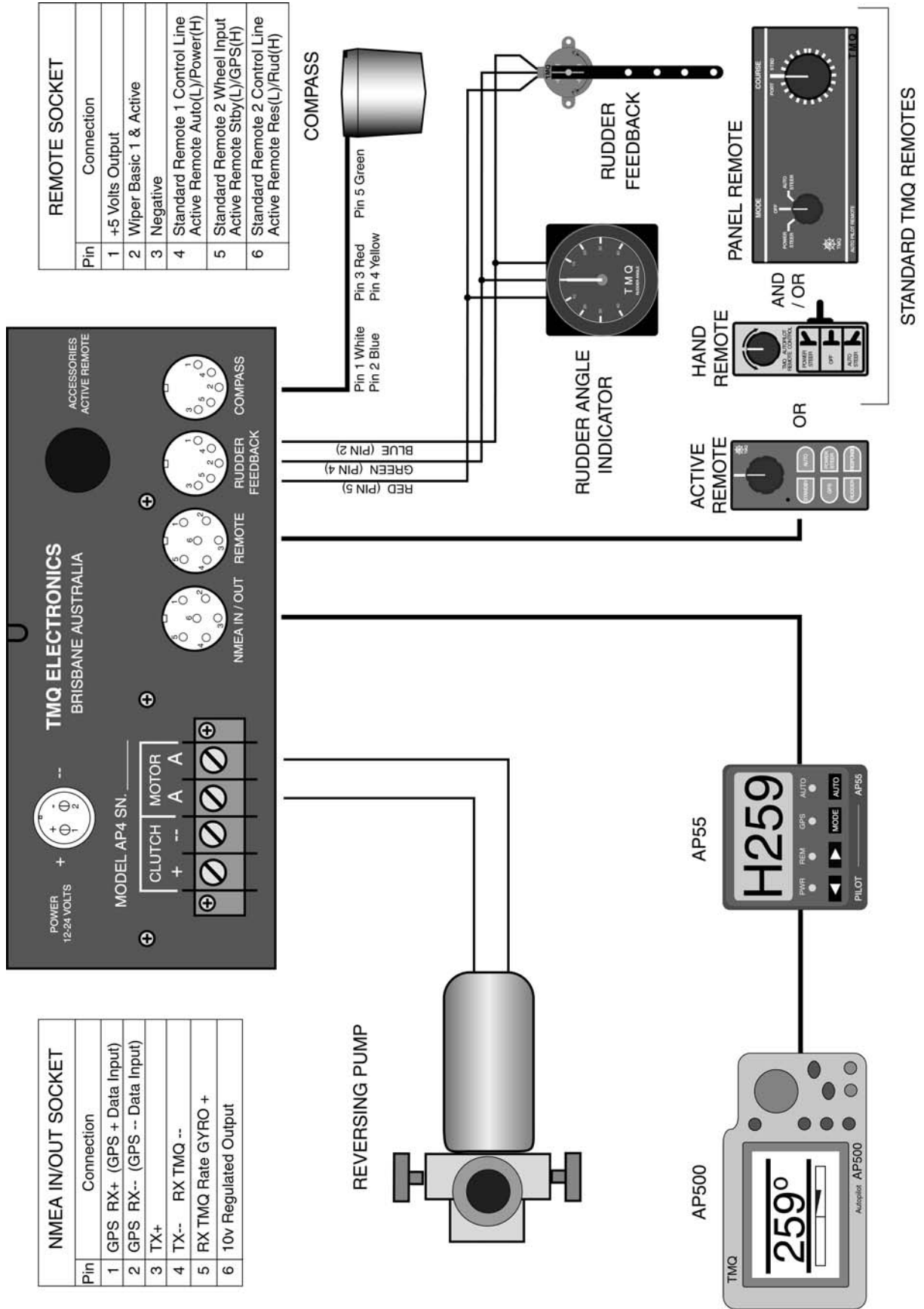
Warning

Time taken for rudder to travel lock to lock should not be less than 12 seconds. This will occur if steering shaft total turns are less than 2. In this type of installation a large sprocket will be required on the steering shaft. Refer to supplier for the correct sprocket size.

