



# TMQ - AP9S 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 TRANSMITTER INTERFERENCE MAY AFFECT VESSEL COURSE SUFFICIENTLY TO ENDANGER YOUR OWN OR OTHER VESSELS.**

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## *Introduction*

The **AP9S** autopilot is a hybrid of digital and analogue technology to give the best of both worlds - excellent steering characteristics with digital compass display, keypad course input, GPS and gyro interfaces, and much more, in a solid metal case.

An AP9S system comprises:

- Autopilot Unit
- Compass
- Rudder Feedback
- Up to two Hand Remote/Panel Remote/Steering Lever/Wheel units
- The facility for remote display heads or active hand remote.

The AP9S Autopilot controls the vessel steering through solenoid valves or relays.

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 via the cable supplied.

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 via the cable supplied.

Provision has been made for: **hand remote**, **panel remote**, **steering lever** or **steering wheel** stations. 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.

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## *System Overview*

The following is a brief list of the capabilities of the **AP9S** autopilot. Each is described in more detail in a separate chapter.

Note: Power to the **AP9S** is supplied via the **Weather** control. Turn the knob control in a clockwise direction to apply power to the AP9S; this will initially put the unit into **Standby** mode.

If the option of Electric steering is enabled, this mode may not be available and the unit will go direct to power steer on turn on.

- **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, entering a course from the keypad, or recalling a stored course with the PRESET button.
- **Power Steer**  
The rudder angle may be controlled by the course knob on the main panel or from one of the remote steering stations.
- **GPS Mode**  
When receiving information from a GPS unit, the autopilot can steer a vessel along a preset track to a latitude and longitude.

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- **Stopwatch Timer Mode**

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**

Two of these may normally be fitted (eg on each side of the bridge), allowing adjustment of the autopilot course, or direct control of the rudder (**power steering**).

- **Rudder Ratio, Weather and Counter Rudder**

These controls customise the **AP9S** 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 "locked" on to provide a warning alarm at any fixed interval and an output for a loud external alarm if alarm not reset within 1 minute of beginning to sound.

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## *Modes of Operation*

### Standby Mode

Turn **Weather** control knob clockwise to switch AP9S on to **Standby** mode.

In this mode

- The Main and Standby lights are on
- No steering control output is generated
- The commercial watch alarm is turned off (if enabled)
- The digital display shows the vessels current magnetic course

Possible alarms

- Stopwatch timer alarm

If the option of Electric steering is enabled, this mode may not be available and the unit will go direct to power steer on turn on.

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## Auto Mode



### **Engaging Auto steering mode**

When in **Standby Mode** and the "AUTO" key is pressed, a beep will sound and the adjacent yellow light will be turned on. The autopilot will lock on to the current heading.

### **Disengaging the Autopilot**

Press the **Standby** button. A beep will sound and the vessel will return to manual steering (**Standby Mode**). The AUTO light will be turned off and STANDBY light turned on.

### **Course Adjustment**

Pressing the Port (red) or Stbd (green) arrow keys will cause a one degree course change in that direction. The display will change to indicate the new **course-to-steer**.

Rotating the course-change knob will change the course-to-steer by one degree for each "click".

Entering a course from the keypad, and pressing GOTO will change the course-to-steer to the heading entered.

### **Rate of Turn Control**

The rate-of-turn control on the front panel sets the maximum number of degrees per second that the vessel will turn through. This rate-of-turn control applies in AUTO and GPS modes ONLY. See the separate section on **Rate-of-Turn** for more information.

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## Power Steering Mode



### **Engaging Power Steering Mode**

Press the **Power** button. A beep will sound and the adjacent light will come on. The rudder will move to the centre 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 the internal and external rudder limit settings.

For information on power-steering with a remote unit (eg: **Electric Wheel** or **Steering Levers**), Refer to the diagrams detailing remote unit connections.

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## 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**

When in any mode, press the "GPS" key. A beep will sound and the adjacent yellow light will be turned on.

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. Rate of turn can be altered by setting **Rate of Turn** knob to required position (refer to Rate of Turn).

If no GPS data is being received by the AP9S, 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 "Auto" key will set the AP9S to **Auto Mode**.
- Pressing the "Standby" key will return the pilot to **Standby**.

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## 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 that are connected to the **GPS In** terminal connections inside the AP9S. The data generated must include **at least one** of the following:

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

If only the **XTE** data sentence is available, the pilot can steer in a restricted manner. 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 AP9S 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.

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**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, and the GPS light will blink. This could be caused by:

- Incorrect wiring of the GPS to the AP9S.
- 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 AP9S 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 factor.
- Ensure that the AP9S compass is correctly aligned and installed.

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## Stopwatch Timer Mode

The AP9S has two timer systems. One, an adjustable timer operates in all modes.

The second timer is the commercial watch alarm operates in any auto modes i.e. Auto, GPS or Auto Remote, and is disabled when the autopilot is set to **Standby or Power steer**.

To set the timer, enter a value between 1 and 60 at the keypad, and press the timer key. That value will be stored into the timer, and it will begin counting down to zero. The timer light will be on, to indicate that the timer is running. When the timer expires, an internal alarm will sound and the timer light will flash. If the timer is not reset within one minute, the external alarm (if fitted) will sound.

If the timer button is pressed with no number entered on the keypad, and no timer alarm sounding, the timer delay will be displayed, and the timer will commence counting down.

While the alarm is sounding, pressing the timer button will cause the timer alarm to cancel, and the timer to begin counting down again. The time delay set will NOT be displayed.

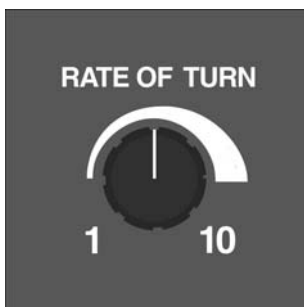
Selecting a stopwatch time of zero will disable this feature.

If the **Commercial watch alarm** feature is enabled, the timer alarm delay in all modes **except** standby is fixed.

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## *Controls*

### Rate-of-Turn Control



This knob sets the rate-of-turn for the vessel, to prevent very sharp turns when changing course.

Fully anticlockwise will turn 1 degree/sec (i.e. 180 degrees in 3 minutes). Fully clockwise will turn 10 degrees per second (i.e. as fast as possible for most vessels).

The slower settings may be used for turns while trawling, trolling, etc., and the Mid-range settings used to prevent dangerous or uncomfortably sharp turns.

Note that the turn rate of a vessel will also depend upon the rudder ratio setting, and perhaps the rudder limits.

If a course change is entered, and then it is realised that the rate-of-turn control is set too low (i.e. the turn is too slow) just alter the rate-of-turn control clockwise until the correct speed is found.

Once a turn is begun, adjusting the rate-of-turn control downward (anti-clockwise) will have no effect. i.e., the turn rate can be **INCREASED** during a turn, but not **DECREASED**.

**The rate-of-turn control applies only in AUTO and GPS modes.**

Rate of turn is also controlled by the rudder limit and rudder ratio controls.

A course-change entered from one of the remote steering stations is not controlled by the rate-of-turn knob.

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## Weather



The main power switch is incorporated in this variable control. When in the OFF position no power is applied to AP9S. By turning this in a clockwise direction from the OFF position, the switch applies power to the AP9S.

This setting is used for adjusting the autopilot's response to varying sea conditions, and varying vessel capabilities. The weather value sets the desired accuracy of the vessel steering. A high weather setting will cause the vessel to steer very accurately but may cause excessive use of the steering.

In good weather, set this control to a high value, but ensure that the drive lights do not flicker continuously. This will give the straightest possible course.

In poor weather, reduce this setting to prevent over-working the steering.

Rotating this control fully anti-clockwise will turn off power to the AP9S autopilot.

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## Counter-Rudder



In some vessels, changing course requires a large amount of rudder to be applied initially, and then a smaller amount of rudder in the REVERSE direction to stop the vessel from swinging beyond its desired course. This is called **counter-rudder**.

The AP9S autopilot has this feature built-in. A **counter-rudder** setting of "1" gives no counter-rudder steering, suitable for light and manoeuvrable vessels. If you find your ship over-steering when under autopilot control, increase the counter-rudder setting by a couple of steps, and see if the next course change behaves better.

Once the correct setting is found for your vessel, it should not need to be changed.

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## Trim



When the AP9S is first switched on and in **Standby** mode, the **Trim** knob should initially be set in **mid** position, which corresponds to a setting of **5**.

There are circumstances in which the autopilot may set the rudder in the centre (according to its feedback unit), but the vessel does not steer straight ahead. Reasons for

this are:

1. The rudder feedback unit may not be perfectly aligned.
2. There may be a side-wind, current, net drag, etc., which causes the vessel to steer to one side.

To find the correct **trim** setting:

With the vessel travelling ahead, switch the autopilot to **power steer** mode. Adjust the **trim** control until the ship steers straight.

