

TMQ ELECTRONICS PTY LTD

AP4 Autopilot

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 not recommended that the autopilot be used while navigating in restricted waterways, as water currents, wind changes or radio interference may affect vessel course sufficiently to be a danger to 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:

- * Autopilot Unit
- * Compass or Compass-Top-Sensor
- * Rudder Feedback
- * An optional Panel Remote/Hand Remote/Steering Lever unit.

This autopilot can drive a hydraulic pump or a mechanical drive motor. 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 one **panel remote**, **hand remote** or **steering lever** station. 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.

Autopilot Operation

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Overview of Operation

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 desired 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 60 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 provide a warning alarm at 5 minutes and an output for a loud external alarm after 6 minutes.

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.

Possible alarms

- * Watch timer alarm

Auto Mode

Engaging Auto steering mode

When the mode switch is set to the **AUTO** position, a beep will sound and the adjacent yellow light will be turned on. The auto pilot will lock on to the heading indicated.

Disengaging the Autopilot

Rotate the mode switch to the **SET** position. A beep will sound 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 36 degrees of course change.

Note

When the autopilot has been "turned off" using a remote unit (panel remote, hand remote, etc), the mode switch will be in the **auto** position but steering is under manual control. 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. A beep will sound to indicate that **power steer** mode has been engaged.

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 the internal rudder limit pot (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). A beep will sound and 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 shall 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 +ve) and 3 (RX -ve) of the AP4 AUXILIARY socket. A suitable cable to match your GPS can be prepared by the installer of your autopilot, the dealer from which you purchased your autopilot, or ordered from TMQ Electronics.

The data from your GPS 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. See later in this section.

The GPS unit must then 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 then your vessel must be **on track**, and heading in the correct direction before engaging the GPS mode, and the auto-sequencing feature is not available.

Remember:

Prior to engaging GPS mode, a route must be programmed 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 inbuilt timer which can be set for any interval between 0 and 60 minutes. When the time expires, the internal alarm will beep. One minute after the internal alarm begins, the external alarm will sound [but only if autopilot has steering control]. 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 watch), then rotate the course knob to set the desired number of minutes. When finished, wait for 3 seconds. The display will then revert to "normal", the time value will be stored into the timer, and it will begin counting down to zero. When the timer expires, an internal alarm will sound. If the timer is not reset within one minute, the external alarm (if fitted, and autopilot is steering) will sound.

If the timer button is pressed while the timer 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, part of the survey regulations for commercial vessels is a watch timer fitted with every autopilot. This feature is built in to the AP4, but is normally disabled (see section below about enabling this feature). When commercial timer is enabled and the autopilot is in control of the vessel (ie in **auto**, **GPS** or **remote trim** mode), the AP4 internal alarm sounds every 5 minutes and louder external alarm one minute later unless the timer is reset. Changing the autopilot mode will reset the timer.

In **set**, **power** and **remote power** modes, the timer can be set to any desired time as for a pleasure-boat.

To enable the commercial watch alarm, cut the short metal link on the board just behind the course control knob (marked CAL), or remember to request this feature when ordering your autopilot.

Remote Trim Mode (Remote Unit Operation)

The following description applies to the **panel remote**. For a **hand remote**, **MAIN** corresponds to **OFF** and **AUTO** corresponds to **TRIM**.

Engaging Trim Mode

Set the **AP4** mode switch to **AUTO**, then change the switch on the remote unit to the **AUTO** position. If the switch is already in the **AUTO** position, move switch to **MAIN** and then back to **AUTO**.

Disengaging Trim Mode

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

By switching the panel remote to MAIN the autopilot will be disengaged. It will behave as in **set** mode, ie 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.

Remote Power Steer (Remote Unit Operation)

The following description applies to the **panel remote**. For a **hand remote**, **MAIN** corresponds to **OFF** and **PWR** corresponds to **POWER**.

Engaging Remote Power Steer Mode

Set the **AP4** mode switch to **AUTO**, then centre the remote unit course knob and switch the remote unit to the **PWR** position. If the switch is already at the **PWR** position, move switch to **MAIN** and then back to **PWR**.

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 **MAIN**.

The auto pilot 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).

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 is used to determine the amount of rudder the vessel requires for steering (actually, the amount of rudder angle applied for a given angle off course).

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

In general, an agile vessel with a relatively large rudder or very small keel will require a small rudder response setting. A large, slow vessel may require a high 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, large rudders or low gearing ratio.)
- * The rudder response knob set fully clockwise signifies the maximum amount of applied rudder (for vessels with slow steering, small rudders or high gearing ratio).

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.

In rough weather, you may require more rudder response than in calm weather .. experiment to find the best settings for your vessel.

Sensitivity (Rudder Tolerance)

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

With the knob pulled out, this controls 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. Pushing the centre knob back in will store the new setting, and heading information is 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 (ie drive lights on front panel flicker continuously).

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

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 on to its correct course again, 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. Note that a suitable buzzer must be attached to this output.

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.

Over-Current Alarm

When the autopilot detects an electrical overload in the motor output circuits, it turns off the motor and releases steering to manual control. This alarm will also sound. After a short period (eg 10-15 seconds), the alarm will cease and the autopilot will resume steering.

The alarm pattern is 0.75 seconds on, 0.25 seconds off.

Autopilot Installation

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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.

Essential AP4 Components:

- (A) Control Unit
- (B) Magnetic Sensor (Compass or Compass-Top-Sensor)
- (C) Rudder Feedback Unit with link arm & cable

Optional Components:

- (A) Hand remote
- (B) Panel remote
- (C) Steering lever
- (D) Rudder angle indicator
- (E) External alarm
- (F) Mechanical drive, sprocket and chain.
- (G) Hydraulic pump system

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.

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 mounted:

- (a) 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 **fluxgate** unit, which is a complete compass, and the **compass-top sensor**, which is used together with a standard magnetic ships compass.