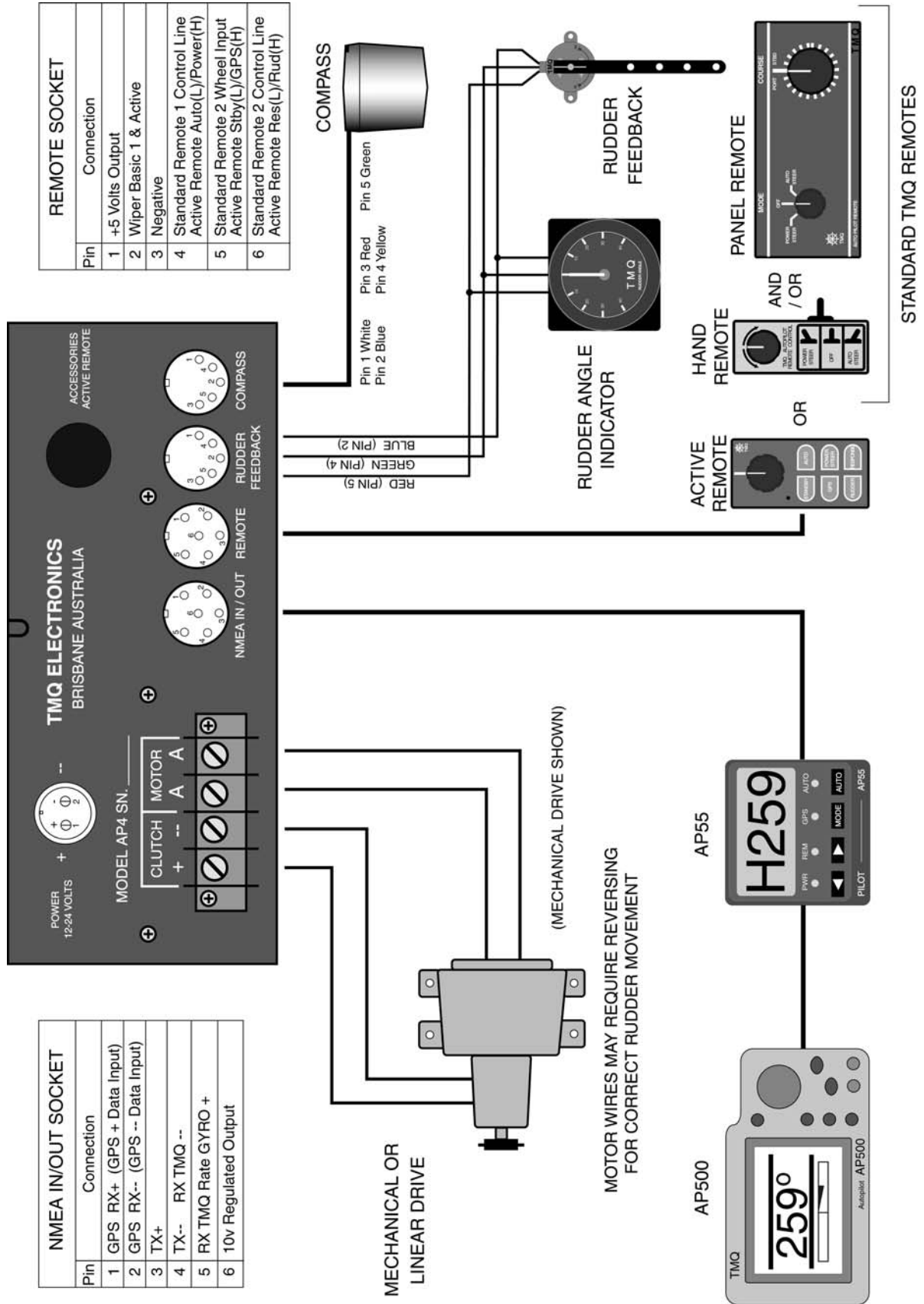
Drive Connection Diagrams



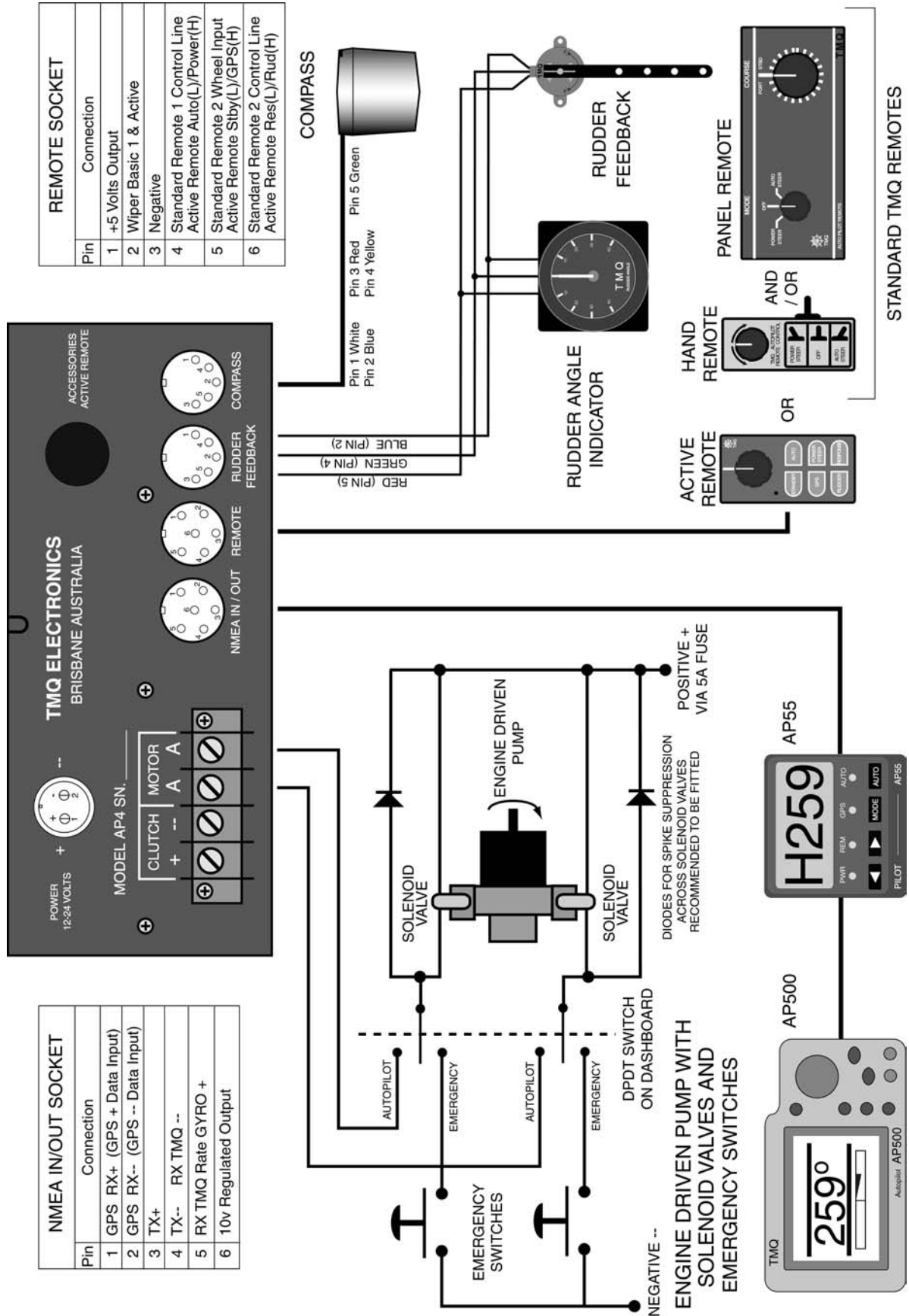
System Connection Diagram - Reversing Pump



System Connection Diagram – Mechanical Drive



System Connection Diagram – Solenoid Valves



Pin	Connection
1	+5 Volts Output
2	Wiper Basic 1 & Active
3	Negative
4	Standard Remote 1 Control Line Active Remote Auto(L)/Power(H)
5	Standard Remote 2 Wheel Input Active Remote Sibyl(L)/GPS(H)
6	Standard Remote 2 Control Line Active Remote Res(L)/Rud(H)

Pin	Connection
1	GPS RX+ (GPS + Data Input)
2	GPS RX- (GPS -- Data Input)
3	TX+
4	TX- RX TMQ --
5	RX TMQ Rate GYRO +
6	10v Regulated Output

NMEA Connection

Data In

For GPS navigation, connect the GPS unit **data output** and **data return** wires to the AUX socket at the rear of the AP4.

Data In Connection - Examples only:

Refer to connection diagram.