The trim control is **not** intended to be used for adjusting the vessel course in auto or power steer mode.

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## Rudder Limit



There are physical limitations to the angle that the rudder can move through. If the autopilot attempts to drive the rudder past these limits, damage to the steering gear or autopilot drive system may occur.

Internal settings are made to ensure that the AP9S will not drive the rudder past the set limits.

An external control on the front panel of the AP9S can then be used to limit the amount of rudder travel to an even narrower range. This can be used to limit the rate of turn of the vessel. Under normal operation the external **rudder limit** control is set at maximum.

See the Adjustments chapter of the Installation section of this manual.

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## Rudder (Rudder Ratio) Control



This setting 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 may be required.

In general, an agile vessel with a relatively large rudder or very small keel will require a small rudder setting. A large, slow vessel may require a high value for the rudder ratio.

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

- A value of "1" signifies the minimum amount of applied rudder (for sensitive steering, large rudders or low gearing ratio.)
- A value of "10" signifies the maximum amount of applied rudder (for vessels with slow steering, small rudders or high gear ratio).

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

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

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## *Installation and Configuration*

### Installation Requirements

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. e.g. 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.

### Position

The **AP9S** main panel should be mounted in an accessible position, protected from rain or salt water.

### 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 away 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 power source for the autopilot should be fused separately from other equipment. Maintain conventional colour coding and, if necessary, mark the cables for ease of identification.

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## 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 and the routing of cables should be considered when wiring the vessel.

## 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.

## Compass Installation

There are two types of compass suitable for this autopilot - a **magnetic sensor unit** (fluxgate)(COMMAG), which is a complete compass, and the **compass-top sensor** (CTS), which is used together with a standard flat-topped 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 double-sided tape. Before fixing the sensor in place, align it carefully so that the **AP9S** compass displays the same bearing as the ships compass. The compass top

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sensor is preferred for steel hull vessels provided a suitably compensated compass is fitted to the vessel.

### Installing a Magnetic Sensor Unit (Fluxgate)(COMMAG)

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

The position of this compass is the most important item in the installation of the autopilot. Good course holding depends 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.

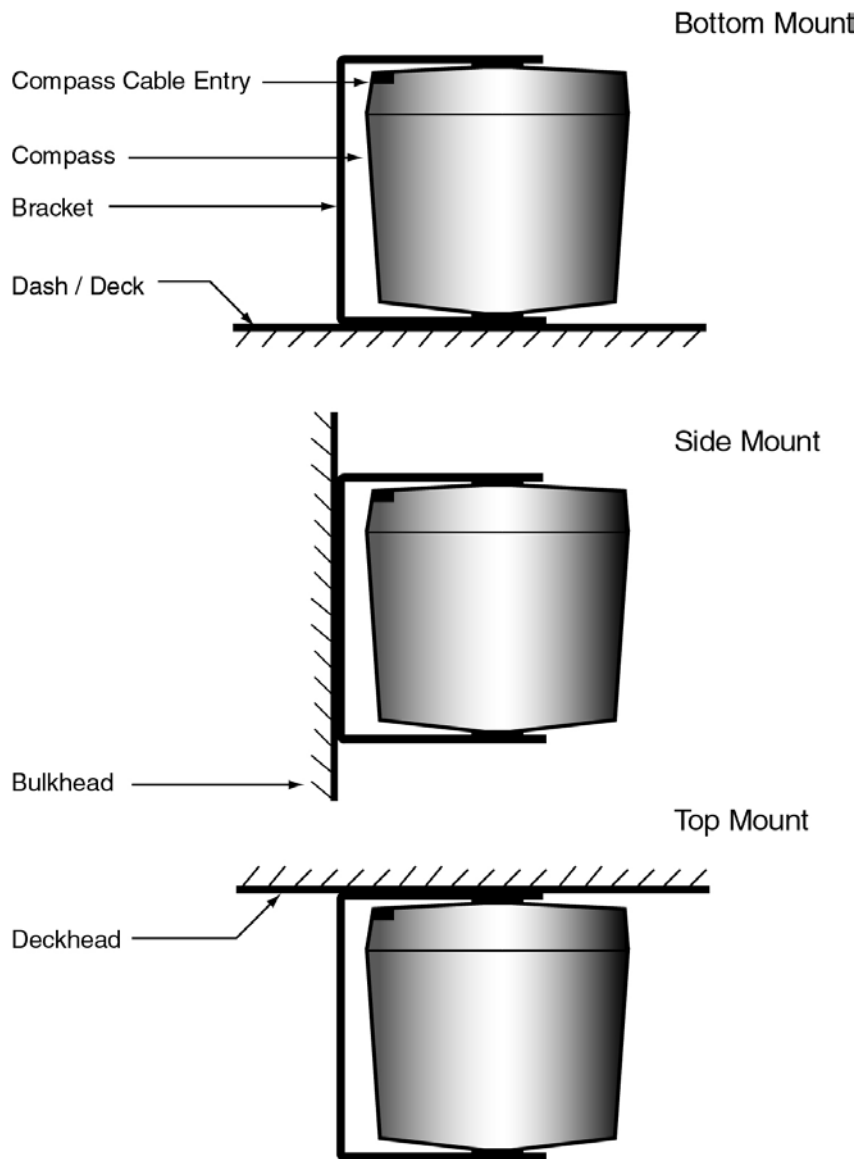
The compass need not be mounted in a weatherproof position. The compass can be mounted on top of a flat surface, on a bulkhead or from the deck head. Check other side of bulkhead for materials, which may cause magnetic interference.

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. See also the diagram "Fluxgate Compass Mounting Options".

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## Fluxgate Compass Mounting Options



### Wiring

The 5-wires & shield of the compass cable must be connected to the correct terminal strip inside the AP9S labelled T4 Compass. The colour code is marked next to the terminal strip. Ensure good contact is made between cable conductors and terminal strip connectors. If the compass cable is required to be longer, contact TMQ for a Compass Extension Cable.

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## **Calibration**

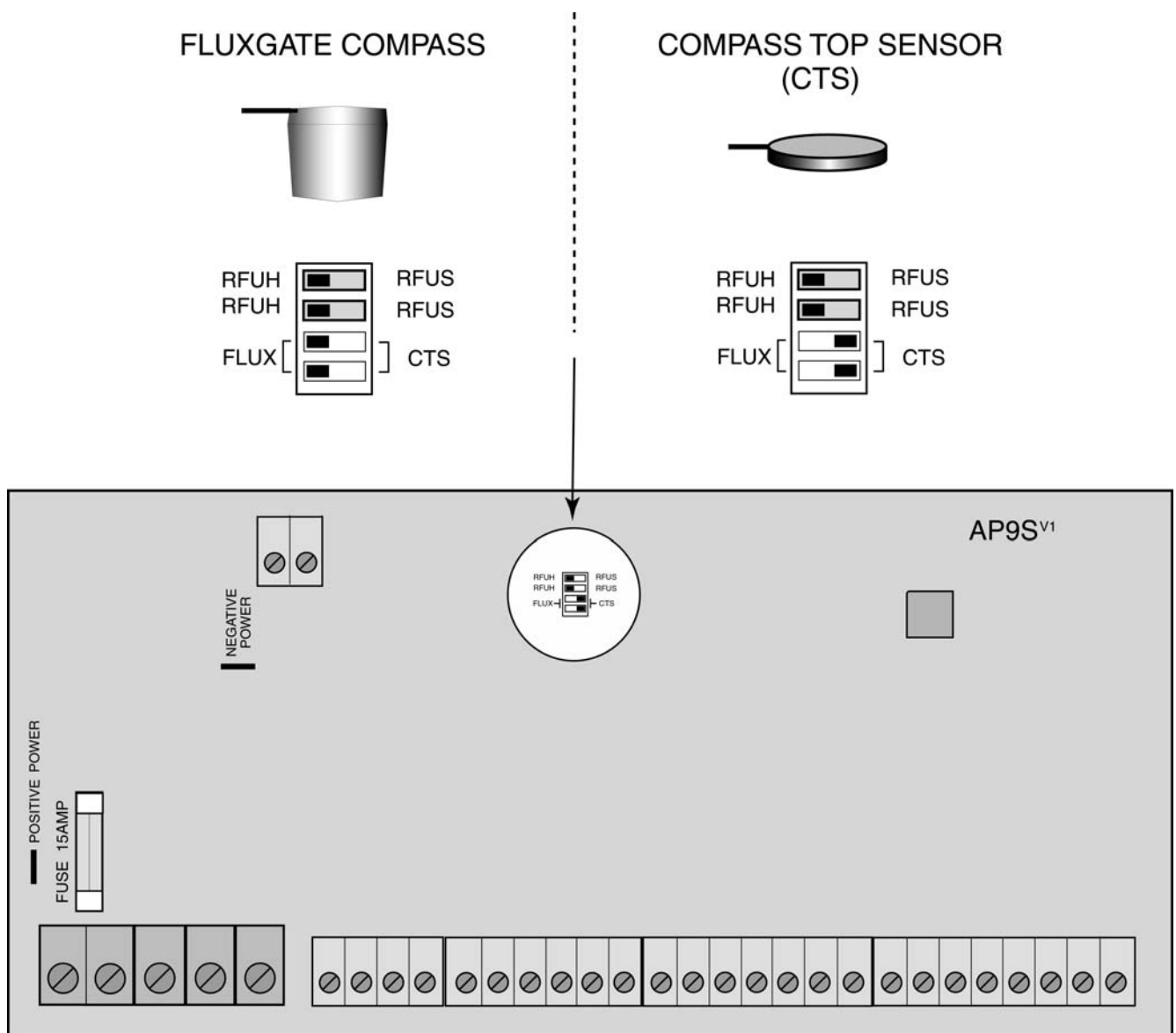
The compass unit will need to be rotated in its bracket for the correct heading to be displayed, lock the compass in position using the ‘Locking Screw’ on the top of the Bracket. The compass is calibrated before leaving the factory and will be accurate enough for sea trials. After initial sea trials, you **may** wish to recalibrate the **AP9S** 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) and compass top sensor can be interchanged. However, the compass detector switches identified as component SW1 on the PCB must be switched to correct position. (Note: Rear cover must be temporarily removed to access the switches).