Installing a Compass-Top Sensor

The sensor unit is placed on the glass plate of the ships compass, in the exact centre of the compass card and secured with an adhesive such as double-sided tape, or silicon sealant. Before fixing the sensor in place, align it carefully so that the **AP4** compass displays the same bearing as the ships compass.

Installing a Fluxgate Compass

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 dependant 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. If the compass is in an exposed location, seal with silicon around the joint.

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 an approximately vertical position. See also the diagram labelled "Compass Installation".

Wiring

The compass 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.

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 recalibrate the **AP4** compass. See the Compass Calibration section of this manual.

Installation of Rudder Feedback

Position

Install rudder feedback as shown in the diagram labelled "Rudder Feedback Unit Installation". The unit should be adjacent to the tiller and must copy the angular movement of the tiller. The markings on the rudder feedback unit indicates 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. If necessary the 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.

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. This must be specified when ordering the autopilot control unit. There is an extra charge for such a feedback.

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.

NOTE: THE ARM ALSO HOLDS AN O-RING AGAINST THE RUDDER FEEDBACK BODY TO FORM A WATER-TIGHT SEAL. DO NOT MOVE THE ARM UP THE SHAFT AS THIS WILL ALLOW WATER INTO THE FEEDBACK UNIT.

Installation of Remote Units

1. **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 diagram labelled "Wiring Details".

2. **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.

There are two cables leading from the panel remote:

- * A two-core power cable
- * A control cable with a 5-pin plug

The control cable is connected to the **remote** socket of the AP4.

Optional power switch

The two-core cable runs through the two-position switch on the front of the panel remote. This can be wired as an emergency power off switch for the autopilot if desired. As the **AP4** allows manual steering to be selected from the remote, this emergency power-off switch is optional.

If you do wish to connect this, one wire of the 2-core cable must be connected to 12 or 24 volts. The other must be used as the autopilot +ve power input.

The On/Off switch on the remote panel will then function as an emergency off switch - setting the switch to off will turn off the AP4 and return steering to manual control.

Voltage drop in supply lines

If using the optional power switch as described above, all power for the autopilot and the drive unit is routed through the remote panel. Therefore, this cable must be capable of carrying high current, and voltage drop over this cable must be kept to a minimum (particularly with a 12V power supply).

Hydraulic Drive Installation

Follow any instructions of the Hydraulic Steering supplier.

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. A reversing pump with adjustable flow rate up to 1000cc per minute (specify 12 or 24 volts).
4. A reversing pump with adjustable flow rate up to 1500cc per minute, suitable for high volume 12 volt installations

Position

All pump units must 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.

If the pump unit has a balance line, the line must be connected back to the helm reservoir.

Precautions

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 tests with the autopilot. Consult your hydraulics manual.

Wiring

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

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

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 B.S. 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 sprockets can be fitted on the motor drive shaft; the variations normally available from the factory are 10 or 24 tooth.

Position

Mounting of the motor unit requires 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, please ensure that the helm pump does not twist under full load.

Wiring

Connect the motor unit to the MOTOR-1 and MOTOR-2 terminal strip locations. If a clutch is required, connect this to the CLUTCH+ and CLUTCH- terminal strip locations. The maximum voltage drop allowed in the motor cable on full load of 10 amps is 0.5 volts. This must be considered when selecting the extension cable. If the motor runs continuously when the autopilot is turned on, switch off and reverse the MOTOR-1 and MOTOR-2 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.

GPS 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:

- * For any GPS unit which has a BNC type output plug (a bayonet plug, taking a "coax" cable with a core and shield), eg for the JRC brand JLU-121, JLR-6000 or NWU-53, connect the core to **RX+** and the shield to **RX-**.
- * For a JLR-4110, connect **TX+** to **RX+** and **TX-** to **RX-**.
- * For a JLR-4500, connect **Data Out +** to **RX+** and **Common** to **RX-**.
- * For a Raychart 600/610, connect **Data Out +** to **RX+** and **Data Common** to **RX-**.
- * For a Trimble NavTracXL GPS unit, connect **TX-** to **RX+** and **SigRef** to **RX-**.

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.

External Alarm Installation

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

For other 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.

The external buzzer should have positive input connected to clutch+ terminal on rear of autopilot and buzzer -ve input connects to **external alarm** pin on **remote** socket (see pin connection in appendix).

A 12-volt or 24-volt buzzer should be used depending on autopilot supply voltage.

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 has moved in the correct direction as indicated on the RFU label.
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 THE SCREW TERMINALS ON THE AP4 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.

Internal Rudder Limits

If the steering motor attempts to drive the rudder beyond its physical limits, it is possible that the motor or steering gear will be damaged. There is an internal **rudder limit** potentiometer that can be adjusted so that this is prevented from occurring.

There are two lights inside the back case indicating the state of the rudder limit circuits ...

- * The port (red) limit light will come on when the rudder position is further to port than the limit set by the **rudder limit potentiometer**. This will cause any port drive command to be ignored, and also turn off the port drive light on the front panel.
- * The starboard (green) limit light functions in the same way for rudder angles to starboard of centre.

To set up the internal limit control correctly:

1. Set the internal **limit (VR7)** potentiometer to fully clockwise.
2. Set the autopilot to **Set/Standby Mode**.
3. Turn the helm by hand to port until the rudder will no longer move, then bring it back toward centre by a small amount.
4. Using a small screwdriver, adjust the **limit (VR7)** pot anticlockwise until the port(red) limit light comes on.
5. Turn the helm to starboard until the rudder will no longer move, then bring it back toward centre by a small amount.
6. If the green limit light is not already on, then adjust the **limit (VR7)** pot anticlockwise until the stbd (green) light comes on.

Over-Current Protection

If the hydraulic or mechanical motor attached to the AP4 autopilot should be unable to turn (eg rudder jammed), then the motor will draw large electrical currents, and may "burn out" itself or the autopilot. The AP4 can sense the amount of current being drawn by the motor and switch itself off if there is a danger of damage. Unfortunately, different types of motor draw different "safe" current levels. Internal potentiometer VR6 is factory-set at a suitable level for most motors. If your AP4 frequently ceases to steer and sounds its **over-current alarm**:

- * Verify that your steering is not jammed or too stiff
- * Consult your autopilot dealer to verify that your steering drive system is sufficiently powerful for your vessel.
- * If no fault is found, rotate the over-current pot further clockwise.