- For any GPS unit which has a BNC type output plug (a bayonet plug, taking a "coax" cable with a core and shield), connect the core to **RX+** and the shield to **RX-**.
- For any GPS or Plotter with open wires follow the relevant operation manual of the unit **TX+** to **RX+** and **TX-** to **RX-**.
- For a TMQ CPLOT, connect **Data Out +** to **RX+** and **Data Common** to **RX-**.

RX+ is pin 1, **RX-** is pin 2 on NMEA connector

For Heading Data from Rate Gyro

Rx + is Pin 5 on NMEA connector - for Rate Gyro Pos.

Rx - is Pin 4 on NMEA connector - for Rate Gyro Neg.

Programming the GPS unit

This is the part of the GPS-to-Autopilot connection that causes the majority of problems. If you have difficulty with the **GPS** connection, please read the relevant sections of your **GPS** manual carefully. The **AP4** autopilot looks for **NMEA 0183** format data containing **APA** or **APB** or both **XTE** and **BOD** information. For more information on

this, see the Operations section of this manual and consult your **GPS unit** manual.

Heading Data

Heading data output is available on pins 3 (+) and 4 (-) of data six pin socket. NMEA heading message eg: \$APHDM,037.2,M

Output heading sentence type can be selected if required. Available options are: HDM, HDT or HDG individually or all three can be output together.

Heading Data Output set-up procedure.

1. In **SET** mode, hold down **GPS** button and press the **TIMER** button, **[900]** will show on the display. Release buttons, rotate course knob until display shows **[912]**. Press the **TIMER** button. The display show **[S-*]**. Eg **[S-1]** as this is the default factory setting.
2. Rotate the course knob to select the required option from the following,
 - 1 = HDM, HDT and HDG
 - 2 = HDM Only
 - 3 = HDT Only
 - 4 = HDG Only
 - 5 or 6 there is no output.
3. Press the Timer button to save the setting and exit the set-up procedure.

External Alarm Installation

For vessels requiring the **commercial watch alarm** feature fitted for survey requirements, an external alarm is required in addition to the **AP4** internal buzzer.

For non survey vessels, this external buzzer is optional.

This alarm will sound if the timer alarm has been sounding for one minute without being reset, and autopilot is NOT in **SET** mode.

A 12 volt piezo buzzer with current draw not exceeding 250 milliamps should be used (TMQ Part No. Siren).

If a siren or alarm unit is used which draws in excess of 250 milliamps, this should be connected via a relay. The external alarm circuit is used to energise the relay coil and the siren or alarm unit is connected via the relay contacts.

Install External Alarm Siren

1. Uncover **AP4** top by unscrewing the 2 X M3 Pan Head screws on either side
2. Identify **T6 EXTALA Terminal** on AP4 board
3. Connect **RED** lead to **A+** terminal
4. Connect **BLACK** lead to **A-** terminal
5. Guide siren cable through back panel grommet and space provided

6. Once completed, replace **AP4** top cover and tighten screws.

To enable the commercial watch alarm refer page 17.

**NOTE: Once the commercial alarm is enabled, it cannot be
reverted.**

Commissioning Checks

Connection Tests

1. Voltage to be connected is the required DC voltage (12 or 24V).
2. ENSURE POLARITY OF THE VOLTAGE SUPPLY IS CORRECT.
3. All electrical connections are correct.
4. Loose cables are clipped or tied up.
5. Turn steering wheel fully clockwise and visually check that moving and mechanical parts do not foul; visually check that RFU arm has moved in the correct direction as indicated on the RFU label or top.
6. Repeat step 5 for anti-clockwise.

Dockside Tests

1. Turn steering (by hand) to midships position.
2. Turn on power supply. Select **SET** on mode switch.
3. Adjust the rudder limits. See **Rudder Limits** section of this manual.
4. Determine vessel heading by a sighting on known heading or compass.
5. Align autopilot magnetic sensor until display reads known heading.
6. Select **AUTO** mode on control unit.
7. **AUTO** light will come on.

**CAUTION: IF AUTOPILOT DRIVES HARD OVER,
IMMEDIATELY TURN CONTROL UNIT OFF.**

Reverse motor drive wires at terminal strip on rear of autopilot and repeat from Step 1.