For magnetic sensor unit (COMMAG/ Fluxgate) **switch to FLUX**

For compass top sensor (CTS) **switch to CTS**



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## Rudder Feedback

### Position

Install rudder feedbacks as shown in the diagram "Heavy Duty Rudder Feedback Installation Diagram". 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 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.

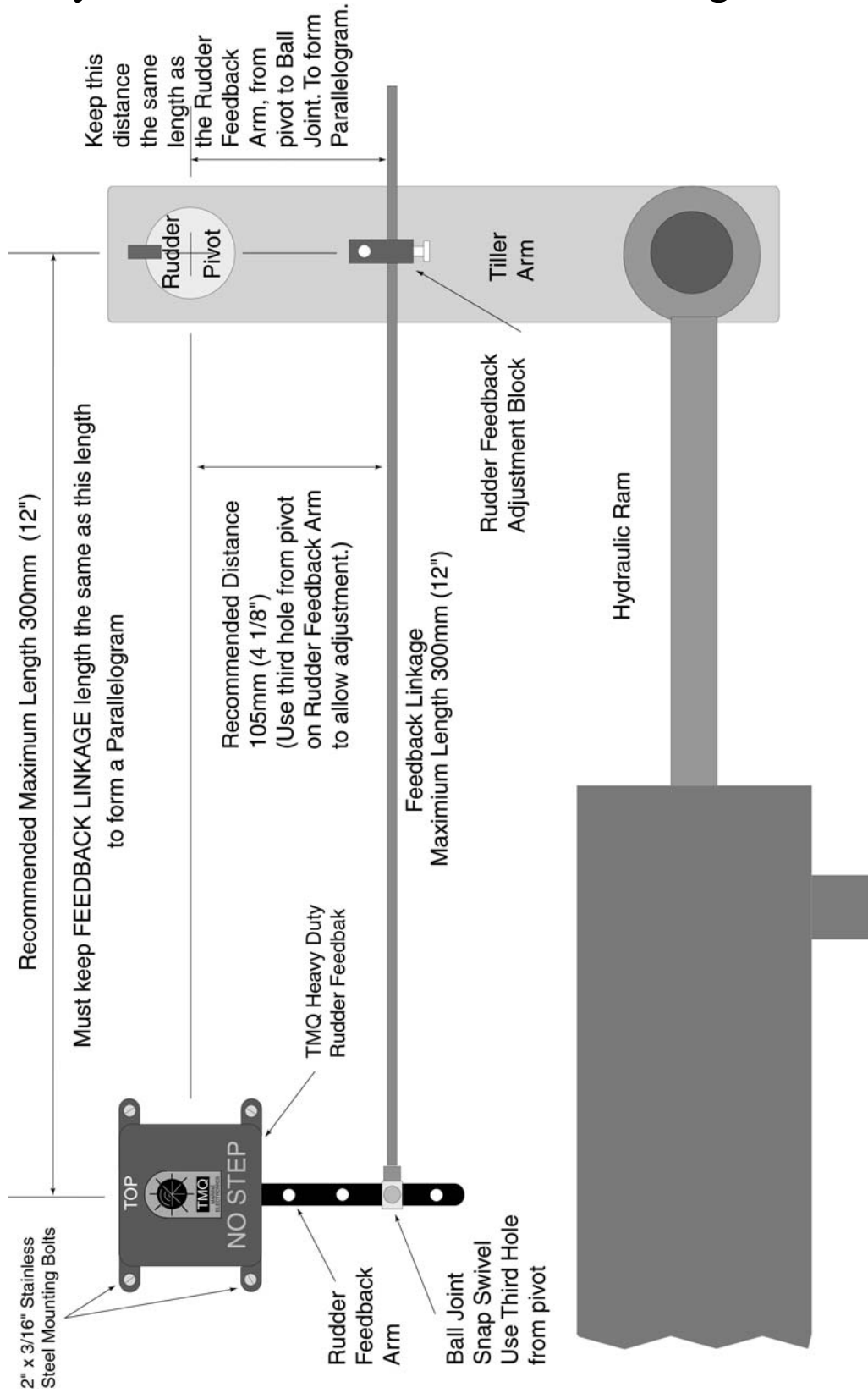
### Electrical connection

**Terminal T3 RFU is marked 5V, RFU1, RFU2 and Negative.  
Connect as follows.**

Terminal 5V:	+ 5 volts
Terminal RFU1:	Signal for Rudder Feedback 1
Terminal RFU2:	Signal for Rudder Feedback 2
Terminal Neg:	Negative

RFUH DIP switch (SW1) should be set to RFUH.

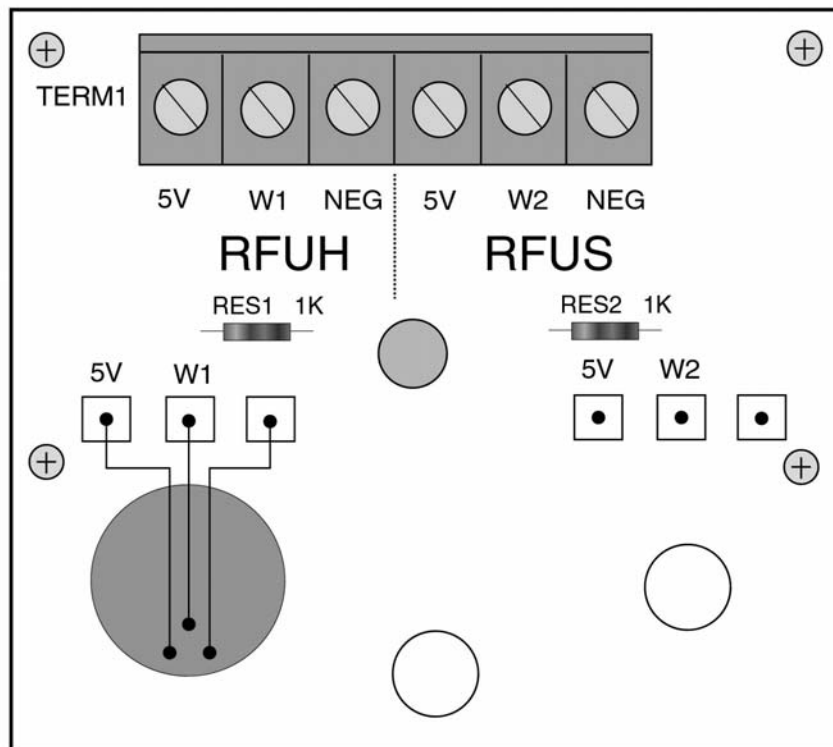
# Heavy Duty Rudder Feedback Installation Diagram



# Heavy Duty Rudder Feedback Connection Details

## Heavy Duty Rudder Feedback Wiring

Connect to the RFUH terminals.



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**After installation of the feedback unit is complete and the linkage is fitted, have the steering of the vessel turned lock to lock and ensure:**

- No undue mechanical strain is placed on the rudder feedback or linkage.

**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. A COMPETENT TECHNICIAN MUST DO THIS.**

### **Rudder Feedback Mounting**

In certain cases the mounting bolts supplied with the heavy duty rudder feedback may not be suitable for the installation. The four heavy duty rudder feedback pillars may be tapped, either ½” or 6mm.

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## Remote Units

### Hand Remote, Panel Remote and Steering Lever (with switch).

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

The cable leading from the unit should be connected to the **Remote** terminal strip in the **AP9S**, as shown by the drawings in the “Connection / Wiring Diagrams” section.

### Remotes Terminal Strip Connections (T5)

Neg	Negative	Blue Wire
5v	5 Volts	Red Wire
Select 2	Remote 2	Logic Signal PWR/STBY/AUTO
Wiper 2	Remote 2	Trim Signal or Wheel Input
Select 1	Remote 1	Logic Signal PWR/STBY/AUTO
Wiper 1	Remote 1	Trim Signal or Wheel Input

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## *Drive Installation*

### Hydraulic Drive

Follow any instructions of the Hydraulic Steering supplier.

The AP9S autopilot can drive spool valves or relays.

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 3 Litre 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 20 Litre per minute.

### Position

All pump units should be installed in accordance with the manufacturers recommendations and instructions.

### Precautions

All air must be purged from the steering system before commencing sea trials with the autopilot. 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.**

**Spike suppression diodes should be fitted to solenoid valves to prevent interference with the autopilot or other electronic.**

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## *NMEA Input Connections*

### Data In

For GPS navigation, connect the GPS unit **data output** and **data return** wires to terminals marked IN- and IN2+ of the NMEA Data terminal T6. The connections to be used are marked IN- (Negative), IN2+ (Signal). See also the diagrams labelled "Remote Mode 1".

### Data In Connection - NOTE: Examples only

- For any GPS unit which has a BNC type output plug (a bayonet plug, taking a coaxial cable with core and shield), connect the core to IN2 + and the shield to IN -.
- For a GPS unit with loose wires connect the positive to the IN2 + and negative to IN -

Refer to diagram for terminal location.

### 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 **AP9S** autopilot looks for **NMEA 0183** format data containing **APA** or **APB** or both **XTE** and **BOD** information. For more information, see the Operations section of this manual and consult your **GPS unit** manual.

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## Heading Data Input

Heading Data Input is on DATA 1 IN- (Negative) and IN1+ (Positive) of the NMEA Data Terminal T6. This connection should be used for equipment such as an input from a Gyro or GPS Compass.

## Heading Data Output

Heading Data Output is on DATA OUT 1 (Positive) and NEGATIVE (Negative) of the NMEA Data Terminal T6.

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## *External Alarm*

An external buzzer may be connected to the internal 2-way terminal strip (T2), terminals **10 V and AL** (EXT AL).

The AL output will be 10 volts when the alarm is not sounding (with alarm connected), and approximately 0 volts when active. TMQ recommends a 12-volt peizo buzzer with maximum current draw not exceeding 250 milliamps be connected to this output.

If a larger type siren or alarm unit, which draws in excess of 250 milliamps is used, this must be connected via a relay. The AP9S external alarm circuit is used to energise the relay coil and power to the siren or alarm unit is connected via the relay contacts.

The external alarm output is activated if the stopwatch timer or commercial alarm has been sounding for longer than one minute.

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## *Compass Calibration*

The compass supplied with your AP9S 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 AP9S compass displays a **constant offset** (eg the autopilot compass reads 3 degrees high **on all bearings**), simply rotate the AP9S compass case to align bearings with the ships compass, **it is not necessary** to re-calibrate the compass as described below.

If the AP9S 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. Select **STANDBY**.
2. Enter "901" by using keypad, then hold down **GOTO**, press **STANDBY**, then release both buttons together. 'CAL' and the current heading will be alternately displayed.
3. Turn vessel slowly through two complete circles in same direction.
4. When the circles are complete, enter "902" by using the keypad, then hold down **GOTO**, press **STANDBY**, then release both buttons together.

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This completes the compass calibration. Check alignment of the AP9S compass by steering vessel due North (000 on ships compass) and, if necessary, rotate outer case of the AP9S compass in its bracket until the heading display reads 000.

Note: The effectiveness of the calibration is dependent upon all 3 steps being completed. Should you wish to abort the calibration procedure at any time during the circle turning, do not carry out step 3.

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

If you are unsure of the success of the calibration, you may return to the factory calibration setting by entering "903", hold down **GOTO**, press **STANDBY**, then release both buttons together. 'rES' will be displayed for approximately 1 second.

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## *Rudder Limit Adjustment*

### Internal Rudder Limits (Setting only on RFU1)

If the autopilot attempts to drive the rudder beyond its physical limits, the steering gear and autopilot drive system may be damaged. An internal **rudder limit** adjustment has been set to prevent this occurring. The external **rudder limit** control on the front panel can then be used to restrict the rudder angle range even further, and is intended to be used to prevent sharp turns, rather than protect the autopilot system.

**NOTE: If the rudder feedback unit has been installed correctly, it should not be necessary to adjust the 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.

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

### **Setting Rudder Limit**

**Note: Set the Rudder Limit on the AP9S front panel to maximum, completely clockwise, before the rudder limits are set using the procedure below**

1. Select **Standby** mode
2. Enter **"905"** and press and hold **GOTO** then **Auto, Standby or Power**, only the standby light will be on  
The display will indicate between 0 and 256 this is representative of rudder position where 128 is centre, 256 is fully port and 0 is fully starboard.
3. Set the rudder to the required Port position and press Port Arrow Button
4. Set the rudder to the required Starboard position and press Stbd Arrow Button
5. To store the Data press **"GOTO"**

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## *AP9S Special Modes*

To enter special modes enter number on keypad, press and hold **GOTO** then press **STANDBY**.

To store the data press **GOTO**.

To exit special modes press **MAIN**.

To use preset value press **PRESET**.

### Selection

901 Start compass calibration (CAL displayed)

902 Store compass calibration

903 Return to default compass calibration. (rES displayed)

904 Not Used.

905 Set limit switches (Analogue Volt Dis)  
**PORT ARROW** (for Port) / **STBD ARROW** (for Stbd)

906 Set commercial watch alarm (A-0 if no Watch alarm) Turn encoder to display A-1. Press **GOTO**, set time and press **GOTO**

907 Not Used.

908 Option remote: **(Also refer to the Connection Diagrams)**

### **r-1**     **Remote Mode 1 ( 2 Standard TMQ Remotes)**

- Remote Unit 1 on Input “Wiper 1” with Control Line “Select 1” being held Negative for Auto, Positive for Power Steer.
- Remote Unit 2 on Input “Wiper 2” with Control Line “Select 2” being held Positive for Power Steer.

- 
- Auto Selected on Input “Wiper 2” with Control Line “Select 2” being held Negative if Control Line “Select 1” not used.
  - No voltage on Control Line “Select 1” or Control line “Select 2”, Autopilot returns to Standby.

**r-2     Remote Mode 2 (TMQ Active Remote)**

- Remote Input on Input “Wiper 1” with Control Line “Select 1” being pulsed negative for Auto, Positive for Power Steer.
- GPS Mode selected by Control Line “Select 2” being pulsed Positive.
- Standby Mode selected by pulsing Control Line “Select 2” Negative.

**r-3     Remote 3 (1 hand remote plus External Auto Select, External Power Steer Input ie Steering Lever)**

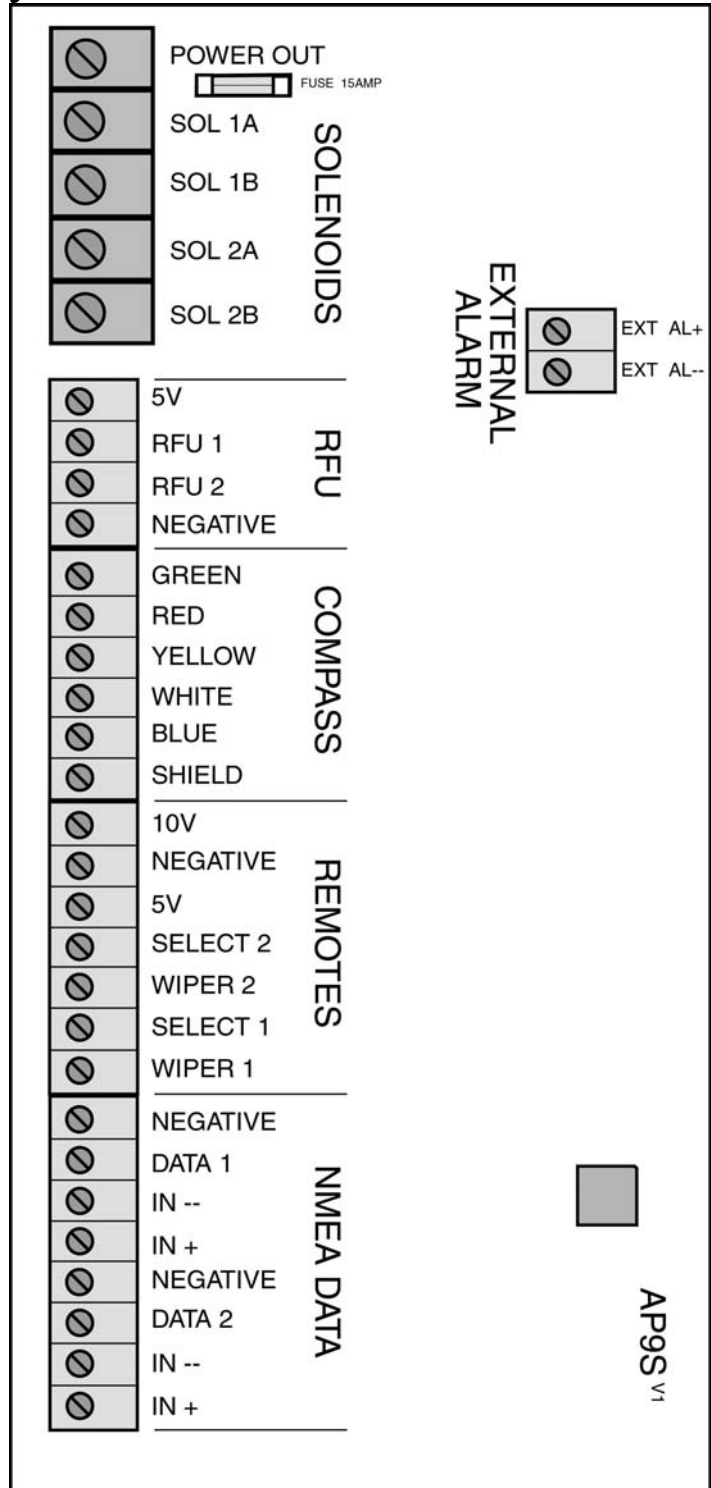
- Remote Input on Control Line “Select 1” and Input “Wiper 1”.
- Control Line “Select 2” pulsed Negative for Auto Selected on Main Encoder.
- Control Line “Select 2” pulsed Positive for Power Steer from steering lever connected to Input “Wiper 2”.

**r-4     Remote 4 (1 hand remote plus External Auto or Power Steer select, control by Encoder.)**

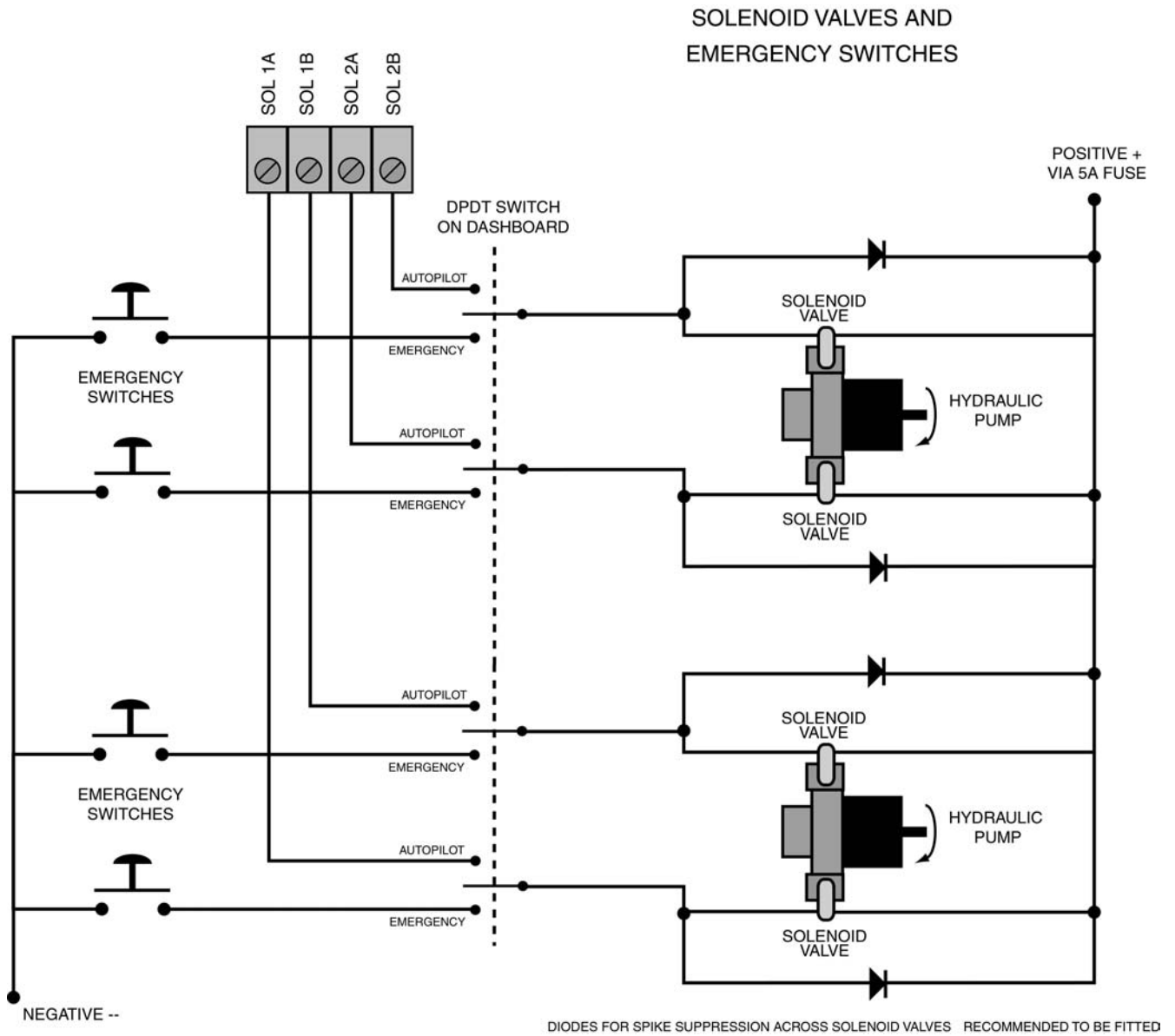
- Remote Input on Control Line “Select 1” and Input “Wiper 1”.
- Control Line “Select 2” pulsed Negative for Auto Selected on Main Encoder.
- Control Line “Select 2” pulsed Positive for Power Steer on Main Encoder.
- Steering lever Input on “Wiper 2” in Standby.

# Connection / Wiring Diagrams

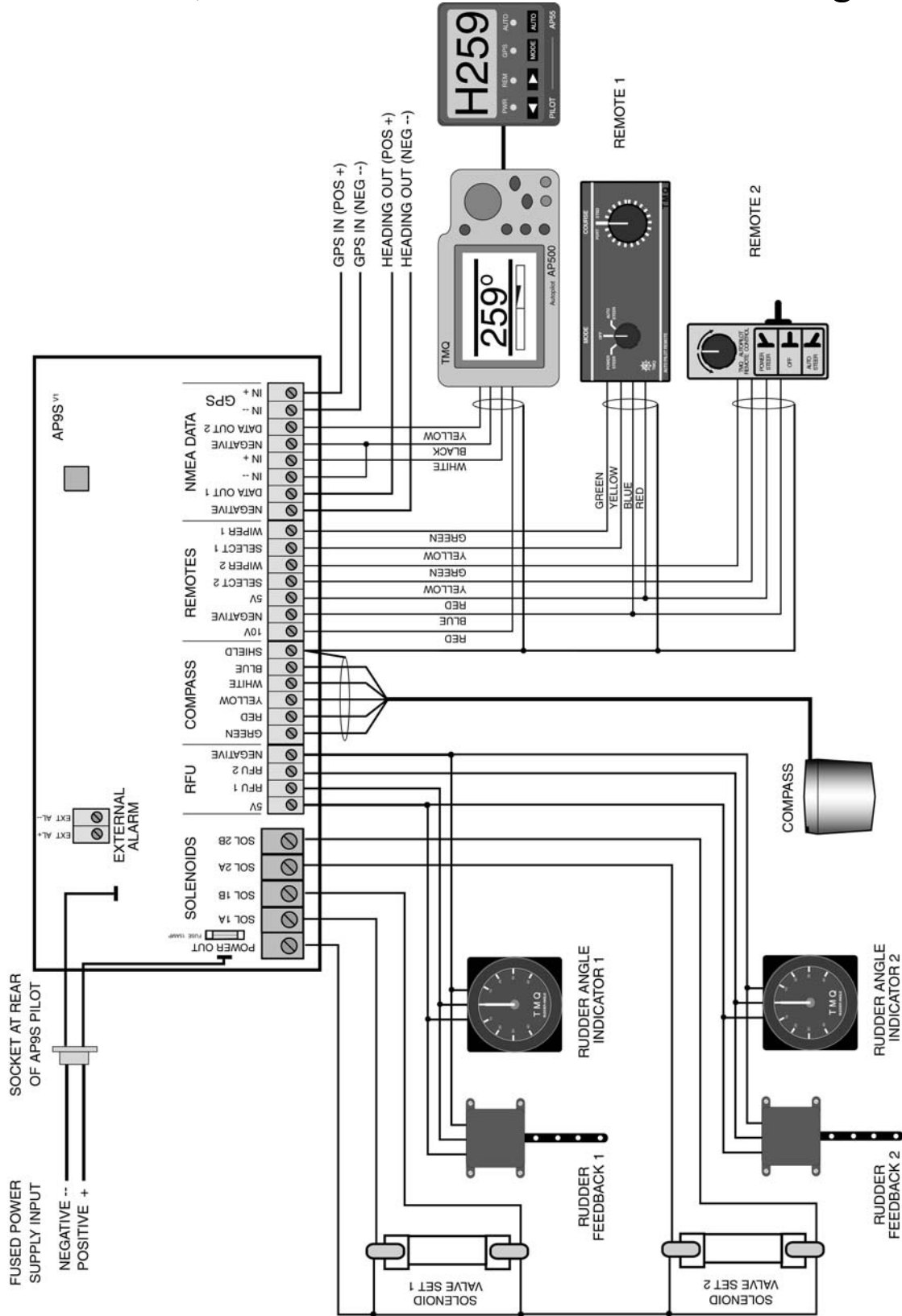
## Connection Layout



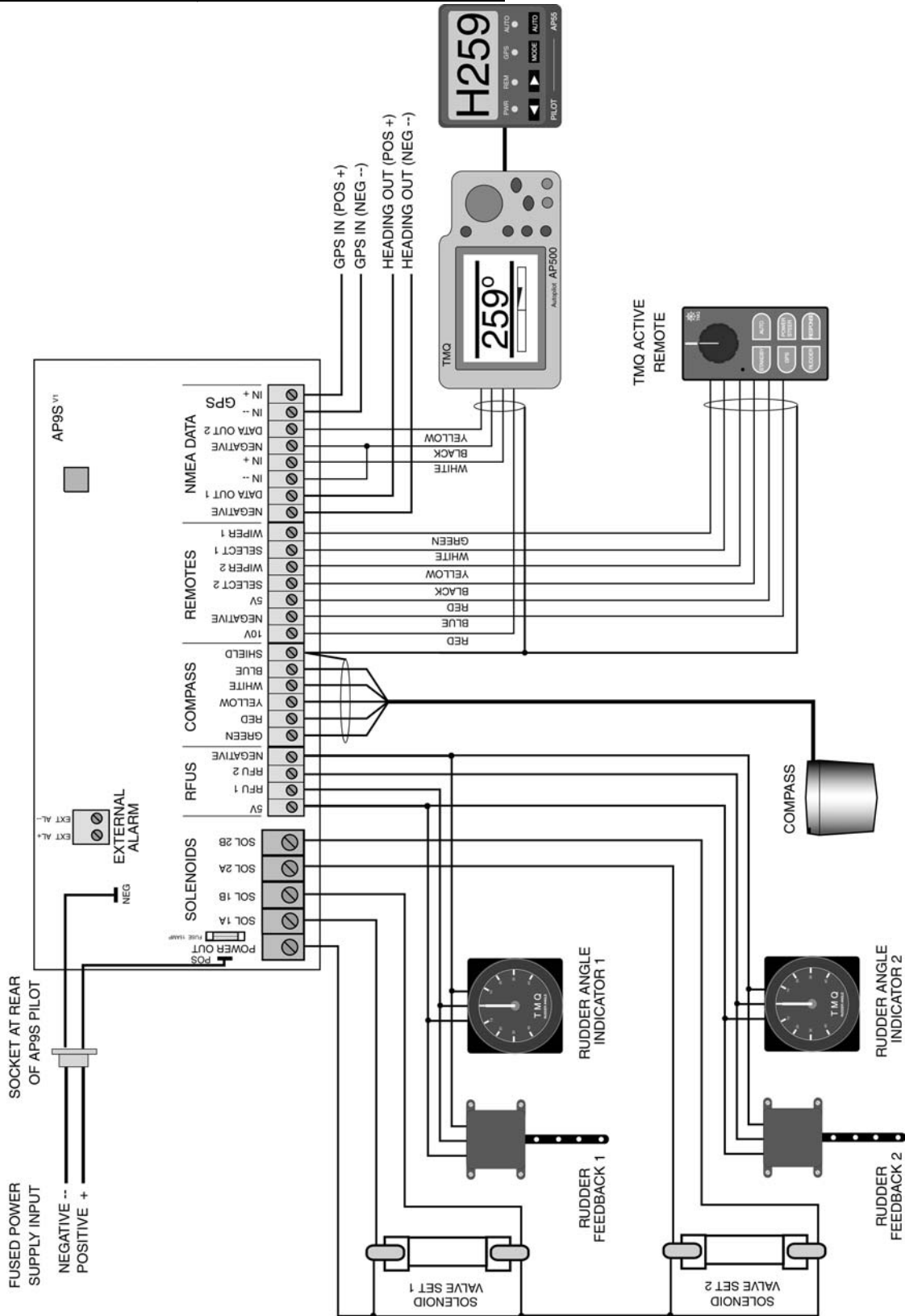
# Emergency Switch Connections



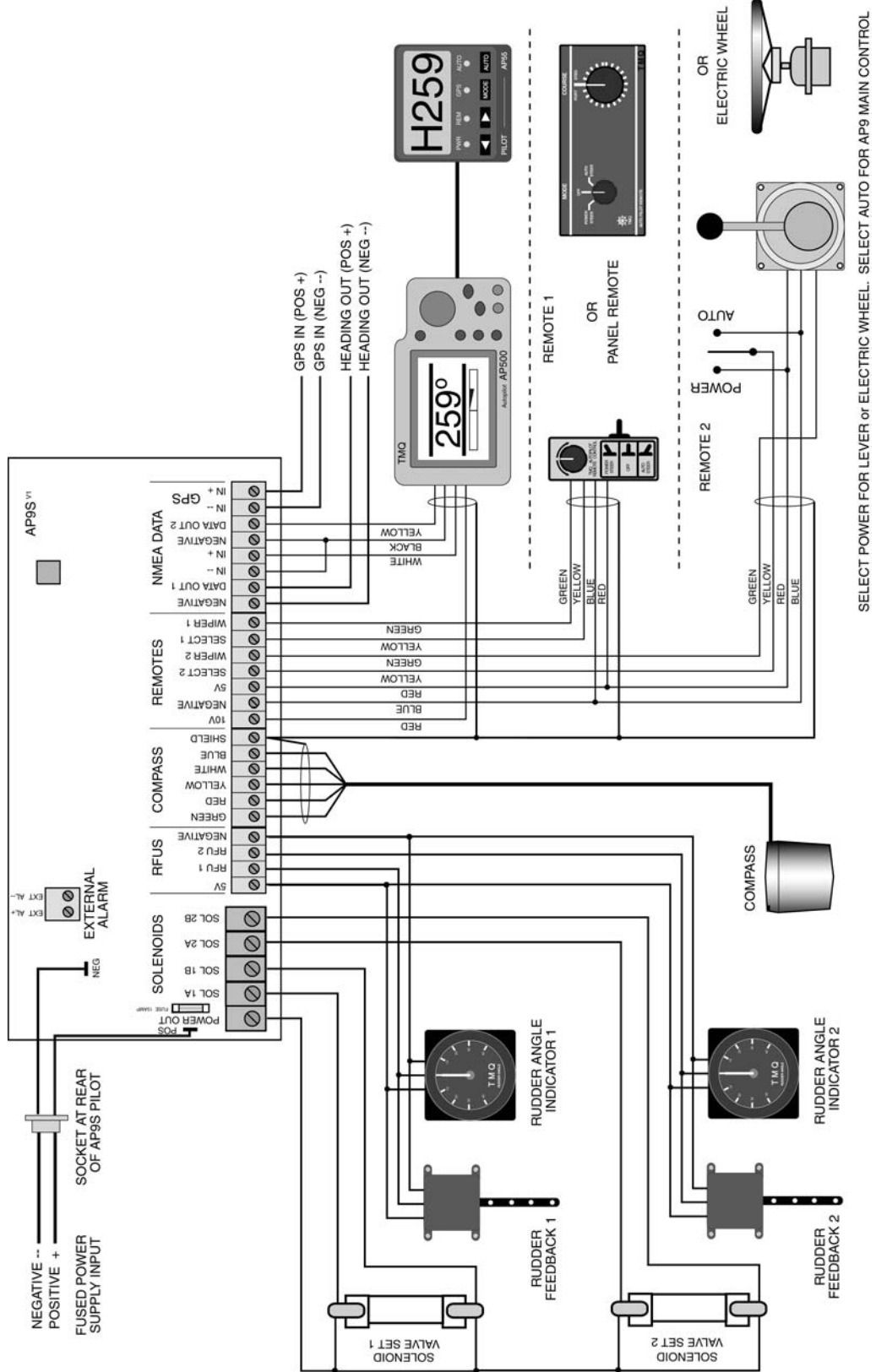
# Remote Mode 1, 2 Std Remotes - Continuous Running Pump



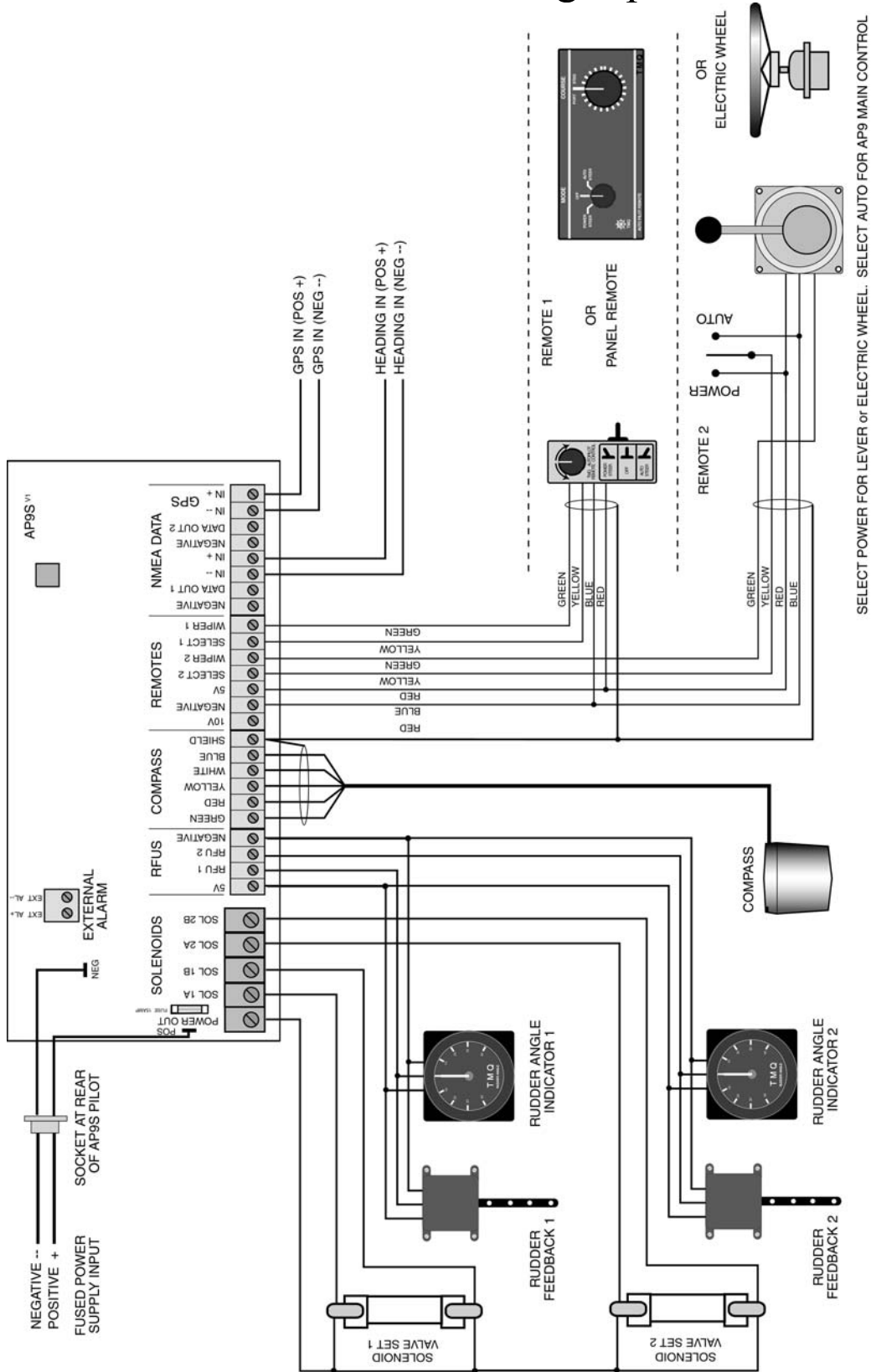
# Remote Mode 2, 1 Active Remote



# Remote Mode 3, 1 Remote and 1 Electric Steering Input



# Remote Mode 3 with External Heading Input



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## ***Optional Extras***

There are a range of optional extras that can be connected to the AP9S system as the need or circumstances require. The AP9S system can be adapted to suit many applications.

Further information can be obtained from the TMQ website at [www.tmq.com.au](http://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

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## Remotes

### Panel Remote



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

### Hand Remote



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

### Active Remote



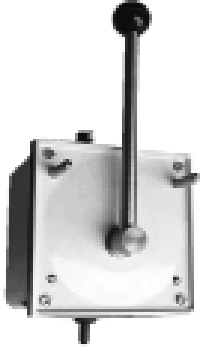
### AP500 Head



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

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## 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.



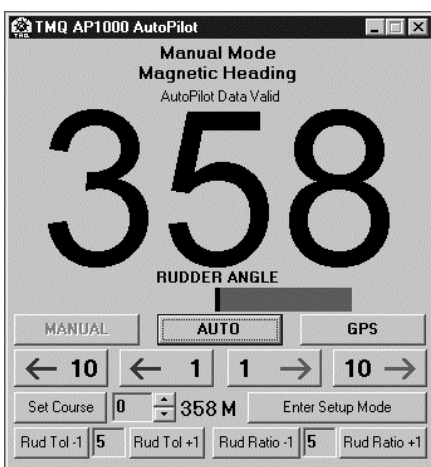
## Hydraulic Drives and Pump Units

### Continuous pumps



Constant running pumps available in varying flow rates for 12 / 24 volt DC systems and 240 / 415 volt AC systems. Accurate flow adjustment to set lock to lock time on some units.

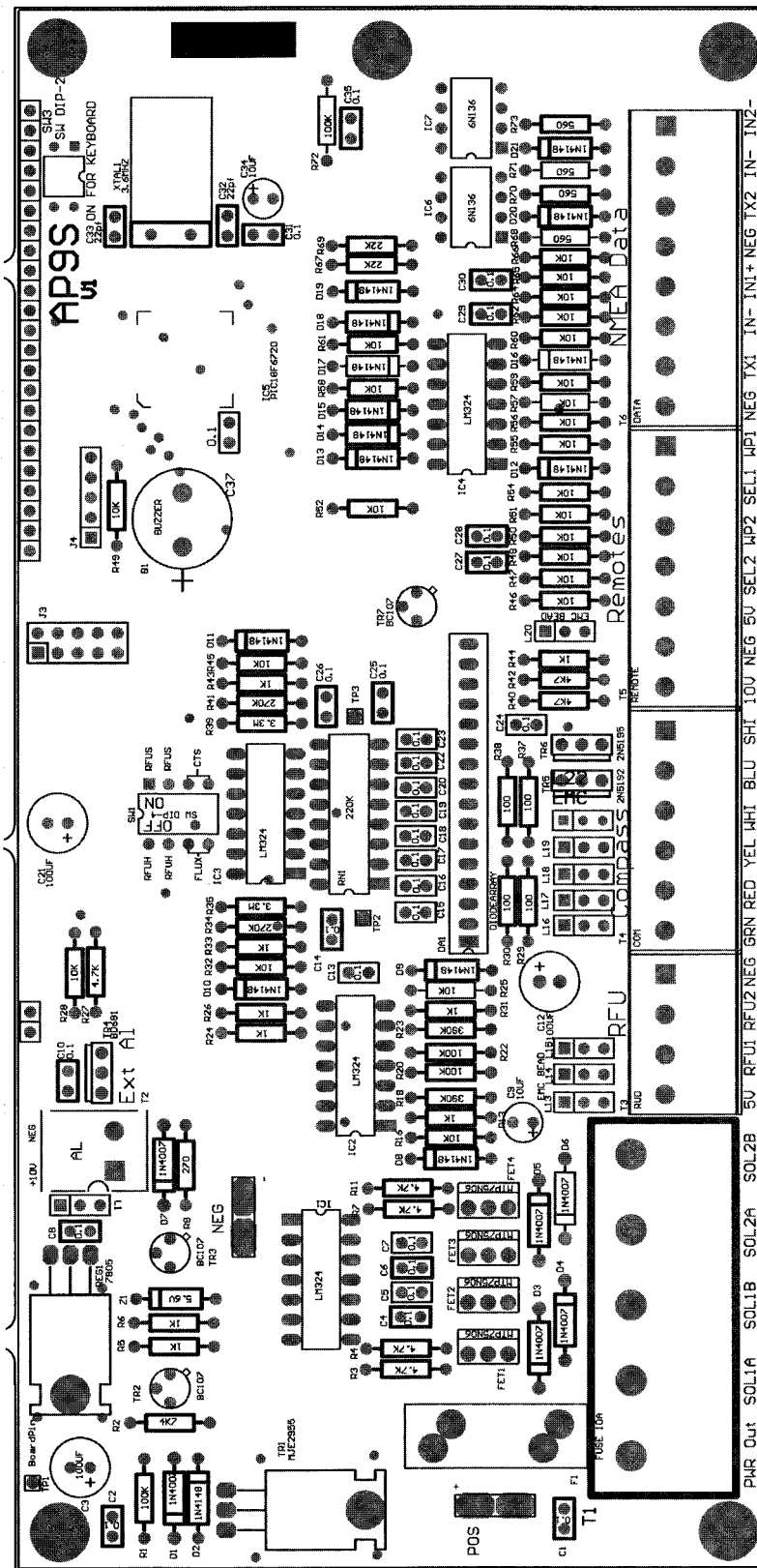
### Computer Software



TMQ AP1000 Autopilot operating Software.

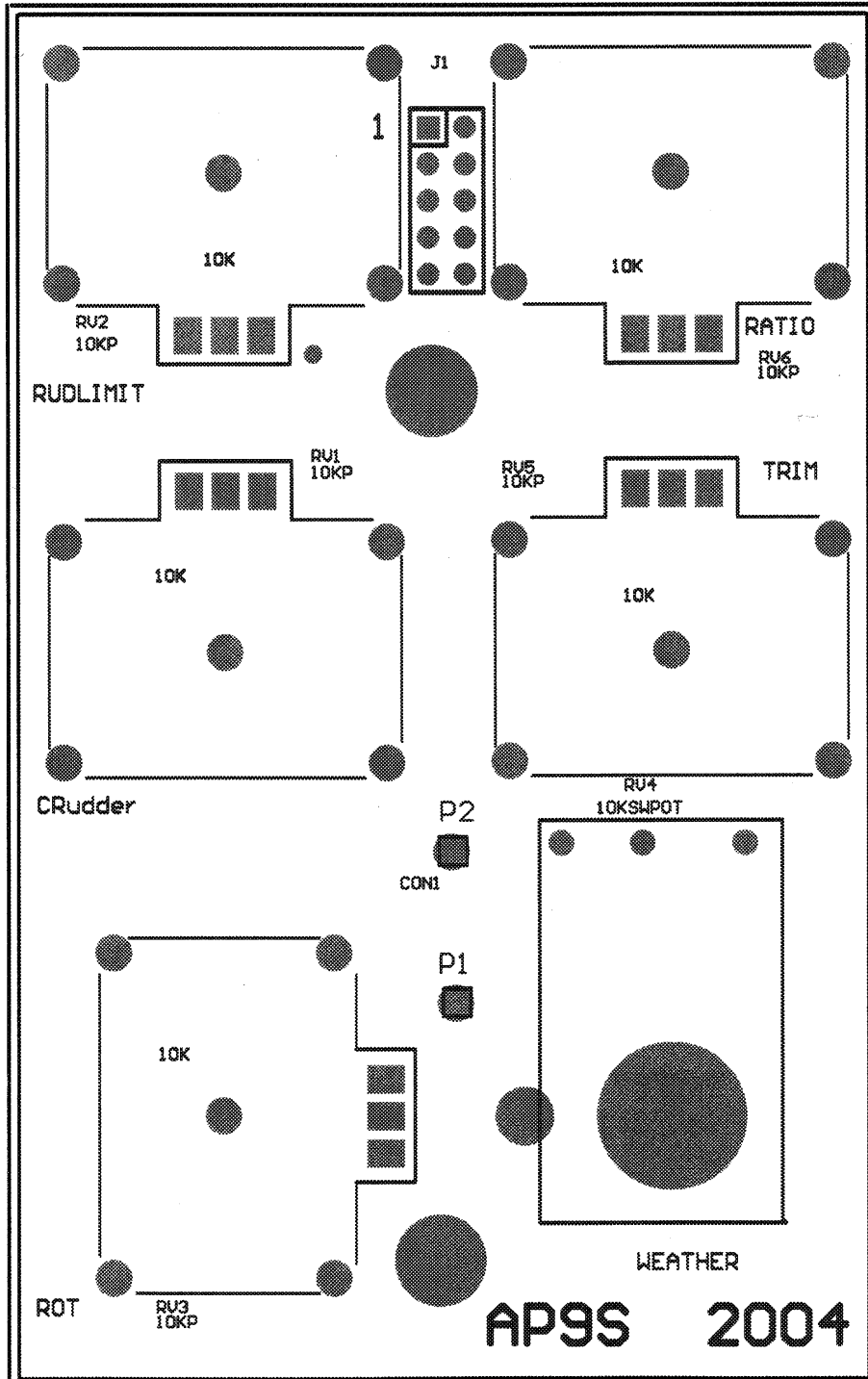
Computer control program enabling autopilot control from a standard PC with serial com. ports. (Cable required)

# Main PCB Overlay

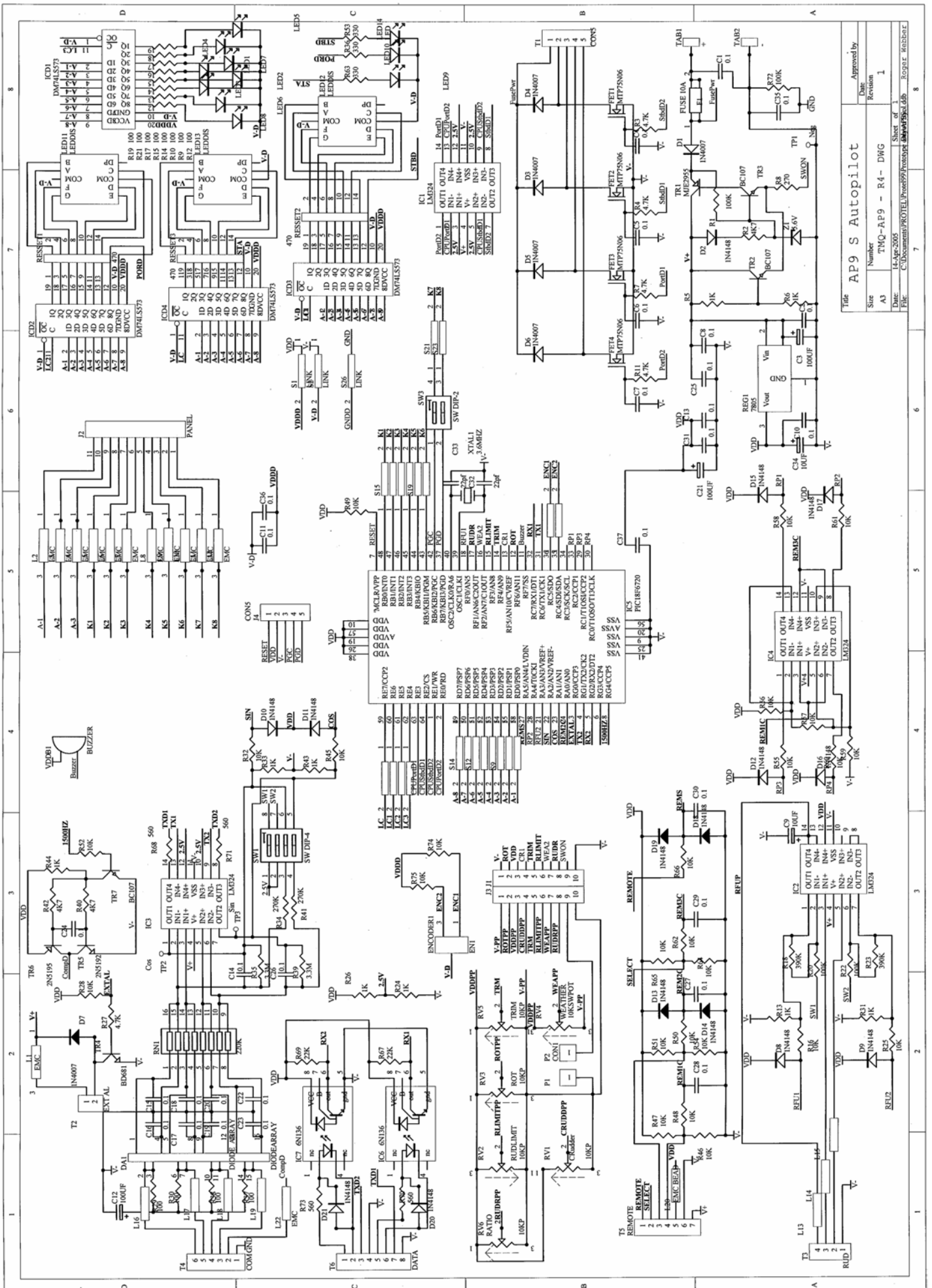




# Control PCB Overlay



# Complete AP9S Schematic



Title		AP9 S Autopilot	
Size	Number	Date	Approved by
A3	TMC-AP9 - R4 - DWG		
Date:	UAXP-5005	Sheet of	1
File:	C:\Documents\ROTEL\Projet\99\Projet\AP9S.dwg	Sheet of	1

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## ***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 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 18 Alexandra Place, Tingalpa, 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

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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.