Compass Calibration

The compass supplied with your **AP4** 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 following 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 **at all bearings**), rotate the compass case to align bearings with the ships compass .. **do not** recalibrate the compass as described here.

Note that this recalibration procedure should only be done in calm waters with adequate sea room.

1. In **Set** mode, hold down the GPS button and press the timer button. The value "900" will appear on the display. Release buttons and rotate course knob until "901" appears on the display. Press the TIMER button. The display will return to normal.
2. Turn the vessel slowly through two complete circles, so that each compass bearing is covered. Each complete turn should take at least 60 seconds. This can be done by hand, or under autopilot control.
3. In **Set** mode, hold down the GPS button and press the timer button, as before. Release buttons and select "902" on the display. Press the timer button.
4. Rotate the compass case so that North is correctly aligned.

The compass calibration does not take effect unless step 3 is completed, so you may abandon the recalibration by simply NOT performing step 3.

You may return to the factory calibration level at any time by following step 1 above, but selecting "903" before pressing **timer**.

Warranty

TMQ Electronics Pty Ltd 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 two years from the date of shipment from the factory.

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

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

1. The defective unit is returned "freight prepaid" to TMQ Electronics Pty Ltd, 264 Tingal Rd, Wynnum, Qld. 4178.
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 Pty Ltd shall not be liable for damage or loss incurred resulting from the use and operation of this product. TMQ Electronics Pty Ltd 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.

AUTOPILOT — COMPASS INSTALLATION

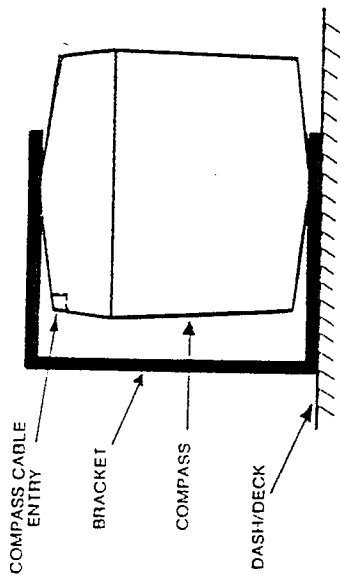


Figure A — Bottom Mount

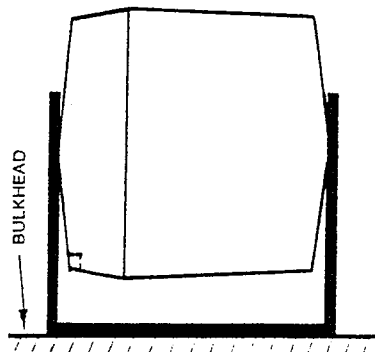


Figure B — Side Mount

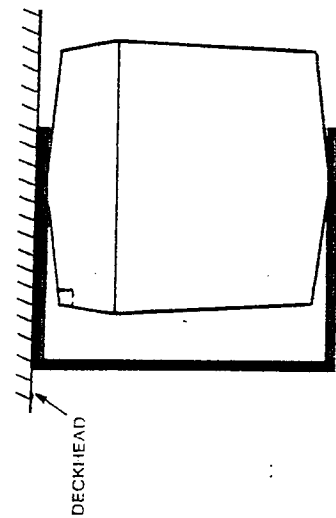


Figure C — Top Mount

NOTE:

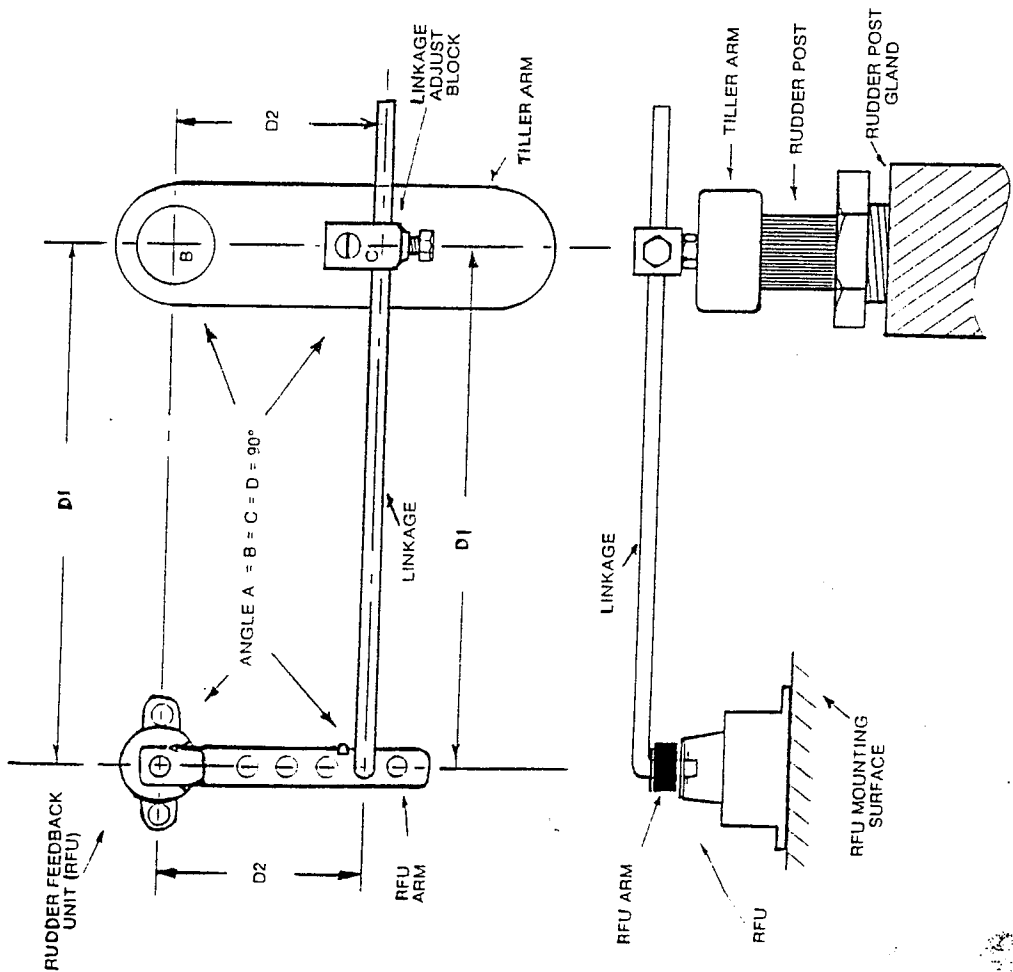
MAGNETIC INTERFERENCE WILL EFFECT THE EFFICIENCY OF THE MAGNETIC SENSOR UNIT. IT IS ESSENTIAL TO POSITION THE MSU FOR MINIMUM INTERFERENCE.