-
8. Turn course knob 10 degrees to starboard.
 9. Green steering light should come on.
 10. Confirm that rudder moves to starboard.
 11. Turn course knob back to centre, then 10 degrees to port.
 12. Red steering light should come on.
 13. Confirm that rudder moves to port.

NOTE: AT NO STAGE SHOULD THE AUTOPILOT DRIVE THE RUDDER INTO THE MECHANICAL STOPS.

14. Move mode switch to **SET** position.

The autopilot is now ready for full operational testing.

Use open waterways for testing until you are familiar with the operation. Complete installation and commissioning form supplied.

Rudder Limits Switch Setting

The rudder limits prevent the steering motor driving the rudder beyond its physical (mechanical) stops. The **limit switch** is set so that the limit display comes on before the rudder reaches the stops.

There are two display symbols **P_L** (port limit), **S_L** (starboard limit) indicating the state of the rudder limit circuits:

- The port limit **P_L** display will come on when the rudder position is further to port than the limit set by the **rudder limit port setting**. This will cause any port drive command to be ignored and turn off the port drive light on the front panel.
- The starboard limit **S_L** functions in the same way for rudder angles to starboard.
- The symbols do not appear in the SET mode.

NOTE: **THE RUDDER LIMITS ARE FACTORY SET BETWEEN 25 AND 30 DEGREES. IF THE RUDDER FEEDBACK HAS BEEN INSTALLED CORRECTLY, THE P L AND S L SYMBOLS SHOULD DISPLAY WHEN THE RUDDER IS MOVED TO THE PORT OR STARBOARD LIMIT.**

Setting Rudder Limit

- Switch to **SET** mode
- Hold down **GPS** button, press **TIMER** button, display shows [900].

-
- Dial up **[905]** by **COURSE** knob, press **TIMER** button.
Display shows rudder position as a scale of 0 to 255, 128 being the centre.
 - Rotate **Steering helm** to desired **Port Limit Position** (display should be between 000 and 110), then press **GPS** button to set the **PORT LIMIT**.
 - Rotate **steering helm** to desired **Starboard Limit Position** (the display should be between 150 and 255), then press the **TIMER** button to set **STARBOARD LIMIT**.

To check **Rudder Limits**, switch AP4 to **PWR** mode, rotate **COURSE** knob to **Port** and **Starboard lock** in turn and visually check rudder has moved to desired limit positions.

Compass Calibration

The compass supplied with your AP4 autopilot has been calibrated during manufacture. 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. The calibration should only be done if the compass is **known** to be inaccurate.

If the AP4 compass displays a **constant offset** (eg the autopilot compass reads 3 degrees high **on all bearings**), simply rotate the AP4 compass case to align bearings with the ships compass. **It is not necessary** to re-calibrate the compass as described below.

If the AP4 compass 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. In **SET** mode, hold down **GPS** button and press the **TIMER** button, **[900]** will show on the display. Release buttons, rotate course knob until display shows **[901]**. Press the **TIMER** button. The display will flash between **[CAL]** and **[***]** (heading).
 2. Turn vessel slowly through two complete circles in the same direction.
 3. In **SET** mode, hold down **GPS** button and press **TIMER** button. Release buttons, rotate course knob until display shows **[902]**. Press **TIMER** button.

Note: If display shows **[rES]** the calibration was invalid and the AP4 defaults the factory setting. Repeat steps 1, 2 and 3 to carry out calibration again.

This completes the compass calibration. Check alignment of the AP4 compass by steering vessel due North (000 on ships compass) and, if necessary, rotate outer case of AP4 compass in its bracket until heading display reads 000.

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. Such adjustment should be repeated annually. 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 following step 1 above but rotating course knob until display shows **[903]** before pressing **TIMER**. Display will show **[rES]** before returning to normal heading.