DO NOT RUN MSU CABLE WITH OTHER CABLES ON THE VESSEL AND MOUNT THE MSU WELL AWAY FROM FERROUS METALS, ELECTRICS AND OTHER COMPASSES.

CAUTION WHERE EVER YOU MOUNT THE MSU, BE AWARE OF WHAT IS ON THE OTHER SIDE OF THAT SURFACE.

APPROVED BY		DATE
Title INSTALLATION — MAGNETIC SENSOR UNIT		
Size A4	Number	Revision
Date: 15.10.93	Sheet 1 of 1	
File: R4BLANK/1	Drawn By: AC	

RUDDER FEEDBACK UNIT (STD) — INSTALLATION



NOTE:

1. LINKAGE ADJUST BLOCK IS MOUNTED ON TILLER ARM. BLOCK SHOULD BE ALLOWED TO SWIVEL WITH RUDDER MOVEMENT
2. LENGTH OF RFU ARM IS ADJUSTED BY LOOSENING HEX NUT ON LINKAGE BLOCK
3. RFU CAN BE MOUNTED ON BRACKET IF NO SUITABLE SURFACE IS AVAILABLE
4. RFU IS FACTORY ALIGNED. WARRANTY VOID IF ARM IS LOOSENED OR LIFTED

APPROVED BY		DATE
Title STANDARD RUDDER FEEDBACK - INSTALL		
Size A4	Number	Revision
Date: 15/10/93		Sheet / of /
File: A4BLANK1		Drawn By: ac

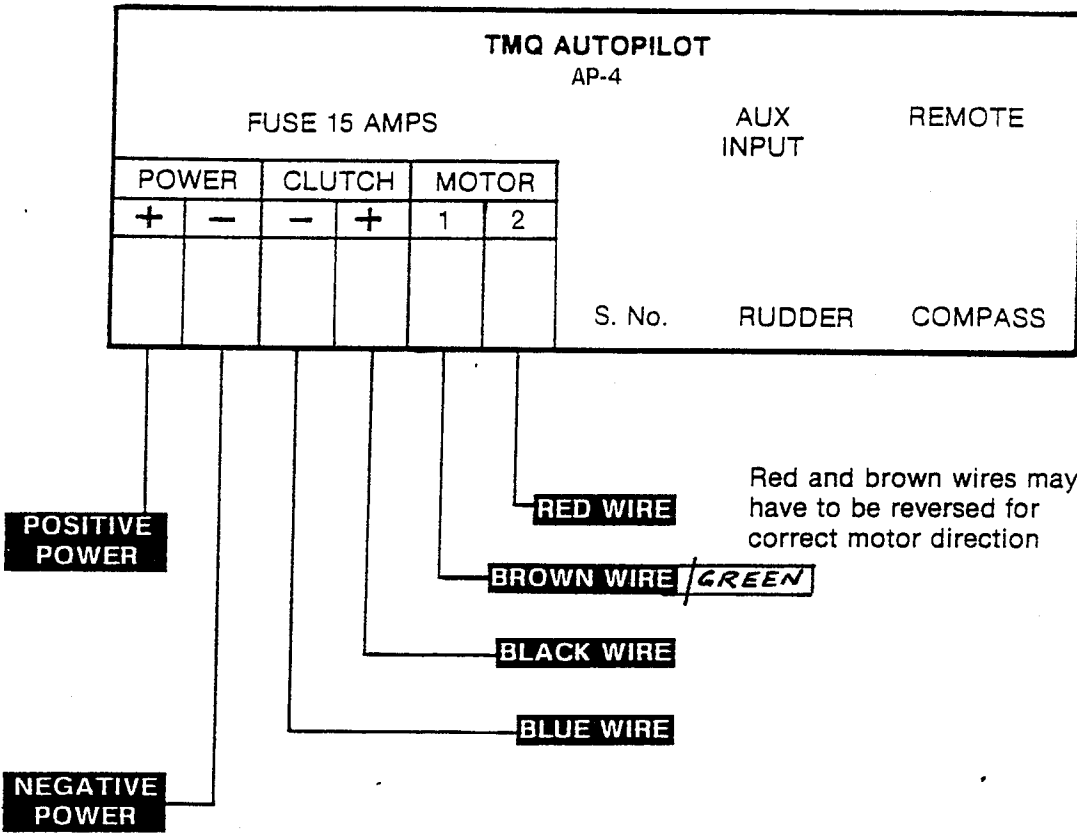
1 2 3 4

A B C D

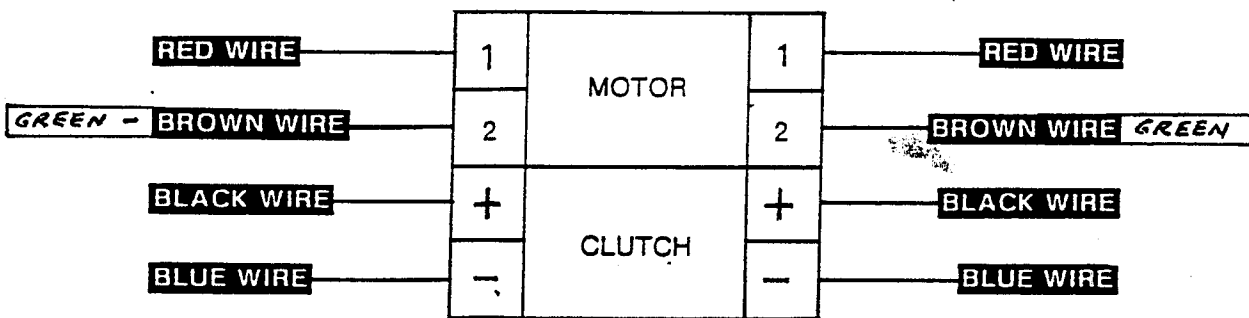
1 2 3 4

Electrical Connections Mechanical Drive

- (1) Power Connection (4m of 2-core cable supplied)
- (2) Compass Cable (supplied)
- (3) Motor Cable (supplied)
- (4) Rudder Feedback Cable (supplied)

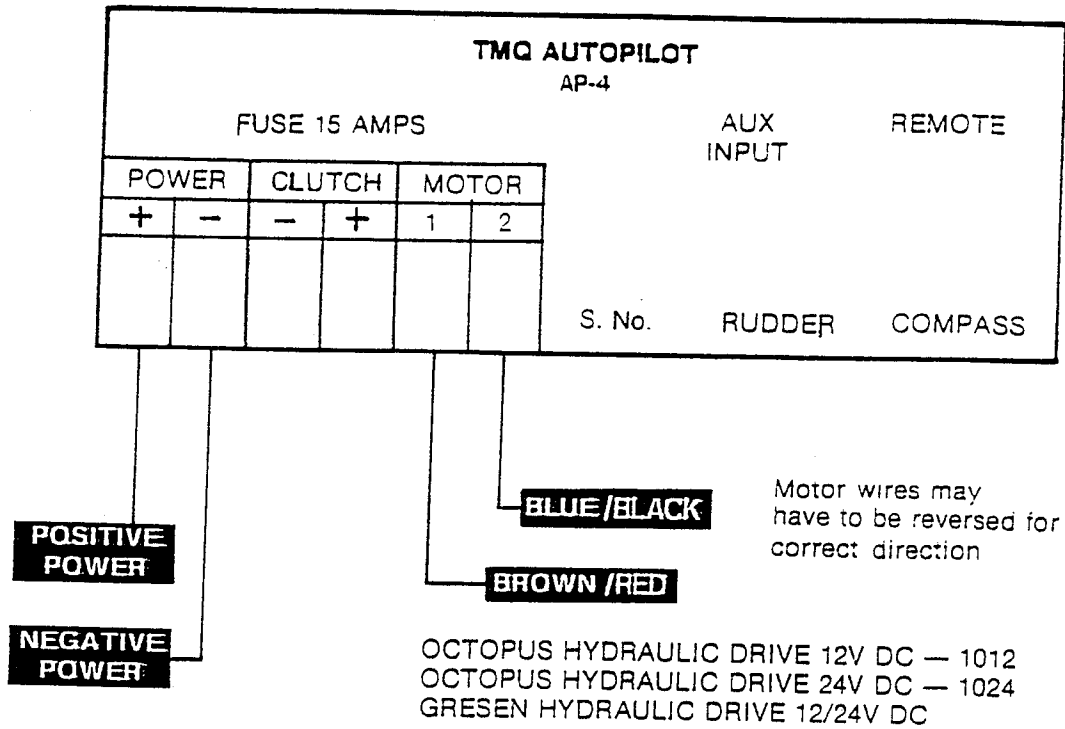


LIMITER MUST BE USED ON 24 VOLTS WHEN INDICATED

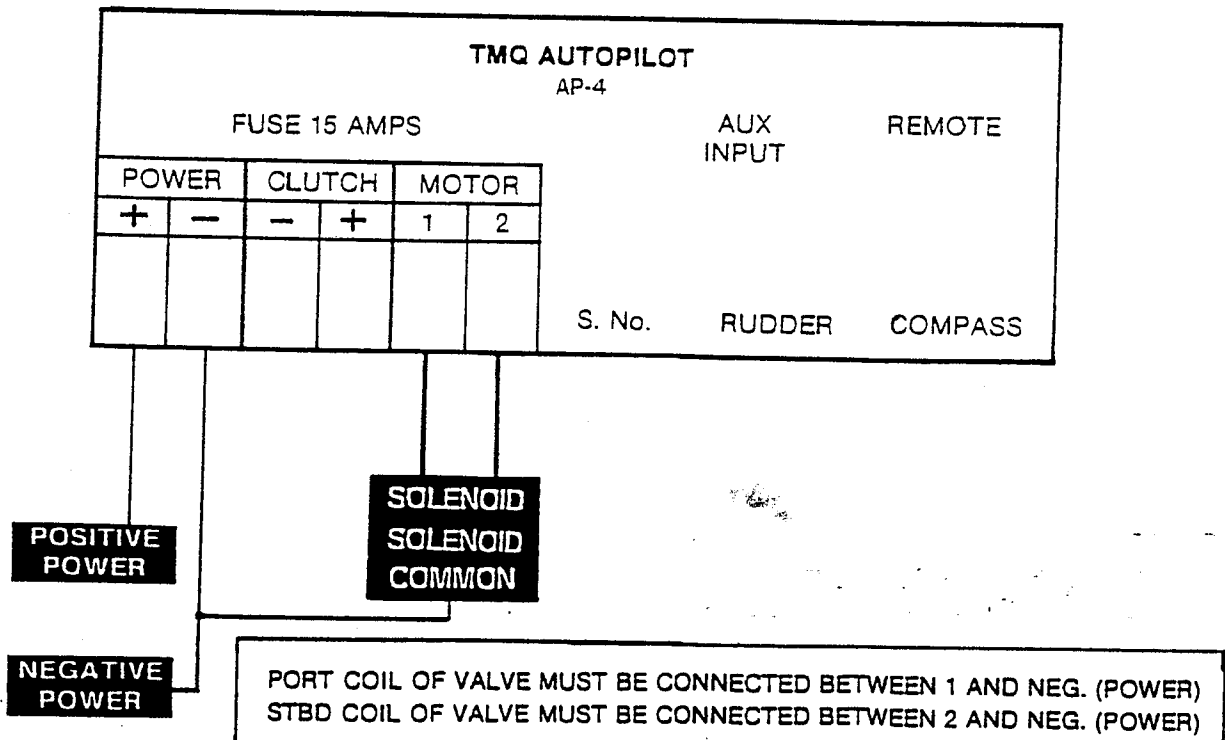


Electrical Installations Hydraulic Drive

- (1) Power Connection Cable (supplied, 2-core)
- (b) Compass Cable (supplied)
- (c) Pump Unit Cable (supplied)
- (d) Rudder Feedback Cable (supplied)



Electrical Connection Oil Control Valves



REAR SOCKET PIN CONNECTIONS AUTOPILOT

AUX INPUT SKT 1	PIN No.	SIGNAL
	1	<i>RX +</i>
	2	
	3	RX -
	4	TX
	5	Neg
REMOTE CONTROL SKT 2	PIN No.	SIGNAL
	1	Remote signal
	2	Negative -OV
	3	Control Line
	4	External alarm
	5	Positive +5V
RUDDER SKT 3	PIN No.	SIGNAL
	1	
	2	Negative -OV
	3	
	4	Rudder Position
	5	Positive +5V
COMPASS SKT 4	PIN No.	SIGNAL
	1	Compass (COS)
	2	2KHZ Square Wave
	3	Compass (SIN)
	4	Compass (COS)
	5	Compass (SINS)

TMQ AUTOPILOT
AP-4

FUSE 15 AMPS

POWER		CLUTCH		MOTOR	
+	-	-	+	1	2

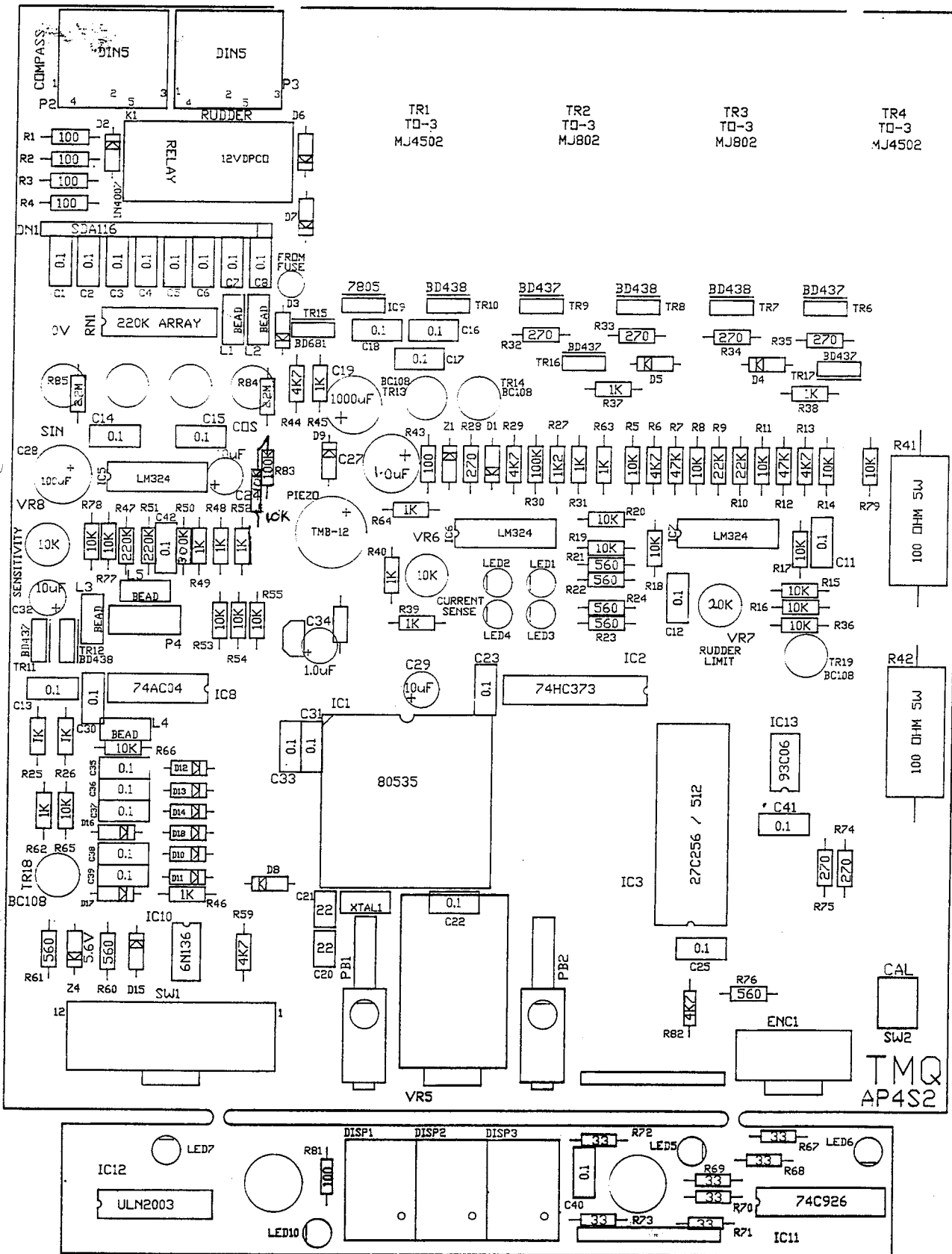
AUX INPUT

REMOTE

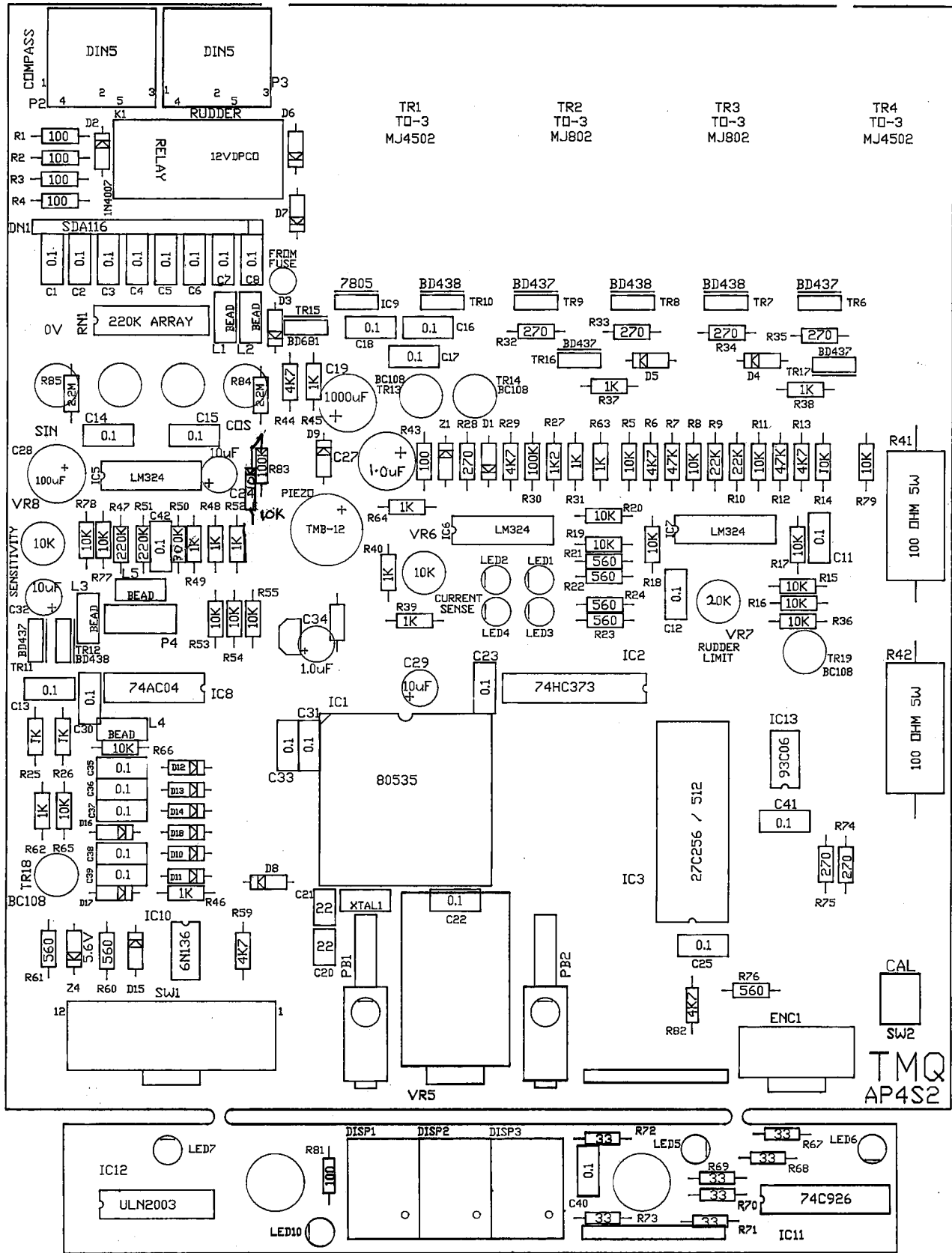
RUDDER

COMPASS

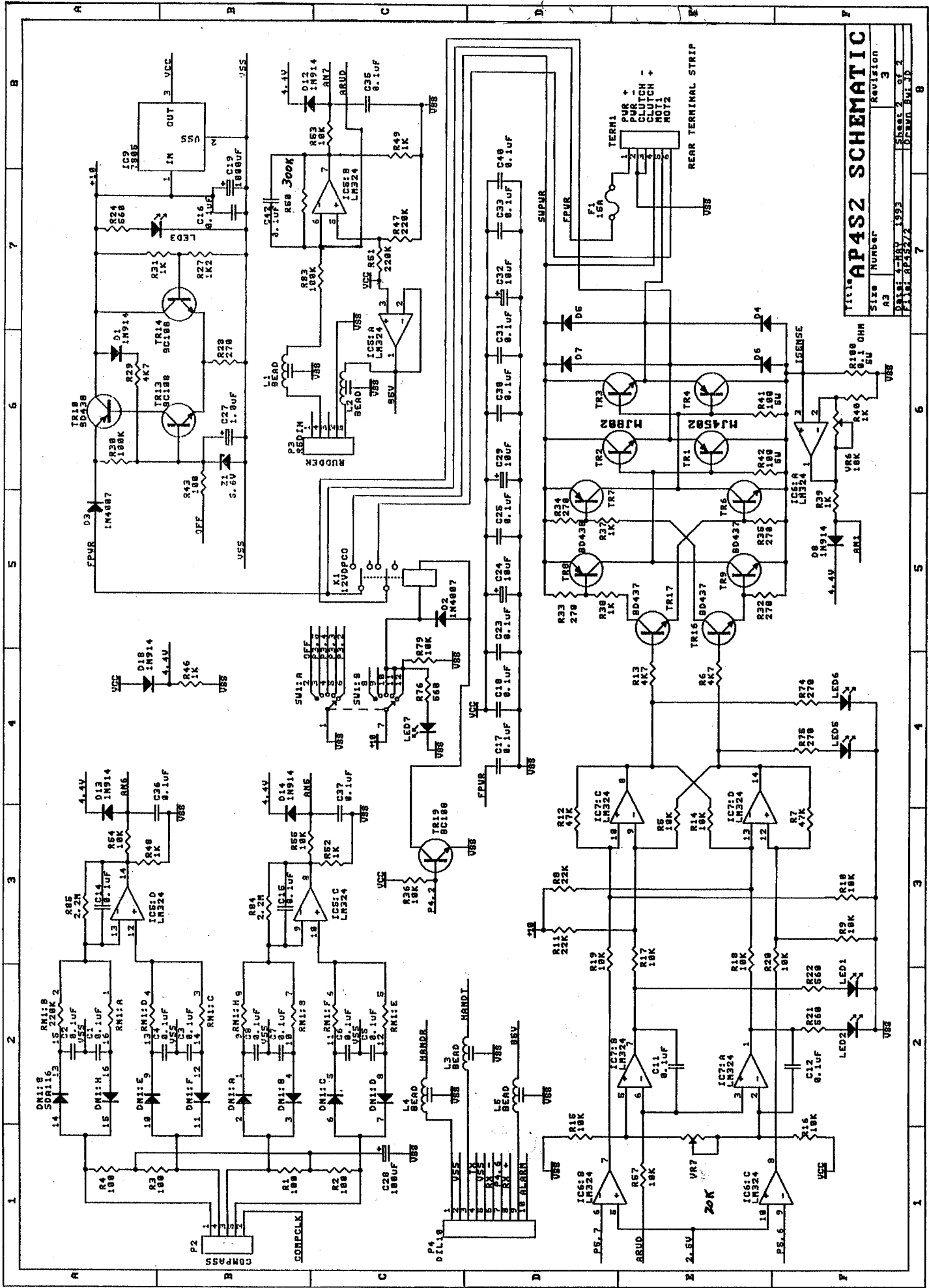
S. No. _____



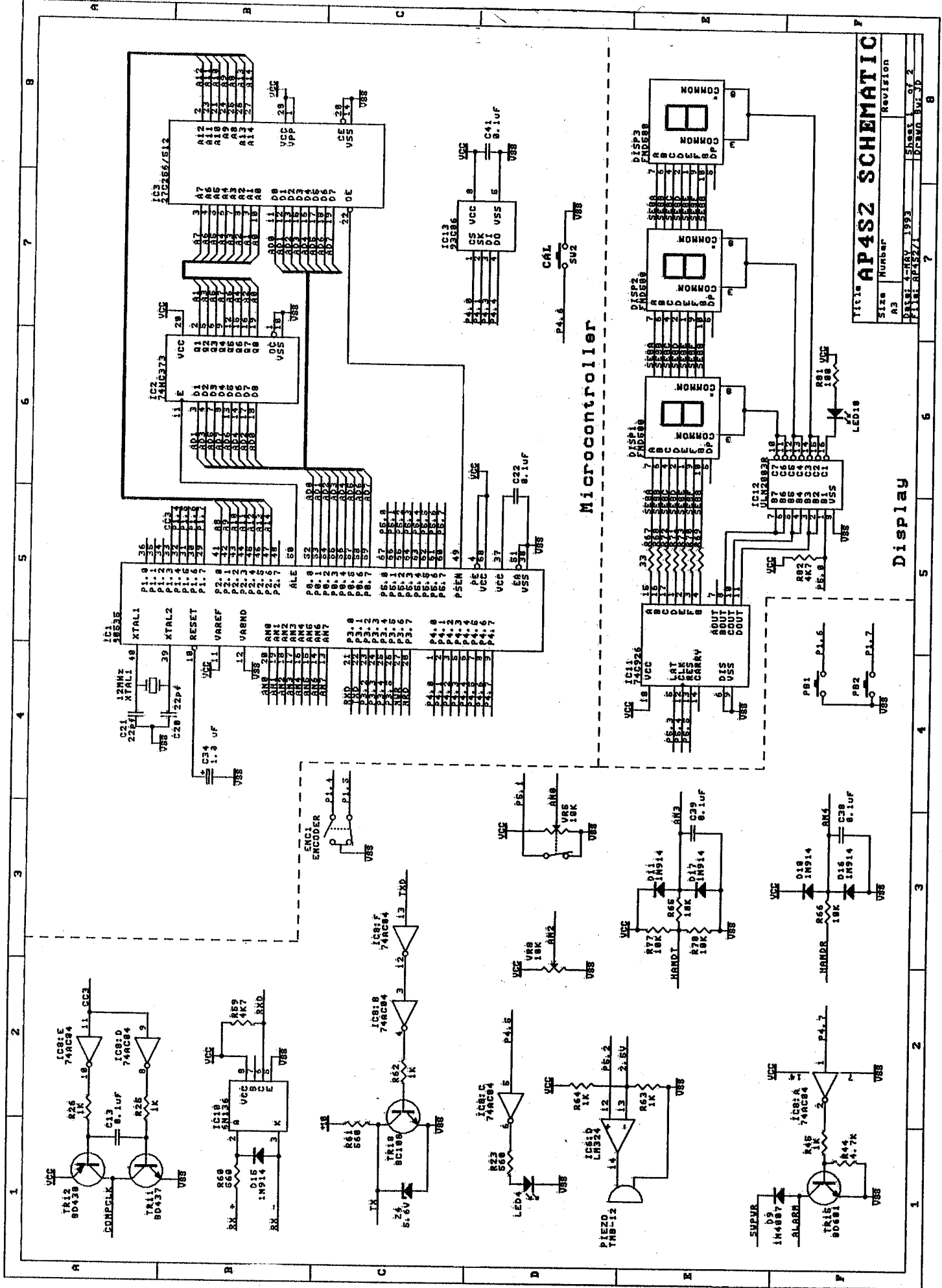
AP4S2 Top Overlay



AP4S2 Top Overlay



TITLE: AP4S2 SCHEMATIC
 SIZE NUMBER
 REVISION
 1
 2
 3
 DATE: 4-REV 1993
 DRAWN: BJI:JD



Title		AP4S2 SCHEMATIC	
Size	Number	Revision	
A3			
DATE	1-18-80	DESIGN	BY 2
FILE	AP4S2	PERSON	BY 2

Microcontroller

Display