AP4 Special Modes

Display Selection

Button Operation

- | | | |
|-----|--|-------------------------------|
| 901 | Start compass calibration [CAL]: | TIMER |
| 902 | Store compass calibration: | TIMER |
| 903 | Return to default calibration [rES]: | TIMER |
| 904 | Factory test for calibration ----- | |
| 905 | Set limit switches:
TIMER/GPS (Stbd) | TIMER/GPS (Port) |
| --- | Set limit to maximum: | TIMER/GPS/GPS |
| 906 | Set commercial watch alarm: | TIMER[A-
1]TIMER[***]TIMER |
| | [A-0] = No watch alarm set | |
| | [A-1] = Watch alarm set | |
| | [***] = Time in minutes | |
| 907 | Set input from other sin/cos source: | TIMER[A01]GPS |
| | [A00] = normal TMQ compass input | |
| | [A01] = other sin/cos input | |
| | To return to TMQ compass input: | TIMER[A00]GPS |
| 908 | Option remote: | |
| | [r-1] = Basic remote | |
| | [r-2] = Active remote | |
| | [r-3] = Basic remote plus power steer on pin 5 | |
| | [r-4] = Basic remote plus power steer on pin 5 in set position | |
| 909 | Average compass mode: | |
| | [A-0] = no averaging | |
| | [A-1] = averaging enabled | |

911 Remote Cal - see Page 39, **912** Heading Output options – see Page 48

Optional Extras

There are 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

Remotes

Panel Remote



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

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 Levers



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



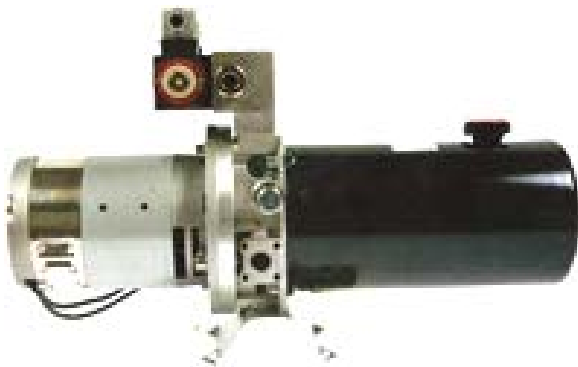
Hydraulic Drives and Pump Units

Reversible pumps



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

Continuous pumps



Constant running pumps available in 2 or 3 litre for 12 volt DC systems. Accurate flow adjustment to set lock-to-lock time.

Linear drives



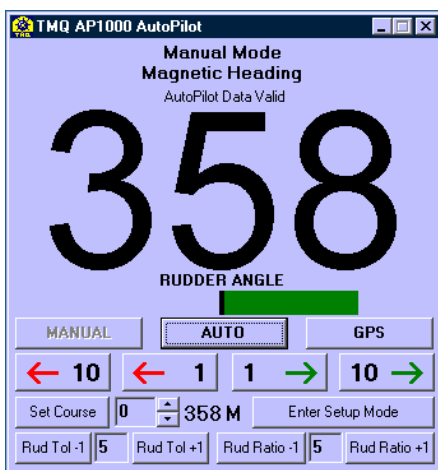
Single rod linear drives can be fitted to a wide variety of vessels. May be attached directly to the tiller or rudder quadrant.

Mechanical drives



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

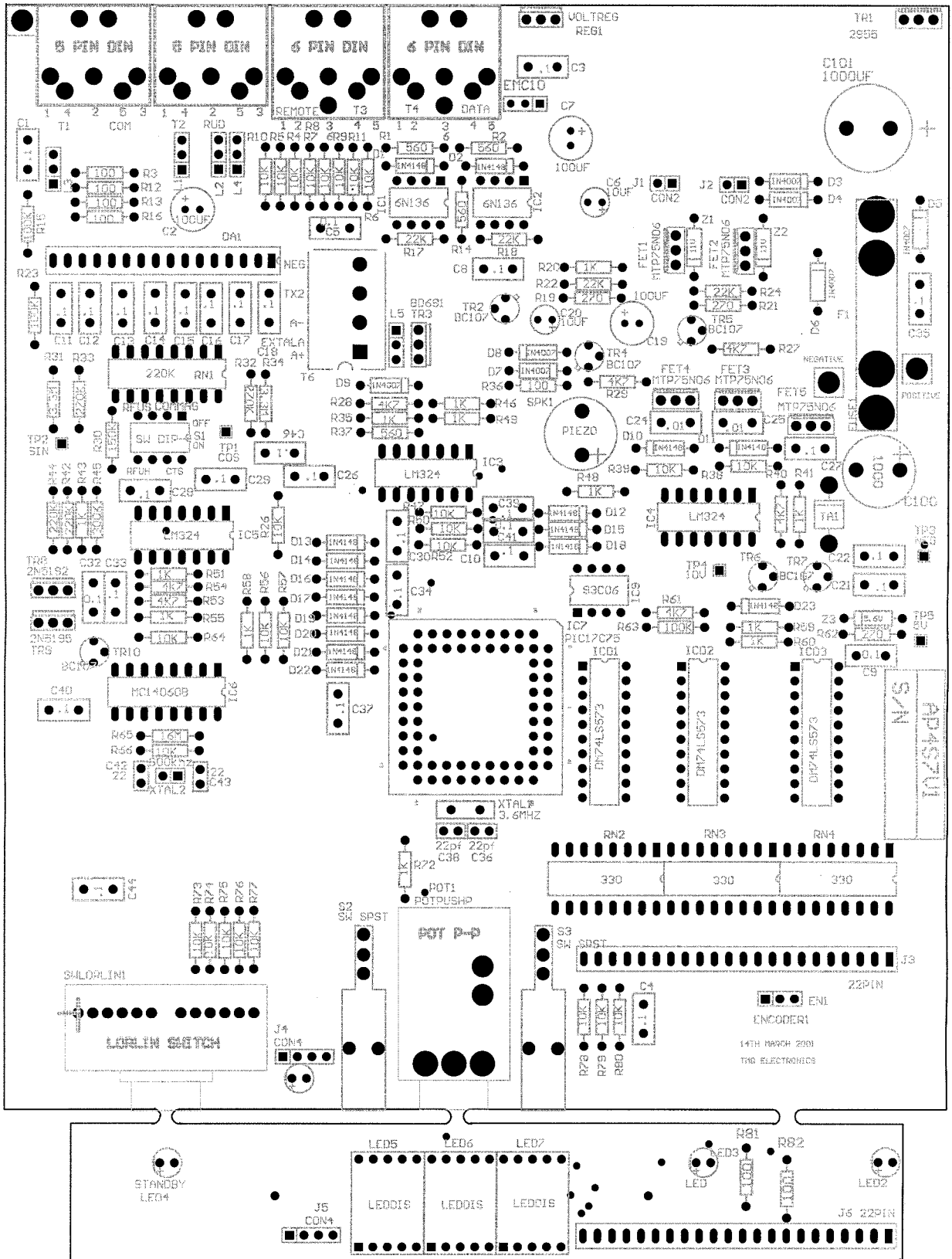
Computer Software



TMQ AP1000 Autopilot operating Software.

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

PCB Overlay



DECLARATION OF CONFORMITY

(MANUFACTURERS DECLARATION)

MANUFACTURER:- TMQ ELECTRONICS
 PO BOX 3348
 TINGALPA DC 4172
 AUSTRALIA
 TEL: +61 7 3890 7788
 FAX: +61 7 3890 7799

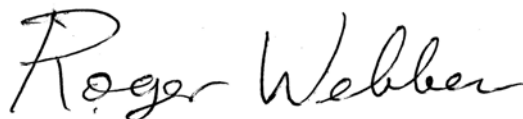
Declares under our sole responsibility that the products:

AP4 Autopilot, Compass Sensor, Rudder Feedback unit and remote accessories, 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.



6 August 2003

Roger Webber, Manager

Warranty

TMQ Electronics 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. By returning the enclosed questionnaire and registering the product. The warranty will be extended to a total of 3 years from the date of leaving the factory.

This warranty is extended to and is solely for the benefit of the original consumer purchaser.

All units in need of repair will be repaired without charge to the purchaser during the above mentioned period in accordance with the following terms and conditions:

1. The defective unit is returned "freight prepaid" to TMQ Electronics 1/18 Alexandra Place, Murarrie, QLD. 4172.
2. Proof of purchase is supplied and original Serial Numbers on equipment have not been changed.
3. Information is provided regarding the nature of the failure or problem occurring.
4. A return address is supplied to enable the equipment to be returned by road freight. Any other means of transport will be charged to the customers account and must be paid in advance.

This warranty does not cover defects or damages caused by unauthorised service or damage through accident, misuse or abuse. The owner is also responsible for providing reasonable maintenance and weather protection of the equipment.

TMQ Electronics shall not be liable for damage or loss incurred resulting from the use and operation of this product. TMQ Electronics reserves the right to make changes or improvements to later models without incurring the obligation to install similar changes to equipment already supplied. Some states do not allow the exclusion or limitation of incidental or consequential damages; therefore the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights, which vary from state to state.

Notes: