Dan's Copy

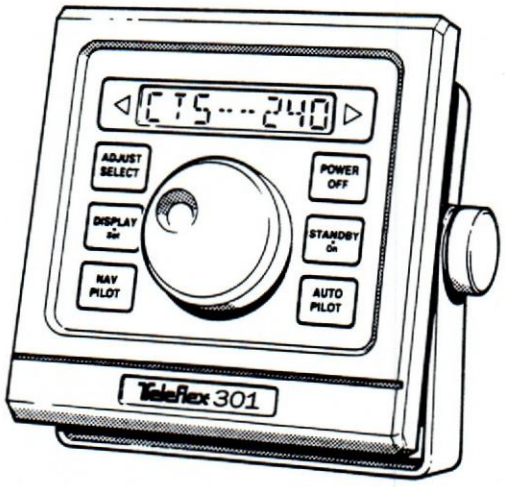
TO STAY HERE

DON'T TAKE IT

Teleflex

301

Owners Manual



TO STAY

HERE

DON'T TAKE

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written by
D.M. Fraser
in 1988

Word Perfect 5.1

Congratulations on your purchase of the Teleflex 301 Autopilot. Once correct installation is completed you can expect years of trouble free performance.

The autopilot's features include user friendly single function operating keys, an easy to use course change knob, full navigator interface capability (such as Loran), rugged solid state construction, a very accurate and stable electronic compass and, of course, quality Teleflex performance.

This manual has 3 main sections.
Operation, Installation and Servicing.

Before proceeding, please read the following special precautions.

READ THIS CAREFULLY

Special Precautions

An autopilot aids in steering a vessel. It is not meant to take the place of a human operator. The operator is responsible for the safe operation of the vessel at all times, following all rules of navigation.

The Teleflex 301 is intended for operation in open waters, clear of ALL obstructions and other vessels. The heading of the ship MUST be observed constantly! The helm is NEVER to be left unattended! Never use the autopilot when cruising near another vessel, the shore or any other hazards to navigation.

CAUTION:

While the autopilot is steering on a correct compass heading, tide or wind can push the vessel sideways, possibly putting you into a dangerous situation. Keep a sharp lookout at ALL times.

If the autopilot alters or fails to maintain the set course, the safety of the ship may be jeopardized. If this happens, switch it OFF immediately. If you can not immediately return to manual control, trip the system circuit breaker on your electrical panel manually or remove the system fuse to completely isolate the autopilot system from the steering system.

Guard all exposed moving parts of the steering gear and autopilot to prevent catching of stowed material, extremities or clothing by accident.

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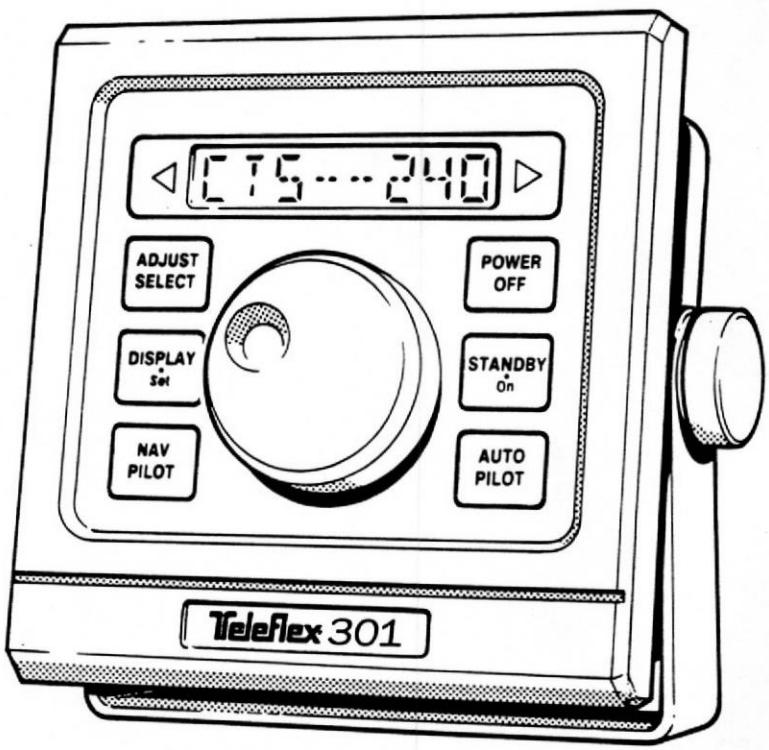
INSTALLING THE AUTOPILOT

SECTION A

Operating Instructions



KEYBOARD DESCRIPTION

MAIN SWITCH FUNCTIONS

POWER OFF

POWER OFF: Shuts off the power.

STANDBY On

STANDBY/ON: Turns on the autopilot.

After the autopilot self tests, the display will read "HEAD 000" (The three zeros represent the numeric direction information), displaying the compass direction or an error code. If an error code appears, check page 4 Section C for an explanation.

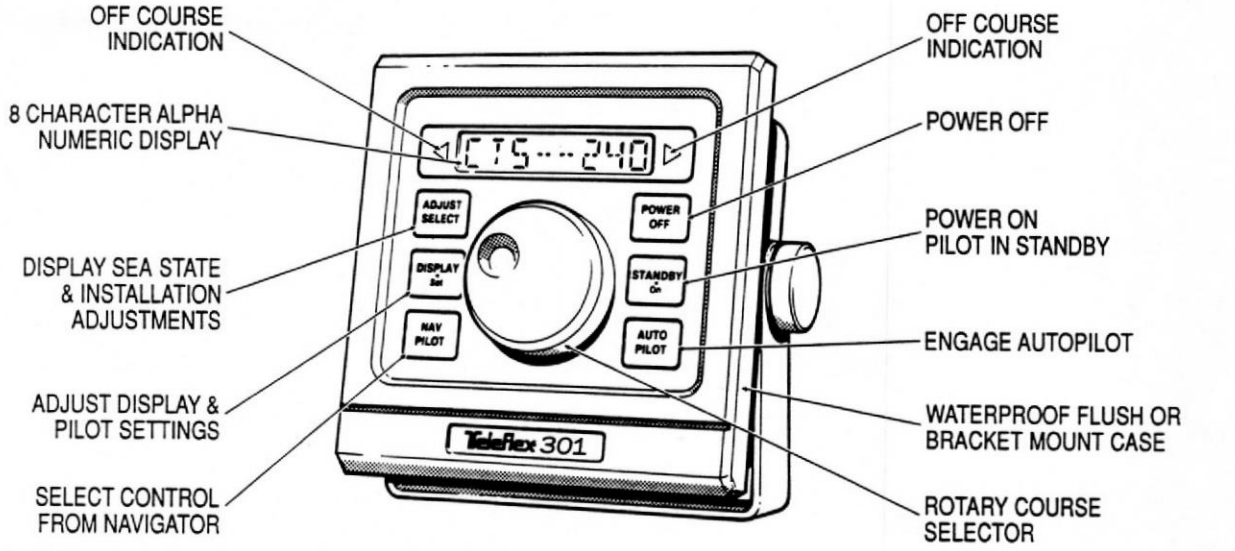
If the Teleflex 301 is in any operating or adjustment mode push this button to return to Standby and return the display to "HEAD 000".

AUTO PILOT

AUTOPILOT: Press this button to engage compass controlled autopilot operation on the course that was shown on the display. The display reads "AUTO 000" and gives the heading steered.

The arrow shaped LEDs will light, indicating the direction the vessel has drifted off course. The autopilot steers in the opposite direction to return you to course. When both LEDs light you are on course.

If the system is in Navigator mode, push the "AUTOPILOT" button to change the operation from Navigator control to compass control on the compass heading the boat was set for at the instant you pressed the AUTOPILOT button.



NAV PILOT

NAV PILOT: If good data is present, when you push NAV PILOT, the boat will go into Navigator controlled autopilot steering, whether it was in STANDBY or AUTOPILOT mode. The display reads "NAV 000", with the heading given by the Navigation receiver.

If the Nav receiver is off or if no data is present, the display reads "NO NAVGR"for 3 seconds then, the display goes back to the message it showed just before the NAV PILOT button was pressed. The system will remain in its previous mode. See page 19 Section A for full operating details.

DISPLAY Set

DISPLAY/SET: From standby, autopilot or Navigator modes, this button's DISPLAY mode is active. If you push this button repeatedly, the display toggles between the normal digital readout, a graphic display and a digital display of cross track error.

GRAPHIC DISPLAY: If you are in standby mode, you will see a display of the rudder angle across the bottom of the display. If you are in autopilot mode the top half of the display shows course error. If in NAV mode, the top half of the display shows cross track error.

If the DISPLAY/SET button is pushed and held for 3 seconds, it will increase, then dim the display backlighting. The light level increases to full intensity them dims down to zero intensity. Let go of the button when the backlighting reaches the desired intensity. 7 is the brightest setting

To learn about the SET functions of this button the sections describing adjustments begins on page 6 Section A

ADJUST SELECT: This button will step you through SET, RUD, RESP and PWM functions and back to the previously selected display. These are operating functions. Detailed instructions on how to use these start on page 7 Section A.

If you hold down the button for at least 3 seconds, you access the setup functions. The display will show "CONFIG". By pressing it repeatedly, you can page through the following functions:

- Configuration (CONFIG)
- Counter Rudder (C/R)
- Trim
- Rudder Ratio Gain (GAIN)
- Rudder Deadband (RDB)
- Rudder Limit (RLIM)
- Compass Damping (DAMP)
- Power Steer Gain (PSG)
- Automatic Deviation (AUTO-DEV)
- Magnetic Variation (VAR)
- Navigator Format (NAVD)
- Navigator Gain (NAVG)

Detailed instructions on these functions start on page21 Section B.

COURSE CHANGE KNOB: Use this rotary knob in the centre of the Keyboard Console to select a new course to steer before engaging the autopilot or to change course when you are in autopilot mode.

PILOT OPERATION

TURNING ON THE POWER

Press "STANDBY/ON" for one second.

Pilot will self test for about 10 seconds. If an error code appears, see the fault section on page 5 Section C. If the system checks out, the display shows your present heading.

TO ENGAGE ON VESSEL'S PRESENT HEADING

Press "AUTOPILOT".

Vessel is now under pilot control. The red and green arrow LEDs light showing the direction of course error at any time. If both are lit, you are on course. The display shows the heading the pilot is steering.

TO RESUME MANUAL CONTROL

Press "STANDBY/ON" again.

The display reverts to "HEAD 000" showing the compass direction. Press "POWER OFF" only to shut off the power to the autopilot.

IN CASE OF EMERGENCY PRESS "POWER OFF"!

TO CHANGE COURSE

TO PRE-SELECT A COURSE BEFORE ENGAGING THE PILOT: Turn the "COURSE Change" knob.

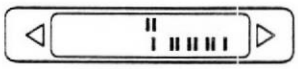
The display will show "Course To Steer".

TO CHANGE COURSE WHILE IN AUTOPILOT MODE: Turn the "COURSE Change" knob. The vessel then turns onto the new course. The display will show the new course as you turn the knob.

TO CHECK RUDDER ANGLE, COURSE ERROR AND CROSS TRACK ERROR

Press DISPLAY/SET once.

A graphic display appears and will differ depending on which mode you are in.



1. From standby mode, the display shows rudder angle.

From autopilot mode, the display shows any course error on the top half and rudder angle on the bottom half. From Nav mode, the display shows any cross track error on the top half and rudder angle on the lower.

2. Cross track error. When you push a second time, the display shows "XTE <00", "XTE 00>" or "XTE >0<", depending on what cross track error information is available.

3. Press DISPLAY/SET a third time to return to the original display.

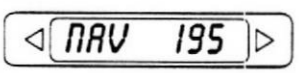
TO ADJUST BACKLIGHTING

Press the DISPLAY/SET button and hold it for 3 seconds.

The light level increases to full intensity, then dims down to zero intensity. Release the button when you reach the desired intensity.

NAVIGATOR OPERATION

Press NAV PILOT to engage navigator controlled autopilot mode from either standby or autopilot mode. If no nav data is present, the display shows "NO NAVGR" for 3 seconds, then it reverts to its previous display and the system remains in its previous mode.



However, unless you have programmed the navigation receiver and reduced any cross track error, the vessel may experience an unexpected course change. See NAVIGATOR OPERATION on page 19 Section A.

REMOTE CONTROL OPERATION

See page 13 Section A for a full description.

SEA STATE ADJUSTMENTS

Sea State adjustments set the pilot's operating points. They are: the pilot presets, rudder sensitivity, response and PWM. Press the ADJUST SELECT button repeatedly until you reach the adjustment you require.

PILOT PRESET OPERATION

The first selection is the Pilot preset. There are two user programmable presets available for fast and slow speed operation. Normally, this is the only adjustment required.

Press "ADJUST SELECT" once. The display reads "SET FAST" or "SET SLOW".

To select the other set of PILOT presets, press DISPLAY/SET.

If, and only if, the factory preset positions do not operate your vessel as well as you expect, you may choose to optimize the settings yourself. In "SET SLOW" mode you should optimize the boat's operation in your normal low speed operating range. To record the changes press the POWER OFF button.

Next, turn the pilot back on, and select PILOT preset "FAST" to optimize the settings for your normal high speed operation. Again turn off the power to record the settings.

Now, all you have to do select PILOT preset mode "FAST" or "SLOW".

Please note that when you shut the pilot off using the POWER OFF button, whatever adjustments are in current use will be stored in the preset memory. Example: if you are in "SET FAST", the settings of all the controls are saved in memory position "FAST". If you are in "SET SLOW", the settings of all the controls are saved in memory "SLOW".

OTHER SEA STATE ADJUSTMENTS

Only use these adjustments if the Fast and Slow presets do not operate the boat properly. If the presets work properly do not use them.

RUDDER RATIO (RUD)

Sets the number of degrees of rudder movement for a given amount of course error. The larger the number, the more rudder you get. See rudder adjustment technique on the facing page, for the effects of this setting.

Range: 00-20

RESPONSE (RESP)

Sets the amount the vessel may drift off course before the correction occurs. See the section on response adjustment, page 11 Section A, for the effects of this setting.

Range: 00-20

PULSE WIDTH MODULATION (PWM)

Selects PWM on or off. PWM is "pulse width modulation" used to control drive motor speed. This allows the rudder to move slower initially for better course keeping. It is normally left on and need only be switched off if you are experiencing degraded autopilot control possibly when going downwind in a following sea or in any other situation where faster rudder control is needed.

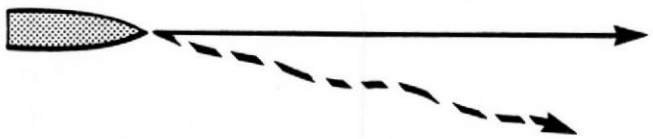
Choices: ON or OFF

ADJUSTMENT PROCEDURE

RUDDER ADJUSTMENT

◁ RUD - 05 ▷

After selecting the pilot preset you wish to alter, press "ADJUST SELECT" a second time to make rudder adjustments.

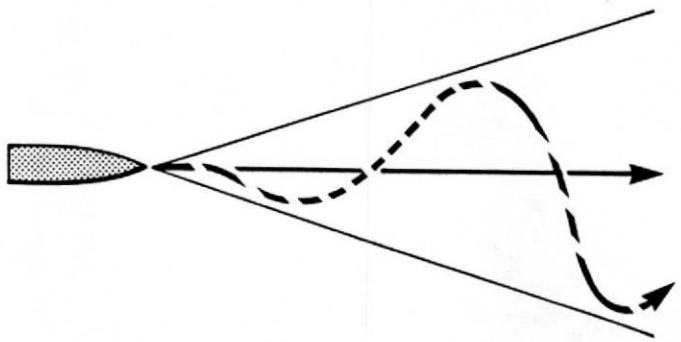


UNDERSTEER

Boat Understeering

Vessel repeatedly drifts off course to one side and is only loosely controlled by pilot.

REMEDY: Increase rudder setting



OVERSTEER

Boat Oversteering

Vessel builds up oscillations from side to side of required course

REMEDY: Decrease setting.

RUDDER ADJUSTMENT

The rudder setting varies the amount of rudder the autopilot applies to correct a given course error. You make this adjustment to prevent over or under steering of the vessel under varying conditions.

If the present value seems too low and you are drifting off course, adjust the setting upwards until the ship starts to oversteer, then back it off slightly. This often happens if you are cruising at slow speeds and in following seas. At cruising speeds, oversteering oscillations may occur and the setting should be reduced toward "0".

Vessels with oversize rudders will need a lower setting. It is usually better to set the rudder at higher speed as low speed setting will definitely cause oversteering at high speeds. However, a high speed setting will usually work acceptably well at all but the slowest low speeds.

TO INCREASE THE SETTING: If you want to increase the setting, press "DISPLAY/SET" once and the setting will increase.

Press DISPLAY/SET again and the increase will stop.

DECREASE THE SETTING: Press DISPLAY/SET a third time and the setting will decrease.

Press DISPLAY/SET a fourth time and the decrease will stop. If at any time you want to exit the adjustment mode, press the button for your present operating mode.

WIND EFFECTS: When turning into the wind, the rate of turning may be slowed by the side thrust of the wind. The automatic Trim will usually compensate for this within 1 or 2 minutes

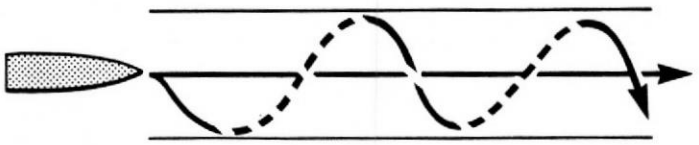
When sailing directly into the wind there may be some reduction in course holding ability due to variable effects from the wind and the vessel's aerodynamics. However, the average course held will be correct.

RESPONSE ADJUSTMENT

◁ RESP - 07 ▷

Press "ADJUST SELECT" a third time.

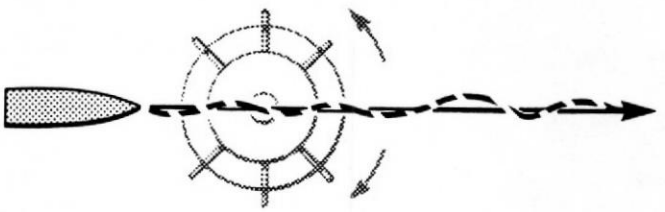
The display shows that Response has been selected.



WANDER

Boat wanders over course: Vessel moves well off course before making a correction.

REMEDY: Decrease setting



EXCESSIVE HELM MOVEMENT/ HUNTING

Excessive helm movement/hunting: Vessel holds course but drive hunts rapidly back and forth. (Power pack is running almost constantly)

REMEDY: Increase response setting

This is the "weather" or "sea state" control. Increase the setting in heavy seas and decrease it in calm. For best course holding, it is better to choose a lower number. In rough seas, increase the setting until the autopilot stops hunting back and forth.

The lowest setting you can use without excessively running the pumpset is best. Aim to set it so that autopilot controlled helm movements are of roughly the same frequency and magnitude as those performed by hand when steering manually.

When going down wind in a following sea, you should reduce the response to avoid loss of control. You may encounter problems with wave sync. In this case you may also need to increase the counter rudder setting a little.

Adjust up or down as in the RUDDER section on page 9 Section A..

PWM SELECTION

Press ADJUST/SET again to display "PWM ON" or "PWM OFF". Use "DISPLAY/SET" to change the setting. PWM is normally left on. It is only switched off in circumstances that require very fast control such as travelling downwind in a following sea. **However, you will experience more wear to your steering system with the PWM switched off and response to minor course errors may be more sudden.**

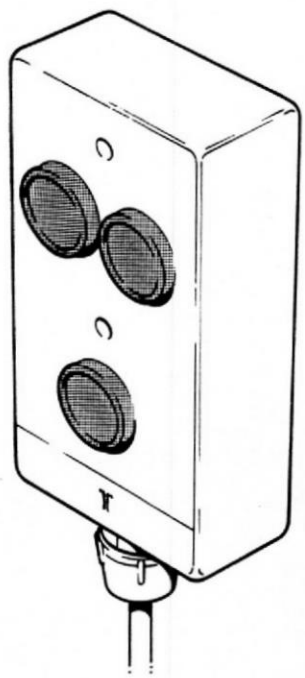
If in doubt leave PWM ON at all times.

If at any time you want to exit the adjustment mode, press the button for your present operating mode.

REMOTE CONTROL OPERATION

AP 2797 DODGE REMOTE

The Remote Dodge and Course Change Unit is a hand held unit on a long cable. Use it to change course or dodge obstacles from any position in the vessel. The unit comes with a mounting bracket and is essential on work boats and for those who sail by themselves.



TO DODGE

1. SELECT DODGE FUNCTION:
With pilot in AUTO mode, press "SELECT" if the dodge lamp is not lit. Please note: the light will flash if the pilot is in standby.

2. PORT DODGE (Left):
Press the red button. Port rudder is applied and the display on the Keyboard Console shows "(((DODGE".

3. RETURN TO COURSE: Release the button.

4. STARBOARD DODGE (Right):
Press the green button. Starboard rudder is applied and the display on the Keyboard Console shows "DODGE)))".

TO CHANGE COURSE

1. SELECT COURSE CHANGE FUNCTION:
With pilot in AUTO mode, press "SELECT" if the course lamp is not lit. Note: the light will flash if the pilot is in standby.

2. CHANGE COURSE TO PORT (Left):
Press the red button. Port rudder is applied and the display on the Keyboard Console will change to show the new course.

3. CHANGE COURSE TO STARBOARD (Right):
Press the green button. Starboard rudder is applied and the display on the Keyboard Console will change to show the new course.

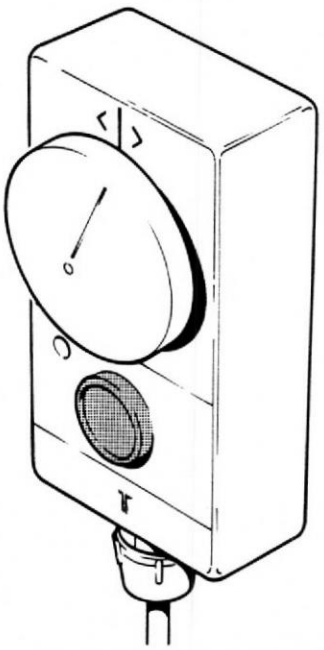
The vessel will often turn slower than the course is being changed. Release button before the new course is reached and approach the desired course by short applications of the button. The display on the Keyboard Console indicates the new course selected instantly.

AUTOPILOT CONTROL AUTO/STANDBY

By pressing both dodge buttons at the same time the autopilot will toggle between STANDBY and AUTOPILOT modes. If you are in standby and wish to engage the autopilot from the remote, press both dodge buttons at the same time. Likewise, if you are in autopilot mode and wish to go to standby, press both dodge buttons at the same time.

POWER STEER CONTROL

The Remote Power Steer Control is a hand held unit on a long cable. Use it to assume full control over the steering from any position on the boat. The rudder follows the position of the control knob. The further you turn the knob, the further the rudder moves. The unit comes complete with a mounting bracket.



1. CENTRE THE KNOB:
With pilot in AUTO mode, move the knob on the remote to the centre position.

Note: The power steer remote engages only when the vessel is under Autopilot control.

2. ENGAGE POWER STEER:
Press "ENGAGE" button. The light on the remote comes on indicating you have selected power steer mode and the Keyboard Console's display shows "P/S 00".

3. POWER STEER:
To steer, turn the control knob.

4. RETURN TO PILOT CONTROL:
Press the "ENGAGE" button again. The vessel will return to pilot control on the present heading. Alternately, to return steering control to the pilot, press "AUTOPILOT" on the Keyboard Console.

NAVIGATOR CONTROL

The Teleflex 301 can be controlled with data received from a radio navigation receiver such as a LORAN, SATNAV or DECCA system that has a compatible output. Formats supported are: NMEA 0180, NMEA 0182 and NMEA 0183.

The data format from your Navigation Receiver determines the method the autopilot may be operated in Navigator mode. The Navigation Receiver can only supply the required data to the autopilot if it is first programmed with the required destination and waypoints. The basic data needed from the Nav Receiver includes:

1. Cross track error. This is expressed in hundredths of a nautical mile (60 feet) to port or starboard.

2. Heading to next waypoint.

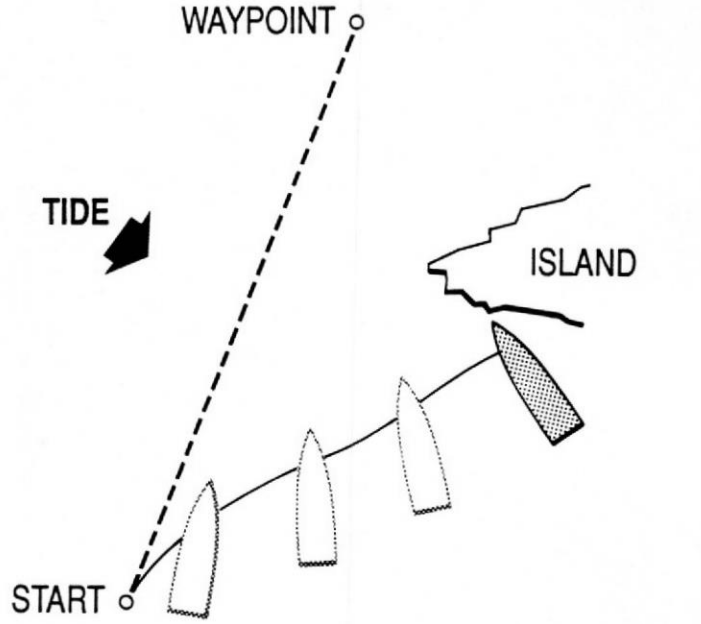
3. Next waypoint number.

The type of data from the navigation receiver varies depending on the data output format of your Navigation Receiver.

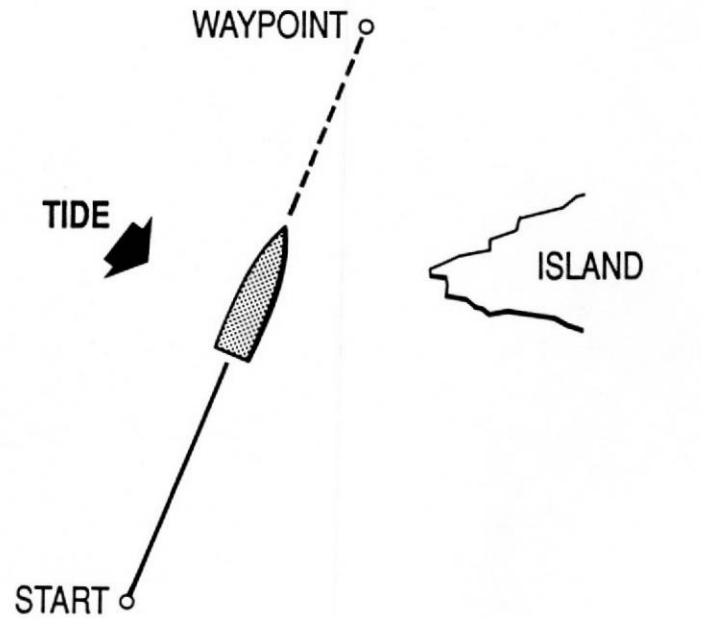
	0180	0182	0183
Cross track error	X	X	X
Heading to waypoint		X	X
Waypoint number			X

In order to get full use of the interface, it is important to understand the principles of control used. It would be very simple to use the heading to the next waypoint calculated by the Navigation Receiver but this would be very dangerous when you are close to land, as tidal offset could cause the vessel to run aground. As illustrated, the Autopilot is quite happy to give you a course through any intervening peninsula or island if it is controlled by heading.

AUTOPILOT CONTROL BY HEADING



AUTOPILOT CONTROL BY CROSS TRACK ERROR



The Teleflex 301 uses Cross Track Error (XTE) to control the autopilot heading, holding the vessel on track to the waypoint. The autopilot is actually controlled by the autopilot's own compass and the cross track error information is used to calculate the Trim (change of compass heading) required to keep your craft on track. Because of this it is important not to be too far off the track when engaging NAV PILOT.

NMEA 0183 Messages

The Teleflex 301 Autopilot can process the following NMEA 0183 messages: APA, APB, BOD, BWC, BWW, CTS, NAV, WBD, XTD, XTE and XTR.

Please note: not all Navigation Receiver makers provide all the data required in a given message. To get the best use from the interface, at least one message containing Cross Track Error, Heading to Waypoint and Waypoint number must be present in the data received from the Navigation Receiver.

If your navigation receiver gives you a choice of messages, use messages "APA" or "APB" for best results.

NAVIGATOR OPERATION

BASIC PROCEDURE

The basic procedure is described on page 6 Section A. The detailed procedure following describes first time use.

DETAILED PROCEDURE

1. PROGRAM NAVIGATION RECEIVER: Program the desired destination. If the navigation receiver provides output of waypoint numbers, program the Navigation Receiver with the required waypoints.

2. CHECK HEADING: Make sure the vessel's heading is within 30 degrees of the course on the Navigation Receiver.

3. CHECK CROSS TRACK ERROR: Press DISPLAY/SET twice. Check the cross track error and confirm that the nav receiver is sending good data to the pilot. The pilot will display "XTE <00" or "XTE 00> if the data is good. If the data is not good, the display reads "XTE>0<". Note: you can check the cross track error any time, and from any operating mode.

4. REDUCE CROSS TRACK ERROR: If the error is greater than 04, reduce it by steering the vessel manually using the wheel (if the pilot is in standby) or the "COURSE CHANGE" knob (if in autopilot mode). Steer the vessel in the direction indicated by the arrows in the XTE display (Not the red and green arrow LEDs). Then, turn the vessel back to the approximate heading to the way point. For best operation the error should be under 04, though the autopilot will correct larger errors.

However, when you press the "NAV PILOT" button, if the error is greater than 04 and left uncorrected, the vessel will try to get onto the programmed track instead of heading directly toward the waypoint.

WARNING: The vessel may turn up to 180 degrees. Therefore, it may make a sudden course change away from the expected heading directly to the way point. This usually only occurs when multiple waypoints have been programmed into the Nav Receiver.

5a. FOR NAVIGATION RECEIVERS WITH NMEA 0180 OUTPUT

i) To Select Course Desired: After checking and, if necessary, reducing cross track error, turn the "COURSE Change" knob so that the display shows the course indicated on the Navigation Receiver.

ii) To Engage Navigator Control: Press "NAV PILOT".

While under navigator control, the display looks like that on the left.

iii) On Reaching a Waypoint: Unless only a small track change is required, less than 15 degrees or so, the vessel will have to be turned manually onto the new track. To do this turn the Course Change knob or manually steer to the new heading and re-engage the NAV PILOT.

5b. FOR NAVIGATION RECEIVERS WITH NMEA 0182 OUTPUT

i) To Engage Navigator Control: After checking and, if necessary, manually reducing cross track error, press "NAV PILOT". The vessel is now under navigator control.

ii) On Reaching a Waypoint: When the waypoint is reached the navigation receiver indicates the new heading required but does not indicate that a new waypoint has been selected. When the waypoint arrived alarm on the navigation receiver sounds, press "STANDBY/ON" then "NAV PILOT" immediately. The vessel will turn to the new track and proceed to the next waypoint. If the nav receiver has arrival alarm output, the vessel will automatically turn to the next waypoint on reaching the waypoint after a 10 second delay. The navigation receiver should sound an alarm indicating a waypoint has been reached consult your Nav Receiver's manual for information on the waypoint arrival alarm.

5c. FOR NAVIGATION RECEIVERS WITH NMEA 0183 OUTPUT

i) To Engage Navigator Control: After checking and, if necessary, reducing cross track error, press "NAV PILOT". The vessel is now under navigator control.

ii) On Reaching a Waypoint: Most 0183 outputs have all the information required for the craft to turn to the next track automatically without any action on your part. If your vessel does not do this when the waypoint alarm on the navigation receiver sounds, check with the supplier of your Navigation Receiver to see whether the data contains one of the sentences containing "Heading to Waypoint" and "Waypoint Number". If not, follow the instructions under NMEA 0180 or 0182 depending on data available.

6. EXIT NAVIGATOR CONTROL

To exit navigator control without exiting autopilot mode, press AUTOPILOT. You then return to compass control on your present heading.

To exit navigator control and return to manual control, press STANDBY/ ON. The display will change to "HEAD 000".

7. ALARMS

If the Navigation receiver indicates an alarm condition, such as loss of signal, the Teleflex 301 will display "NAV DATA", "NAV TIME" or other messages and give an audible alarm. The pilot will hold the vessel on its present heading and will not accept any further changes from the nav receiver until the nav receiver signals the autopilot that the data is good again. The Navigation receiver may also indicate this alarm condition. See the instructions for your nav receiver for further information.

For many fault conditions, pressing "DISPLAY/SET" will give you a message concerning possible reasons why the alarm ocurred. To clear the alarm press "STANDBY/ ON" to manually steer the vessel or "AUTOPILOT" if you wish to revert to compass control. Re-engage navigator controlled operation once the nav receiver has indicated the fault has cleared.

Alternately, you may press "NAV PILOT" but if the data is still bad the autopilot will give another alarm. If the interruption of signal was only momentary, navigator controlled steering will resume. If the alarm will not clear, turn the pilot off then on and resume autopilot control under compass control or steer the vessel manually.

SECTION B

Installing the Autopilot

PRE-INSTALLATION CHECKS

Before installing your new Teleflex 301 autopilot system, carry out the following checks:

1. Correct items delivered?
2. Units undamaged?
3. Correct voltage drive unit?
4. Correct size fittings on hand for hydraulic pump?
5. Correct hydraulic fluid available for system?

INSTALLATION SUMMARY

1. Mount the Keyboard Console.
2. Mount the Distribution Box.
3. Route the Keyboard Console cable.
4. Mount the Rudder Reference Unit.
5. Mount the Flux Gate Compass Sensor.
6. Mount the remote controls (if used).
7. Mount the pumpset or other actuator.
8. Connect the clutch or solenoid wires (if used).
9. Connect the DC power leads.
10. Connect the navigator (if used).

GENERAL INSTALLATION PRACTICES

Read the installation instructions all the way through before starting

1. Before any drilling or cutting takes place the exact location and cable routing for every unit should be decided.

2. Install all components, the Keyboard Console, the Rudder Reference Unit, the Flux Gate Compass Sensor unit, the Distribution Box, the remotes (if used) and the pumpset before trying to make the system work. Testing an incomplete system will give symptoms that may make the system appear defective, wasting a lot of your time.

3. Check that your units are the correct voltage for your boat. The voltage is marked on each unit's serial number label.

4. Observe the Compass Sensor safe distances for mounting.

5. Keep all cables as far away as possible from those carrying radio frequency (RF) signals. A distance of at least 3 feet or 1 metre is recommended. Failure to observe this precaution may result in erratic operation when radio transmissions are made. Mount all components as far from radio transmitters, including antenna, especially radar, as is conveniently possible.

6. Keep DC supply cables as short as possible. If possible, connect the negative lead directly to the battery. The positive lead must be connected to the battery through a fuse or circuit breaker of the appropriate rating. See the power connection instructions on page 18, Section B for the correct sizes.

Under NO circumstances should any power lead for the autopilot be used to supply other equipment. Switching transients from the other equipment may cause erratic operation.

7. If you have to extend the length of any cable, make the splice in a waterproof box in an easily accessible location. The extended length must be at least the same gauge as the original. ONLY use shielded cables to extend shielded cables and connect the shields. The shields are only to be grounded at the Distribution Box.

The cable to the drive unit is especially critical as the extra voltage drop can degrade performance, especially on 12V systems. This cable should be heavier than the original wire.

8. Any outer shielding on a cable should be left isolated except where it is specifically indicated on a drawing that a grounding connection is possible.

9. The outer cases of all units are fully isolated from the circuitry. Preferably the power should not be connected directly to the hull. If you are installing an autopilot in a vessel so wired, make sure the power is connected only at the main distribution point to minimize the possibility of RF interference and/or electrolysis.

10. Clamp all wires to fixed points every 1/2 Metre (18 inches) or less. Where cables pass through bulkheads, protect them with a clamp, sleeving or a grommet to prevent wire damage.

11. When mounting components bear in mind that someone (possibly you!) may have to pull it out for repair. Especially on newly built boats, make sure that the locations where you mount various components are easy to get to and will remain easy to get to. Make sure that nothing, especially big, bulky or heavy items, will be installed in front of them.

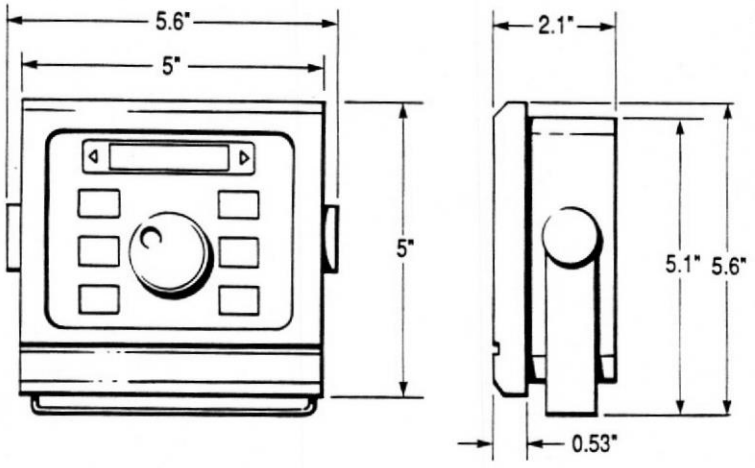
12. Install each component in as dry a location as possible. It is common sense to give units as much protection as you can, even those units rated as waterproof.

13. Cables are already supplied with each component. The Wire Colours and their Codes are as follows:

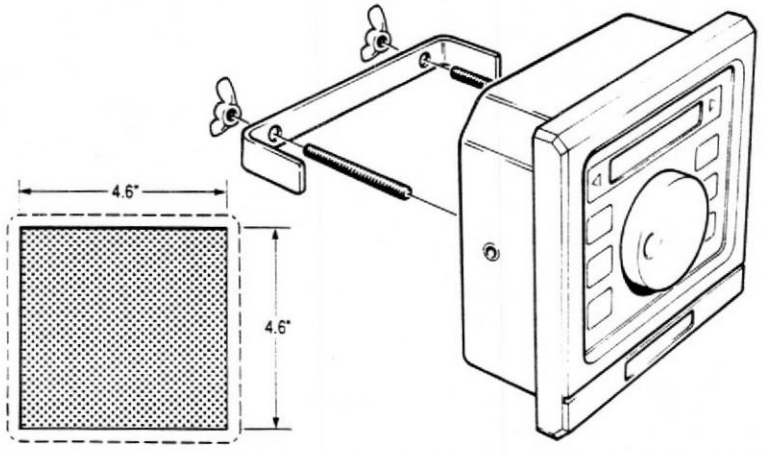
R	RED	B	BLUE
BK	BLACK	BN	BROWN
Y	YELLOW	G	GREEN
W	WHITE	GY	GREY
V	VIOLET OR PURPLE		

COMPONENT INSTALLATION

MOUNT THE AP2727 KEYBOARD CONSOLE



BRACKET MOUNT



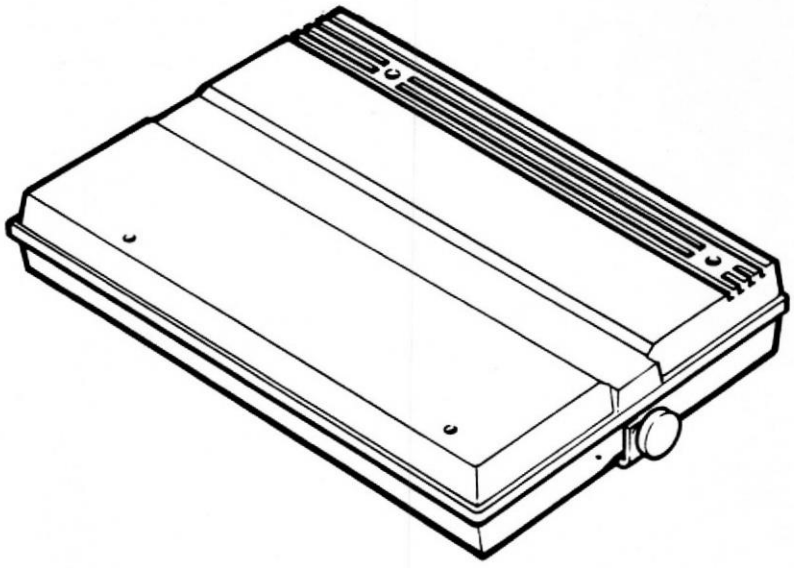
FLUSH MOUNT

Cable supplied: 22 Feet/6 Conductor/Shielded
Compass safe distance: 48" (1.2 Metres)
Environmental Classification: Waterproof

a) Mount it to allow easy operation. The helmsman will use it a lot. It should be mounted in a location free of salt spray, where the cables may be easily routed.

b) Use the mounting bracket provided for overhead or surface mounting or flush mount it in the instrument panel. If flush mounted use the gasket provided to seal the opening

2. MOUNT THE AP2618 DISTRIBUTION BOX



Compass Safe Distance: 53" (1.3 Metres)
Environmental Class: Splash resistant - Should be mounted under cover in a ventilated location, not subject to temperatures higher than 120°F (55°C).

a) Mount it on a bulkhead in a dry position near where most of the ship's wiring is routed.

b) Remove the mounting bracket and secure the bracket to the bulkhead. Then, remount the Distribution Box to the bracket.

c) Note the minimum compass safe distance. The box should be at least 53" (1300mm) from the Compass.

d) When mounting it keep in mind any gear that may be installed later. It may be you that has to get at the box by crawling over a fuel tank, reaching behind a ventilation duct in the dark.

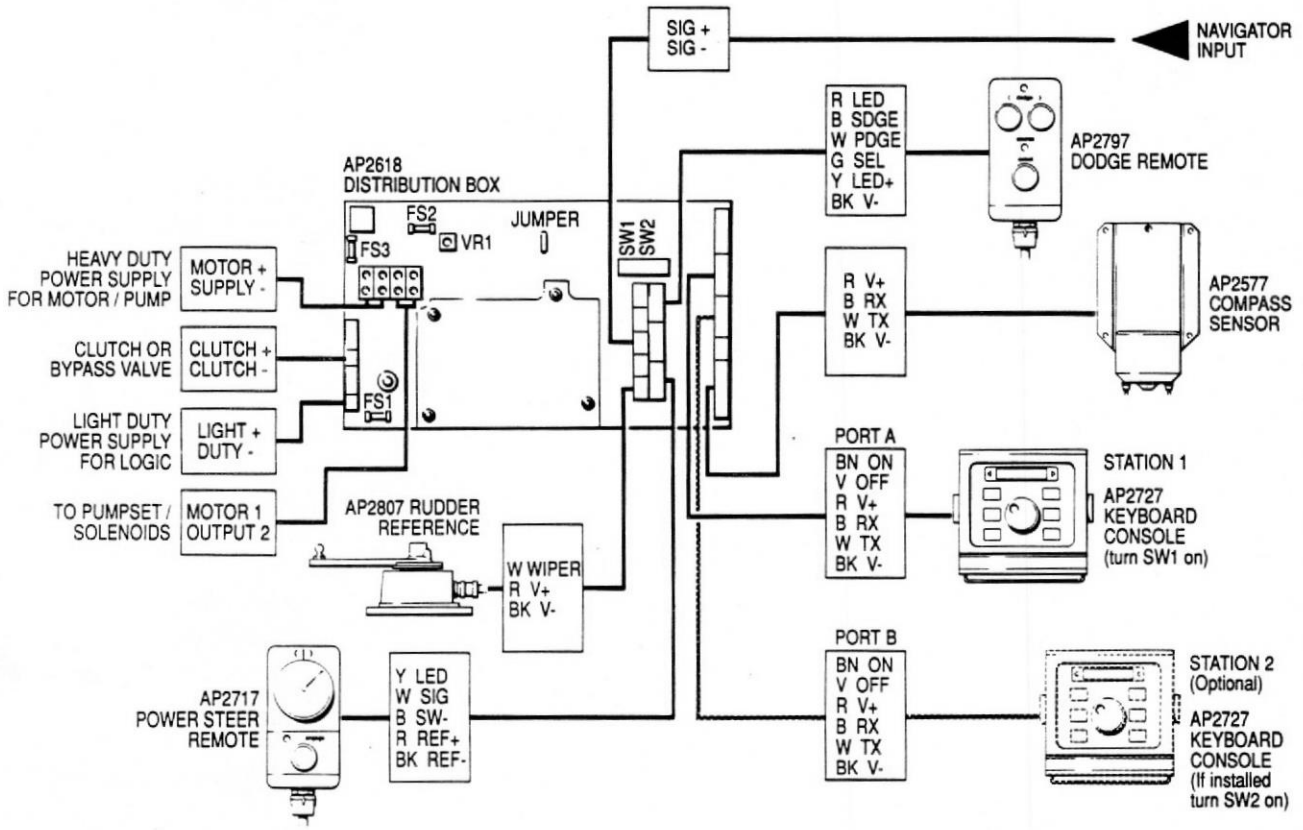
e) Looping the cables before they enter the box will allow easy service access. Make sure any slack in the cables is close to the Distribution Box.

f) The box should be placed so that the distance from the heavy duty power supply (from the battery) to the box and from the box to the drive unit is kept to a minimum.

g) If the Distribution Box is installed in the engine room, make sure that the unit is not exposed to temperatures above 120°F (55°C).

h) To get at the terminal blocks, remove the screws holding on the top cover and remove it. The wiring connections are printed on the circuit board. Double check your connections before firing up the system.

WARNING: Reversed polarity of input power may cause major system damage.



SYSTEM CONNECTION

ROUTE THE KEYBOARD CONSOLE CABLE

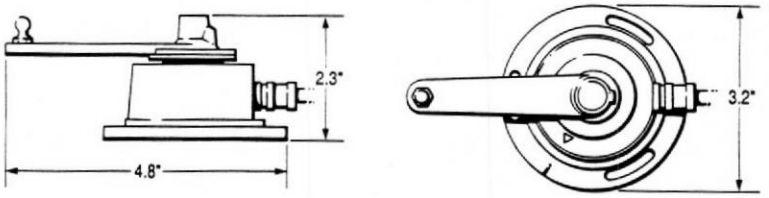
a) The Keyboard Console cable must be routed to allow enough slack so the Keyboard Console rear cover may be removed easily. Care should be taken, especially when mounting a Keyboard Console on a flying bridge, that the cable be routed as far as possible from antenna leads to minimize the risk of RF interference.

b) To route the cable, you may have to temporarily remove the connector from the free end of the cable. Make a drawing to be sure you return the wires to the same terminal from which you removed them. This is VERY important.

c) Plug the cable from the first Keyboard Console into the terminals on the far right side marked "PORT A", making sure DIP switch SW1 is on. Also make sure the wire colours line up with the markings on the board. If a second Keyboard Console is being installed, plug it into the adjoining set of terminals marked "PORT B" and move the DIP switch SW2 to the on position. This tells the Autopilot that two Keyboard Consoles are being used. See the drawing on page 6, section B.

d) After connecting the cable(s) to the Distribution Box, clamp the exposed portions of the shielded cable under the grounding strip in the Distribution Box. Fit it down into one of the "U" shaped depressions securely to preserve the system's RF shielding.

MOUNT THE AP2807 RUDDER REFERENCE UNIT



Cable supplied: 40 Feet/3 Conductor/Shielded
Compass safe distance: 12"/300mm
Environmental Classification: Waterproof

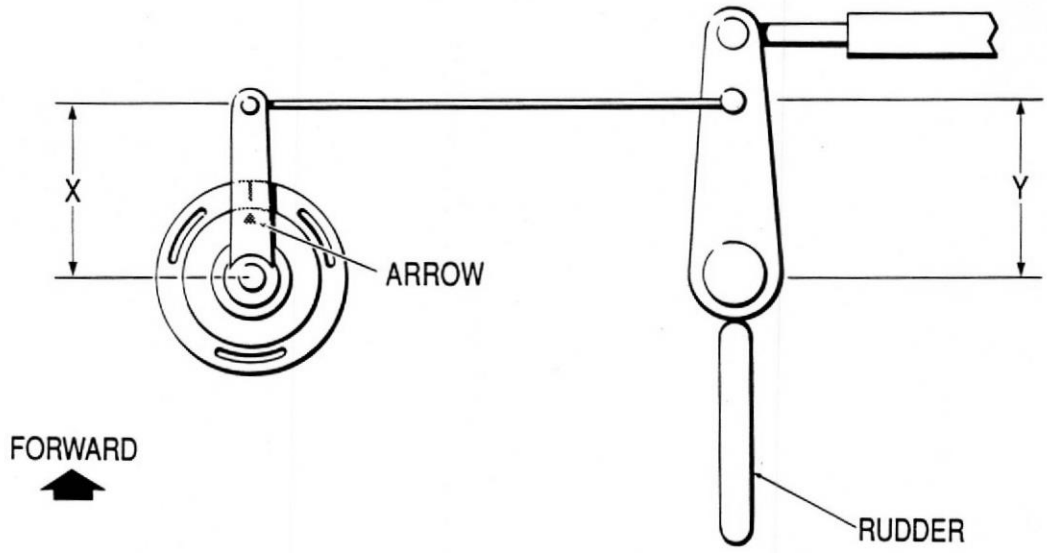
a) If a rudder reference unit is already on board from an existing system, do not use it! The Teleflex 301 rudder reference unit precisely matches the characteristics of this autopilot and performance cannot be guaranteed with another rudder reference.

b) Mount the rudder reference on or near the steering gear. While waterproof, place it in as dry a position as possible, consistent with proper operation.

c) Mount the unit near the rudder in such a way that when the linkage is connected, the movement of the Rudder Reference Unit shaft will be a faithful copy of the movement of the rudder stock.

d) NORMAL MOUNTING: Illustrated on page 9, Section B. The point of connection to the tiller arm should be about 75mm (3") from the centre of the rudder stock so that the rudder and Rudder Reference Unit arm move parallel to each other. The four points of the rudder reference pivot point, the two swivel ends of the cross link and the rudder pivot point should form, with the rudder centred, a square cornered shape. In most cases dimensions "X" and "Y" should be equal. If not, you may have some difficulty finding control settings that give you stable operation.

REVERSED MOUNTING: Illustrated on page 10, Section B. The point of connection to the tiller arm should be about 75mm (3") from the centre of the rudder



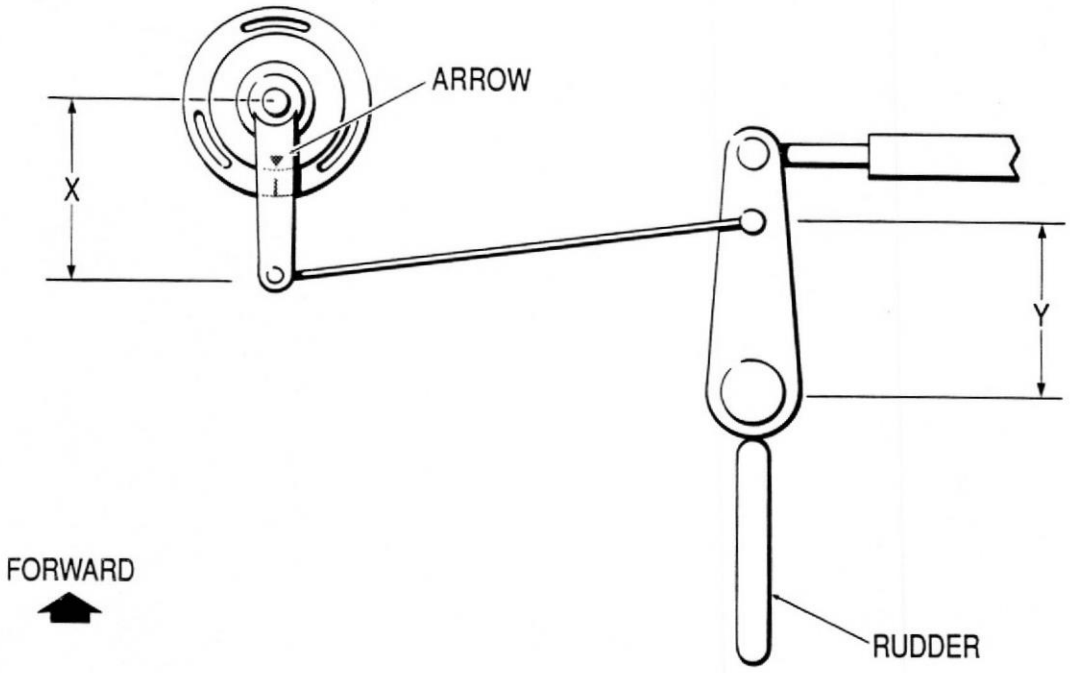
NORMAL MOUNTING

stock. In most cases dimensions "X" and "Y" should be equal. The cross link arm should be mounted at about a 15 degree angle to avoid binding. With the rudder centred, the tiller arm and rudder reference arm should be parallel as shown. If not, you may have some difficulty finding control settings that give you stable operation.

Note: On stem drive or outboard systems length "X" may have to be shortened to prevent oversteering. Initially, make "X" and "Y" the same then adjust "X" if necessary when you do the dockside tests and adjustments starting on page 20, Section B.

e) You may have to make a platform of some sort to support the body of the Rudder Reference Unit. Mounted it in such a way that the arm lays on the same side as the arrow moulded into the case of the Rudder Reference Unit. It will not work if the arm lies on the other side.

Please note: in some cases you may not be able to attach to the rudder stock within 3" of the pivot point. It will be necessary to extend the arm of the rudder reference unit. If you need to extend it you will find an arm extension kit in a small plastic bag, packed with the rudder ref-



REVERSE MOUNTING

erence unit. You will have to drill a 3/16" hole in the rudder reference unit arm to attach the extension.

f) Align the Rudder Reference so that the arrow on the case lines up with the arm as closely as possible while the rudder is in position for straight ahead steering. If this is not done, the vessel may tend to drift to one side when the autopilot is engaged until the trim circuit can compensate for the unbalance. Also, the rudder angle display may not be centred.

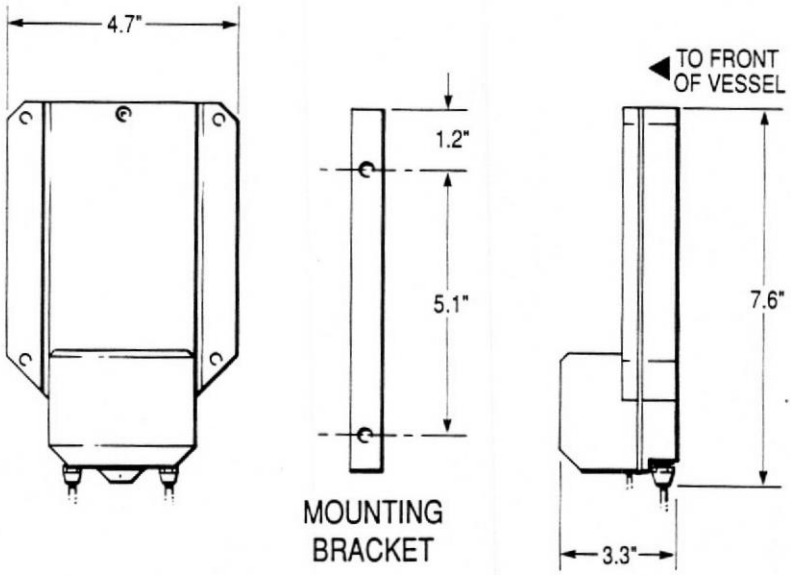
g) After routing the cable to the Distribution Box, connect it to the terminals on the right side marked "RUD REF". Make sure the white wire is in the terminal marked "W". Clamp the exposed portion of the shielded cable under the input block next to the terminals.

h) The Rudder Reference Unit cable has 3 wires connected to a removable terminal block. If you must remove this block to route the cable, make a drawing to be sure you can properly reconnect the wires. Connect it to the Distribution Box. See the drawing on page 6, Section B.

i) The steering gear is often in a locker also used for stowage. Make sure that the rudder reference unit cannot be jammed by ropes, buckets, fenders, etc. If necessary, construct a cover to prevent this.

WARNING: It is very important that the rudder reference be mounted properly and adjusted according to the instructions starting on page 21, Section B. Otherwise, the preset control settings will not work and you may be unable to find control settings that will properly operate with the autopilot.

INSTALL THE AP2577 FLUX GATE COMPASS SENSOR



Cable supplied: 14 Feet/6 Conductor/Shielded
Environmental Classification: Waterproof

a) Mount the sensor vertically on a cross vessel bulkhead away from large amounts of steel or electrical wiring. Refer to the table "Minimum Safe Distances" on page 14, Section B. The physically optimum position is generally 1/3 of the way back from the bow, as low down as possible in the vessel. See item "e)" as well.

b) On steel vessels the Compass Sensor may need to be mounted on the mast between three and ten feet from the main structure for proper operation.

c) Do not install the compass where magnetic material such as tool boxes, oil cans, chain etc. may be later stowed.

d) To test the proposed location, use a hand compass to see if there is any major deviation. Switch on any electrical equipment that may cause deviation and observe the hand compass.

If changes occur, do not install the compass sensor in this position. It could cause the pilot to change course in a dangerous manner.

e) On fast vessels, mount the compass sensor well away from the forward end, as close to the stern as possible without approaching the engines too closely.

Mounting too close to the bow may cause instability due to vertical accelerations when steering into heavy seas.

f) TRANSIT SCREW: Loosen the transit screw on the bottom of the sensor. Screw it out by 10 full turns to allow full movement of the coil assembly. If it sticks out too far for your mounting, remove it, cut 3/8" off the screw and replace it. The screw must be in place to preserve the water tight integrity of the Compass Sensor. Failure to loosen the screw will result in very poor system operation.

g) The Compass Sensor must be mounted vertically (within 15") with the large end down and the round side toward the bow.

h) Screw the mounting bracket into a cross ship bulkhead with the hook end down using brass or stainless steel non-magnetic screws.

i) Failure to observe minimum mounting distances may result in erratic or unstable operation of the autopilot in some directions.

MINIMUM MOUNTING DISTANCES

Radios, RDF, Depth Plotters, etc.	3' (1 Metre)
Power cables carrying over 0.5 Amp	3' (1 Metre)
Radar Equipment	10' (3 Metres)
Engines or other large steel or iron mass	3' (1 Metre)

j) After installing the bracket, hook the Compass Sensor onto the bracket and secure it with the stainless steel screw supplied.

k) After routing the cable to the Distribution Box, connect it to the terminals in the lower right corner marked "COMPASS". Make sure the colours line up with the markings on the board. Clamp the exposed portion of the shielded cable under the input block next to the terminals.

l) If you remove the connector from the cable to route it, make a drawing of where the wires go to avoid re-connection errors. Misconnection may damage the compass. Connect it to the Distribution Box. See the drawing on page 6, Section B.

MOUNT THE AP2717 REMOTE POWER STEER CONTROL

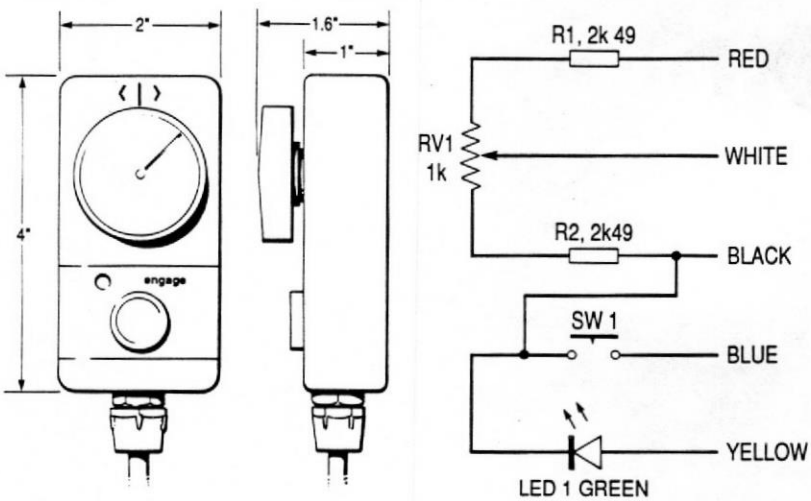
a) The remotes, while waterproof, should be mounted out of direct salt spray. Some users mount them inside a hatch or locker to be pulled out when required. This has the added advantage of keeping the cable tidy when not in use.

b) Screw the mounting bracket to a suitable surface with stainless steel screws.

c) Route the cable to the Distribution Box, Plug the AP2717 Power Steer Remote into the terminals in the lower right corner marked "PWR STR" or "PWR STR 1". Make sure the colours line up with the markings on the board. Clamp the exposed portion of the shielded cable under the input block. See the drawing on page 6, Section B.

d) Make sure the cable has some sort of strain relief or clamp where it passes through a bulkhead to be sure there is no danger of ripping the cable out of the Distribution Box. To do this tie a loose knot in the cable at some suitable location.

e) It is strongly recommeded that a system "kill" switch be mounted near the remote control. Any type of good quality switch wired in series with the system's light-duty power input cable will work. This allows the user to shut down the system should anything go wrong while they are away from the main Keyboard Console.



Cable Supplied: 30 Feet, 5 Conductor Stranded
Compass Safe Distance: 12" (300mm)
Environmental Class: Weatherproof

MOUNT THE AP2797 REMOTE DODGE AND COURSE CHANGE UNIT

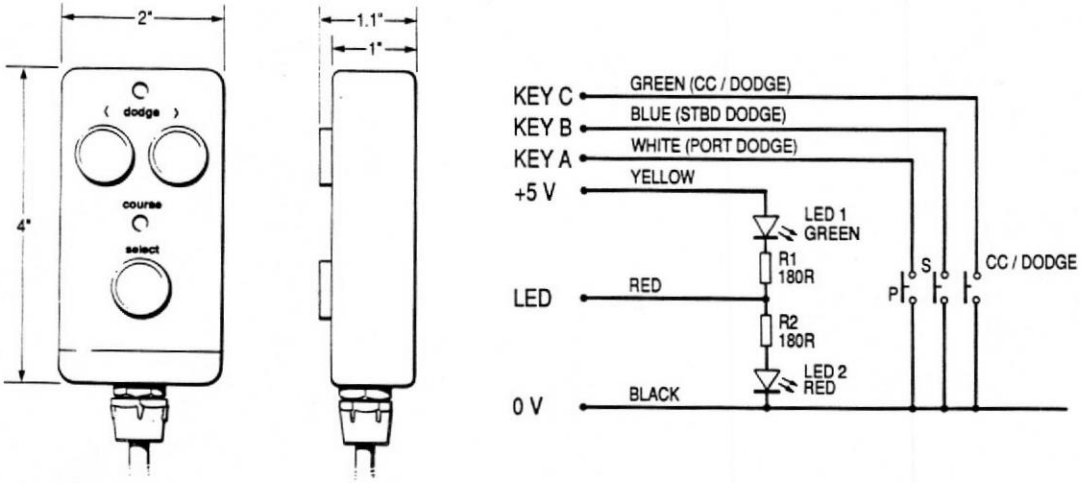
a) The remotes, while waterproof, should be mounted out of direct salt spray. Some users mount them inside a hatch or locker to be pulled out when required. This has the added advantage of keeping the cable tidy when not in use.

b) Screw the mounting bracket to a suitable surface with stainless steel screws.

c) Route the cable to the Distribution Box. Plug the AP2797 Dodge Remote into the terminals marked "HAND REMOTE". Make sure the colours line up with the markings on the board. Clamp the exposed portion of the shielded cable under the input block. See the drawing on page 6, Section B.

d) Make sure the cable has some sort of strain relief or clamp where it passes through a bulkhead to be sure there is no danger of ripping the cable out of the Distribution Box. To do this tie a loose knot in the cable at some suitable location.

e) It is strongly recommeded that a system "kill" switch be mounted near the remote control. Any type of good quality switch wired in series with the system's light-duty power input cable will work. This allows the user to shut down the system should anything go wrong while they are away from the main Keyboard Console.



- Cable Supplied: 30 Feet, 6 Conductor Stranded
- Compass Safe Distance: 12" (300mm)

Environmental Class: Weatherproof

MOUNT THE ACTUATOR OR PUMPSET

a) This may be a hydraulic pumpset, electrically or engine driven or a mechanical actuator. Consult the pumpset's own installation manual for proper installation procedures.

b) OUTPUT CIRCUIT: The Teleflex 301 is designed to drive a reversing motor or solenoid valves to control an engine driven pump. The "CLUTCH" output is usually used only in conjunction with a mechanical drive with a release clutch or a solenoid operated bypass valve in a linear hydraulic actuator. In many systems, the clutch output is not used at all. The clutch output turns on whenever the system is switched on and AUTOPILOT or NAVPILOT functions are selected.

c) Route the cable to the Distribution Box and connect it to terminals on the large terminal block marked "MOTOR OUTPUT 1 & 2". While this cable should as short as possible, it must be at least 5 feet (1.8 Metres) in length. This length acts as a choke to filter out motor noise. Any excess length should be coiled up neatly and out of the way. If directional solenoid or spool valves are used, one terminal from each should be connected to the "MOTOR SUPPLY +" terminal while the other wire from each solenoid would connect to the "MOTOR OUTPUT" terminals. If solenoid valves are used, move the jumper in the distribution box to the "SPOOL" position. See the drawing on page 6, Section B.

d) Clamp the cable under the grounding strip in the box. This serves as the strain relief. The cable should be at least 10 gauge. If this gauge is not available use two runs of 12 gauge or three runs of 14 gauge wire for each conductor.

CONNECT THE CLUTCH OR BYPASS SOLENOID WIRES (IF USED)

a) These wires connect to terminals on the far left side marked "CLUTCH + & CLUTCH -" on the small terminal strip in the Distribution Box.

b) Use at least 18 gauge wire.

CONNECT POWER TO THE DISTRIBUTION BOX

a) Two DC sources are required by the system. A light-duty one to power the control logic and a heavy-duty source to supply power to the actuator. The positive leads for each should be connected through separate fuses or circuit breakers.

b) Before connecting the power, make sure the fuses for the autopilot system in the vessel's distribution panel are NOT installed or if circuit breakers are used, that they are set in the OFF position.

c) Keep the DC supply cables as short as possible. Take the negative lead directly to the battery negative in the boat. Connect the positive lead to the battery through a fuse or circuit breaker.

d) The light-duty supply should have a 5 amp fuse (AGC5) or circuit breaker in the + lead. The light duty supply connects to two terminals in the left lower corner of the Distribution Box. The one nearest the end is the negative (-) input. The next one toward the centre is the positive (+) input. The marking may be partially hidden by the toroidal coil in that corner. Use 18 guage or heavier wire. See the drawing on page 6, Section B.

e) In a 12V system the Heavy-duty supply requires a 30 amp fuse or circuit breaker. In a 24V system, use a 20 amp fuse or circuit breaker. The heavy-duty power is connected to the large terminals on the left marked "MOTOR SUPPLY + & -".

On boats with two battery systems, wire the heavy-duty supply to the battery normally used for starting the engines. This is allowable as the heavy-duty supply is not normally used unless the engine is running and it will not drain the battery.

f) For the heavy duty supply use 10 gauge cable. If not available, use two runs of 12 gauge or three runs of 14 gauge.

g) Under NO circumstances should any power lead to the autopilot be used to supply other equipment. Switching transients may cause operating problems. Also, make sure the motor or heavy-duty supply and the light-duty supply are run separately.

h) If an engine driven pumpset is used (with a directional control valve assembly) rather than a reversing electrical pumpset, move the jumper in the Distribution Box to the "SPOOL" position from the "PWM" position.

CONNECT THE NAVIGATOR (if used)

a) The Navigation Receiver should be connected to the terminals on the right side of the Distribution Box marked "NAV" or "NAV 1", using the cable supplied with the navigation receiver.

b) If the cable is co-axial, connect the centre conductor to the "SIG +" terminal and the shield to the "SIG -" terminal, not to the ground clamp.

c) If you need extra connectors for this or any other connection, please consult your Teleflex dealer.

DOCKSIDE TESTS AND ADJUSTMENTS

SWITCHING ON

CAUTION! PLEASE READ THESE INSTRUCTIONS THROUGH BEFORE SWITCHING ON THE SYSTEM FOR THE FIRST TIME. Incorrect wiring, especially polarity reversal, may cause MAJOR damage to the Teleflex 301 system and is NOT covered under warranty. Starting the engine with the autopilot switched on may damage it also.

Testing this system without the engine running may cause improper operation due to low battery voltage. This most often happens with 12 Volt systems. In addition, engine driven pumpsets require running the engine to operate the rudder though some tests may be done without the engine running.

1. Double check the power to make sure it is +12 to +24 Volts negative ground.

2. Check for correct fuses and/or circuit breakers. Make sure none of the circuits are over or under protected and that the system has good, secure grounding back to the batteries. The correct sizes, fuses or circuit breakers are described in items d) and e) on page 18, Section B.

3. Double check to be sure all system components are installed and wired correctly. Do not test an incomplete system.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage: 30 Volts DC
All input voltages (except NAV input): 0 to 5 Volts DC
Nav ports : -15 to +15 Volts DC (Nominal 0 to 5 V)
Storage temperature: -55 to +150° F
Operating temperature: 30 to +120° F

PRE-TRIAL CHECKS

1. CHECK THE STEERING: Manually turn the rudder(s). Make sure that the steering is free to move from lock to lock without binding or fouling the linkage of the Rudder Reference Unit. Manually turn the rudder to the centre position.

2. POWER ON: Switch on the circuit breakers or install the fuses in the power distribution panel now. Switch on the pilot now by pressing "STANDBY/ON". - for 1 second If the steering operates, switch off the system immediately and recheck the wiring. The system will self test. If a system fault code appears, see the fault display section on page 6, Section C. If okay, the display will show "HEAD000" or other heading.

3. CONFIGURATION SET: Select the configuration for the type of ship: displacement, semi-displacement or planing following the installation adjustments on page 25, Section B.
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4. RUDDER POLARITY: Press "DISPLAY/SET" to display the rudder position. Turn the rudder to port (left). The rudder indicator should move to the left. If it moves to the right, the Rudder Reference Unit is wired backwards. Reverse the red and black wires from the Rudder Reference Unit in the Distribution Box. See the illustration on page 6, Section B. - See picture of display on page A6

5. RUDDER CENTRE: Move the rudder to the position normally required to steer the vessel in a straight line. If the rudder angle indicator does not read centre scale, rotate the Rudder Reference Unit until centre is indicated. Screw it down securely with corrosion resistant hardware.

6. RUDDER LIMIT: The Teleflex Rudder Reference Unit has electronic rudder limits. When these limits are reached, the rudder position display will flash. Make sure that this occurs before you reach the limit of actual rudder travel.

To check the rudder limit, press DISPLAY/SET. The graphic display of rudder angle appears. Then, turning the wheel by hand, make sure the display starts to flash BEFORE you reach the mechanical rudder limit. If the display starts to flash more than 2/3 of a turn before the

mechanical limit or if it never flashes at all, you will have to reset the limit.

To reset it, hold down the ADJUST/SELECT button until you see "CONFIG" then repeatedly press ADJUST/SELECT button until you see "RLIM". Adjust the setting up or down with the DISPLAY/SET button. Then, press STANDBY once and DISPLAY/SET once to recheck that the display starts to flash before you reach the mechanical endstop of the rudder.

WARNING: A rudder limit setting of 10 gives 30 degree limits if the linkage is correctly installed. The autopilot will not work correctly if the setting that gives a 30 degree rudder limit is much below 7 (like 5 or less). If you need a rudder limit setting a fair bit below 7 for a 30 degree rudder limit, find out why and adjust linkage on the Rudder Reference Unit for a reading of about 7 to 10 for a 30 degree limit. Otherwise you may have to make substantial changes to several other settings including RUD and GAIN for proper autopilot operation. The pre-set values will not work

7. PUMPSET POLARITY:

At this time, make sure it is safe for the steering gear to move about under autopilot control. Set the rudder to the centre position.

Press the "AUTO" button. Very little or no rudder movement should occur. Move the course control knob clockwise. The rudder should move to starboard. Turning the knob counter-clockwise should move the rudder to port. If the rudder moves in the wrong direction or goes hard over in either direction, switch off the power and reverse the wires on the MOTOR OUTPUT 1 & 2 terminals. See the drawing on page 6, Section B.

Turn the power back on and repeat the tests. If the rudder moves continuously, switch off, thoroughly re-check the system connections and start the tests over.

8. RUDDER DEADBAND: If the rudder stays centred but hunts back and forth (you may only notice a loud buzzing from the pumpset), increase the rudder deadband (RDB) setting. This hunting may be actual movement or just a buzzing from the actuator. This is often caused when the steering gear on the vessel is very loose. This is preset to a default value of 03. A high setting, usually over 07, is a symptom of sloppy steering gear and will result in poor autopilot control. A low setting with the system buzzing when at rest will cause excessive steering system wear. A setting that just stops hunting or buzzing is best.

9. COMPASS CHECK: Press STANDBY/ON on the Keyboard Console and check that the heading is close to the vessel's actual heading. If there is a large error, you may have forgotten to loosen the transit screw on the Compass Sensor.

This check should not be carried out while you are moored next to a steel quay, jetty or dock, bridge, another vessel or any other large metal mass. Beware of concrete as it usually has reinforcing steel in it.

If you get a large compass error, you may have to move or remount the Compass Sensor.

10. REMOTE KEYBOARD TEST: If a second Keyboard Console is installed, make sure its "STANDBY/ ON" and "POWER OFF" buttons operate properly.

11. REMOTE TEST: Check that any remotes work properly and in the correct direction.

If the dodge remote works in the wrong direction, reverse the blue and white wires. If the remote power steer control works in the wrong direction, reverse the red and black wires. Once this is done, double check that the engage button works properly.

Check that any remote disengage or system kill switches work properly.

Sea trials may now be carried out to determine the best settings for optimum autopilot performance.

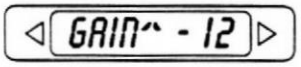
AUTOPILOT CONTROL SETTINGS

These control settings are normally adjusted during sea trials on initial installation to calibrate the AUTOPILOT presets. See page 26, Section B for more details. Once these adjustments are made, they seldom, if ever, need resetting during normal operation. ONLY change the settings after trying the preset adjustments

HOW TO CHANGE THE ADJUSTMENTS

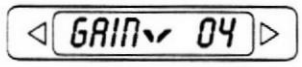
1. ACCESS INSTALLATION ADJUSTMENTS: Hold down the ADJUST SELECT switch about 3 seconds, until "CONFIG" is displayed.

2. SELECT REQUIRED ADJUSTMENT: Press ADJUST SELECT again and again to page through adjustments.



3. ADJUST SETTING: Press DISPLAY/SET and the setting number will increase with a small arrow pointing up.

To stop increasing the setting, press DISPLAY/SET again.



To decrease the setting number, push DISPLAY/SET a third time. The display will also show a small arrow pointing down.

To stop the decrease, press DISPLAY/SET a fourth time.

4. MOVE TO THE NEXT ADJUSTMENT: At any time, to move to the next setting, press ADJUST SELECT.

5. STOP ADJUSTMENT: To go back to STANDBY, press STANDBY/ON. To change back to AUTOPILOT press AUTO PILOT and for NAV, push NAV PILOT.

CAUTION: Changes to the settings are not stored until you turn off the pilot using the "POWER OFF" button. If you shut off the pilot with the circuit breaker on your electrical panel, the new data will be lost. On switching off, the data will be stored in the memory for whatever PILOT preset you are in. Make sure you are in "SET FAST" when tuning the system for high speed operation, and make sure you are in "SET SLOW" when tuning the system for low speed operation.

CONFIGURATION ADJUSTMENT

Before you try to tune the pilot from scratch, you should select "CONFIG" and try one of the preset configurations.

The pilot is programmed to enable the Installation Adjustments and Sea State settings to be preset for Planing, Semi-Displacement or Displacement hulls. These settings are for general guidance and some adjustment may be required to tune the autopilot to a specific vessel for maximum performance.

In addition, you can use the "Restore" function to return to the settings when the pilot was last turned off. Use the restore function when experimentation with various settings results in poorer performance.

The preset configuration levels are:

Function	Planing		Semi-Disp.		Disp.	
	fast	slow	fast	slow	fast	slow
Rudder Ratio	06	08	08	10	10	12
Response	01	01	01	01	01	01
Counter Rudder	01	03	03	04	04	06
Trim	04	04	04	04	04	04
Rudder Deadband	03	03	03	03	03	03
Rudder Limit	07	07	07	07	07	07
Damping	01	01	01	01	01	01
Gain	01	01	01	01	01	01

TO SELECT PRESET PILOT CONFIGURATIONS

1. Hold down the ADJUST SELECT switch about 3 seconds, until "CONFIG" is displayed.

2. Press DISPLAY/SET and the display reads "PLAN-OFF".

3. If you wish to use the Planing vessel configuration, press DISPLAY/SET again. The display shows "PLAN-ON".

4. Press ADJUST SELECT and the display reads "SEMI-OFF".

5. If the vessel is a semi-displacement type, press "DISPLAY/SET". The display reads "SEMI-ON".

6. Press ADJUST SELECT and the display reads "DISP-OFF".

7. If the vessel is a displacement type, press "DISPLAY/SET". The display will change to "DISP-ON".

8. Press ADJUST/SELECT again and the pre-sets will berestored to the last setting used when the power was last shut off.

9. Once you have the configuration you want, press the button for your operating mode to return to your previous mode of operation.

CAUTION: Changes to the settings are not stored until you turn off the pilot using the "POWER OFF" button. If the pilot is shut off with the ignition switch or the circuit breaker on your electrical panel, the new settings will be lost.

If at any time you want to exit adjustment mode, press the button for your present operating mode STANDBY/ON, AUTOPILOT or NAVPILOT.

OTHER INSTALLATION SETTINGS

C/R Counter rudder: Sets rudder movement against rate of change of course. This function is meant to return the rudder to the centre position just as the vessel is coming onto the correct heading. The higher the setting, the more counter rudder is applied. Too little counter rudder may result is excessive overshoot when you dial in a major course change. Too much counter rudder will result in oversteering oscillations. The correct amount will give you about 10 degrees of course overshoot on a 90 degree course change. Adjustment procedure is detailed on page 36, Section B.

Range: 00-20 This setting is normally no higher than your Rudder (RUD) setting to prevent oversteering oscillations.

TRIM: Sets the rate at which automatic trim is applied. The setting determines how fast the vessel will respond to a consistent condition that is constantly disturbing the heading to one side. These conditions may include following seas, wind, tide or RPM imbalance on multi-engined vessels. Higher settings apply more trim faster, resulting in a quicker return to course after a disturbance. However, too high a setting, especially on a larger vessel can result in over correction and possible over steering oscillations. Too low a setting may result in the vessel taking too much time to respond to imbalance conditions. See page 37, Section B for details.

Range: 00-20 This setting is normally in the range about 03 to 08. Adjustment outside of this range is needed only in exceptional circumstances.

GAIN Rudder Ratio Gain: This is coarse adjustment of the amount of rudder applied for a given course error. It requires adjustment from the default setting of 01 only on very hard to steer vessels. A higher setting results in more rudder being applied for a given course error. If the RUD setting is between 05 and 10 for normal operation do not adjust the GAIN. Too high a GAIN setting will

cause oversteering oscillations. If you get too much rudder on 01, shorten dimension "X" on the rudder reference. See the drawing on page 9 Section B. See page 35, Section B for GAIN setting details.

Range: 01-10 This is left on 01 in all but the most exceptional circumstances.

RDB Rudder Dead Band: Sets allowable rudder position backlash due to steering system slop, etc. It prevents excessive rudder actuation. A higher setting will result in less steering system actuation and wear, but too high a setting will result in poorer course holding. A setting over 07 usually indicates that the steering system is worn and needs maintenance. Too low a setting will cause rudder jitter at dockside. This has a default value of 03 and is normally set as low as possible at dockside without the rudder hunting back and forth. See page 21, Section B for adjustment details.

Range: 00-20 (0 degrees to 2 degrees) If in doubt, leave this on 03.

RLIM Rudder Limit: Sets maximum rudder limits. If the limit is set too high, it may result in the rudder hitting its end stops, possibly damaging the vessel. RLIM is normally set as high as possible without the rudder hitting the end stops. Too low a setting will result in limited rudder travel, which may cause sluggish control. However, limited rudder travel may be desirable in boats with very fast rudders. If the setting is 05 (02 for example) or less for ± 30° rudder travel see the drawings on pages 9 and 10 in Section B. You may have to shorten dimension "X". Failure to adjust this will result in overly sensitive autopilot action, instability in some directions and oversteering problems. See the rudder reference unit's installation instructions and page 21, Section B for further details.

Range: 01-10 (3 degrees to 30 degrees) This is normally never used below 05.

DAMP Compass Damping: Damps the input received from the Compass Sensor. Increasing this setting slows down the rate at which the compass detects changes in direction. Leave it in the default setting of 01 unless you must mount the compass high up on the vessel or you have extremely rough seas. Too high a setting will result in poor course holding. A low setting may result in excessive jitter in the compass heading display in some exceptional installations. If in doubt, leave this adjustment at 01. See the Installation Section B, page 12 concerning compass location.

Range: 01-10

PSIG Power Steer Gain: Sets the amount the rudder moves for a given rotation of the knob on the power steering remote. The higher the setting, the more the rudder will move for a given amount of knob rotation. Too high a setting may result in very touchy power steering. See page 37, Section B for details.

Range: 01-10

AUTO-DEV Automatic Deviation: Activates the auto-deviation correction procedure for the Compass Sensor. The Automatic Deviation procedure is carried out as part of the sea trials on initial installation of the system or after major service. See page 31, Section B for the procedure.

CONFIG Configuration: Selects preset pilot adjustments for planing, semi-displacement or displacement hulls. Details are described on page 26, Section B.

SEA TESTS AND ADJUSTMENTS

Read these instructions all the way through before starting adjustments.

Do NOT turn on the autopilot until after the engine has been started and the supply voltage has stabilized. Starting the engine with the autopilot switched on may damage it.

1. CLEARANCE: The autopilot mode must not be engaged until there is at least twice and preferably four times the clearance for a 360 degrees turn in either direction at most any speed. Do not turn it on near shore, buoys, other boats or anything.

2. SEA CONDITION: Sea trials should be carried out in average sea conditions for that vessel. Do not attempt them in rough conditions.

3. Make sure the CONFIGURATION has been set for this type of vessel.

AUTOMATIC DEVIATION CORRECTION

Before making any other adjustments, Automatic Deviation Correction must be carried out. If this cannot be carried out due to the size of the vessel and restricted waters use the Compass Sensor without correction.

WARNING: If not done, the compass readout may be inaccurate and there may be some control instability in some directions, especially north.

PREPARATION

The automatic deviation correction procedure enables the compass deviation to be automatically compensated based on a 360 degree constant rate starboard turn.

The vessel should be well away from any potential sources of error such as steel bridges or large ships, and be in calm water.

MAKE SURE THE TRANSIT SCREW HAS BEEN LOOSENED OR REMOVED FROM THE COMPASS SENSOR BASE.

Power up the system and check that the displayed heading agrees approximately with the known ship's heading. Check this approximate agreement through 360 degrees to see that the display follows correctly and that the system is fully operational and no wiring errors exist.

The Teleflex AP2577 compass sensor is able to correct for deviations up to a maximum of 45 degrees. However, in extreme cases, residual errors are likely to remain after correction. The larger the initial deviation, the less accurate the final correction.

Note: Initial deviations greater than 10 degrees may affect autopilot steering performance and will make the heading display inaccurate.

AUTOMATIC DEVIATION CORRECTION PROCEDURE

The actual correction routine starts when the vessel passes North and continues through a 360 degrees Starboard turn. Make a smooth turn that lasts between 1 and 2 minutes. With a twin engined craft, use the engine controls to spin the boat. With a single engine boat, use ~~hold~~ the wheel or tiller ~~in place~~ and adjust the engine speed to give a circle approximately 50 metres or 160 feet in diameter at a speed of about 8 kph or 5 knots. Allow the vessel to make at least one complete turn before you start the calibration. This ensures the vessel is being turned at constant speed.

Maintaining a constant turning speed is esential for good results. Use a constant amount of helm and engine speed with relatively calm conditions. Tide will not affect the results but excessive wind or swell may cause large errors.

a) First access the installation adjustments. Hold down the ADJUST SELECT button about 3 seconds, until "CONFIG" is displayed.

b) Press ADJUST SELECT again and again until the display reads "AUTO-DEV". Press "DISPLAY/SET" once, if the compass has been previously been corrected, the word "CORRECT" is displayed. Clear the old compensation by pressing "DISPLAY/SET" twice. The display then shows "CLEAR". If the compass has not previously been compensated, the display reads "CLEAR" as soon as "DISPLAY/SET" has been pressed once.

c) Turn the vessel through 360 degrees to starboard and observe the display. If an error code appears, the magnetic field strength is too low or too high. Error codes are described on page 34, Section B

d) When the vessel is settled into its second turn make sure no error codes have been displayed (if you get an error code correct the condition before proceeding). When the vessel is between West and North, press "DISPLAY/SET" twice more. The display will ~~still~~ read INIT'D. "~~CLEAR~~". When the vessel passes North, the display will change to "RUNNING". When the circle is complete and the unit accepts the measurements, the display shows "CORRECT". If there are errors, the digital display shows an error code. Clear it by pressing the "DISPLAY/SET" key. If you wish to repeat the calibration, repeat as above.

Press Standby/On ~~or Auto~~ to return to Standby

AUTO DEVIATION ERROR CODES

2 Magnetic field strength too high. The sensor is probably mounted too close to the engine or other large metal body. You may have to relocate the compass sensor.

3 Magnetic field strength too low. The sensor may have to be mounted higher up in the vessel due to magnetic shielding caused by the hull.

6 Calculation overflow. This means that the micro computer has been unable to complete the necessary calculations. Pressing DISPLAY/SET may not reset the system and you may have to switch the system off, then on again, to reset it.

If you get error codes 2 or 3, try moving the Compass Sensor farther away from metal objects such as the engines or radio frequency emitting devices, such as the radar or radios. See the compass sensor installation instructions on page 12, Section B.

Recompensation will be required if the autopilot is moved to another vessel.

Note: These error codes may be displayed at any time. They are not dependent on an Auto-Deviation being carried out. However, they appear only after "DISPLAY/SET is pressed with AUTO-DEV displayed.

STOP HERE: Try the vessel now on FAST and SLOW presets as described on page 7 Section A. If the presets do not work well try adjusting the rudder and response settings. If the operation is satisfactory, stop here. Use the tests that follow to verify the operation. Only if further adjustments appear necessary should you adjust any settings. The factory presets are satisfactory greater than 75% of the time.

Make adjustments until the vessel operates properly under one set of conditions, at either slow cruising or high speed running, with the PILOT preset in position FAST or SLOW.

DAMPING ADJUSTMENT

This allows the signal from the FLUX GATE COMPASS SENSOR to be damped. Normally you do not need to adjust this setting unless the Compass Sensor is mounted high above the water. An example of this would be on the mast of a steel hulled vessel. If the heading display jitters excessively in rough weather, increase the setting.

RUDDER AND RUDDER GAIN ADJUSTMENT

At a low speed, engage the "AUTOPILOT". If the rudder goes hard over to one side, either the rudder reference unit or the pumpset wired are backwards. Correct this before you proceed any further. Refer to page 21, Section B for the test procedure.

If the vessel is under steering (i.e. too little rudder gain correction being applied as per page 9 Section A) increase the rudder (RUD) setting. If too much rudder is being applied and the vessel is oversteering, decrease the setting. The usual problem is oversteering.

If the rudder setting that works for your vessel is between 15 and 20, increase the rudder gain (GAIN) and reset the rudder (RUD) so that for average conditions you are operating in the region of 05 to 10. If the rudder setting is between 00 and 04, decrease the rudder gain as above so the rudder operates in the region of 05 to 10. If the rudder gain is already at 01, reduce length "X" on the rudder reference. See page 9 Section B for an illustration and page 28, Section B for further information.

CHECKING THE COUNTER RUDDER SETTINGS

Increase vessel speed to normal cruising. Make sure the rudder (RUD) is set to allow for good, stable straight ahead cruising. Use the COURSE CHANGE and turn the pilot through 90 degrees. Observe the overshoot before the vessel stabilizes on the new course on the vessel's compass. It should be about 10 degrees. If a larger overshoot occurs, increase the setting of the counter rudder. If the vessel approached the new course very slowly, decrease the counter rudder setting until a small amount of overshoot occurs.

Make these turns in alternating directions as constantly turning in one direction will build up a large amount of automatic trim correction that will give you false symptoms.

After making this adjustment, you should repeat the rudder adjustments as these adjustments interact with each other.

WARNING: Too little or too much counter rudder can set up oversteering oscillations. The best C/R setting is usually about the same or slightly less than the "RUD" setting.

Check autopilot operation at high and low speeds and on various courses. If in doubt use the default setting. If you get oversteering oscillations, return the vessel to manual control and stabilize it before trying to continue the adjustments.

WARNING: Commercial vessels, such as fishing boats, are normally harder to steer and usually need a counter rudder setting higher than that needed for a pleasure boat, often slightly higher than the RUD settings.

TRIM SETTING

On single propeller vessels it is only possible to check the trim setting during conditions that cause the vessel to steer with an offset rudder. Therefore, the correct trim setting can only be found through experience. If at certain times the vessel is constantly going off it's heading in the same direction, more trim may be needed.

To check trim on twin engine vessels, run the boat under pilot command with both engines running, then reduce (increase) the RPM on one of the engines so that it is running at half (twice) the RPM of the other. The vessel will initially go off course but should return to course within 60 seconds. If the vessel takes longer, increase the value set for trim.

At low RUD settings, a higher trim setting can make the trim control take over the steering of the boat. The result may be a slow variation of the course, back and forth. It is suggested that the trim setting should seldom be very much larger than the RUD setting.

POWER STEERING ADJUSTMENT

Adjusts the amount the rudder moves for a given rotation of the knob on the power steering remote. The higher the setting, the more the rudder will move for a given amount of knob rotation. Too high a setting will result in very touchy power steering.

Begin the sea trials with the power steering gain set at 05 (This is the level selected by the preset pilot configuration), then increase or decrease the setting as required.

NAVIGATOR INSTALLATION ADJUSTMENTS

If a navigation receiver is used, test it at this point. If the autopilot seems to respond violently to data from the navigation receiver or if it seems slow to respond, check the navigator installation adjustments starting on page 39, Section B.

ENTERING THE ADJUSTMENTS IN THE PILOT PRESET MEMORY

Record these settings by shutting off the Teleflex 301 with the POWER OFF button.

Then, turn on the Teleflex 301 again and make another set of adjustments for a second operating condition with the PILOT preset in the other position and shut off the pilot with the POWER OFF button.

Now, you need only change PILOT presets between FAST and SLOW rather than make multiple adjustments when your operating conditions change.

After completing these sea trials, the data will be stored in the microprocessor memory until future adjustments are made. You should record these settings on paper in case they are accidentally changed by an operator.

If you must return to settings that existed the last time the pilot was turned off, use the pilot adjustments to select "RESTORE".

WARNING: PILOT DATA IS NOT STORED UNLESS THE PILOT IS TURNED OFF WITH THE "POWER OFF" BUTTON

NAVIGATOR INSTALLATION DISPLAYS

a) To access navigator adjustments, hold down the ADJUST/SELECT button until "CONFIG" appears in the display.

b) Press ADJUST/SELECT repeatedly until you see a display of "VAR-E00".

c) SET MAGNETIC VARIATION: The system is set up so that magnetic bearing to waypoint is the preferred operating system. This requires that the navigator sends magnetic bearings to waypoint. Check to make sure it does so or that it may be programmed to send magnetic bearings. NO VARIATION should be entered into the pilot.

If only true heading output is available from the Navigation receiver, then VARIATION MUST be entered into the pilot so that correct magnetic headings may be derived.

If the Navigation Receiver is sending NMEA 0182 or 0183 data with true headings only, enter the local variation from your charts. Do not adjust the variation if you only have NMEA 0180 data available. This ensures the vessel turns to the correct heading when selecting the next waypoint. See the section on Navigation control principles on page 16 Section A.

Range: W45-E00-E45

d) To adjust the setting, press DISPLAY/SET and the setting number will increase. To stop increasing the setting, press DISPLAY/SET again and it will stop.

e) To decrease the setting number, push DISPLAY/SET a third time. To stop the decrease, press DISPLAY/SET a fourth tine.

f) At any time, to move to the next adjustment, press ADJUST/SELECT.

g) SET DATA FORMAT FROM NAVIATION RECEIVER: Select NAVD-0. Set for data format from your Nav Receiver.

Choices: NAVD — 0 (NMEA 0180)
NAVD — 1 (NMEA 0182)
NAVD — 2 (NMEA 0183A)
NAVD — 3 (NMEA 0183B)

Note: If the nav receiver uses NMEA 0183 and you are not sure which version is used, try NAVD-2 first. Then if 2 does not work try NAVD-3.

Note: Any format change is not read by the microprocessor until the POWER OFF button is pressed.

h) SET NAVIGATOR GAIN: During sea trials, set navigator gains, "NAVG__". If the navigator gain is set too high, the vessel, when under navigator control, will make excessively large step corrections in the pilot's attempts to return the vessel to track. The idea is to set this gain as high as possible without inducing this effect.

If the gain is set too low, the pilot will be unable to keep the vessel on track. Settings over 04 are only required in exceptional circumstances. If in doubt leave this at the default setting.

i) To go back to your previous mode of operation, press the button for that operating mode, STANDBY/ON, AUTOPILOT or NAV PILOT.

CAUTION: Changes to the settings are not stored until you turn off the pilot using the "POWER OFF" button. If the pilot is shut off with the circuit breaker on your electrical panel, the new data will be lost.

SECTION C

Servicing Instructions & Trouble-shooting

While it is possible for a user to service the autopilot, at times a skilled field service technician and digital voltmeter are required. If you are not confident you can handle the servicing, do not attempt to field service the system. You may void your warranty.

SYSTEM SUMMARY

The basic system consists of the following:

Electronic Fluxgate Compass Sensor providing heading input.

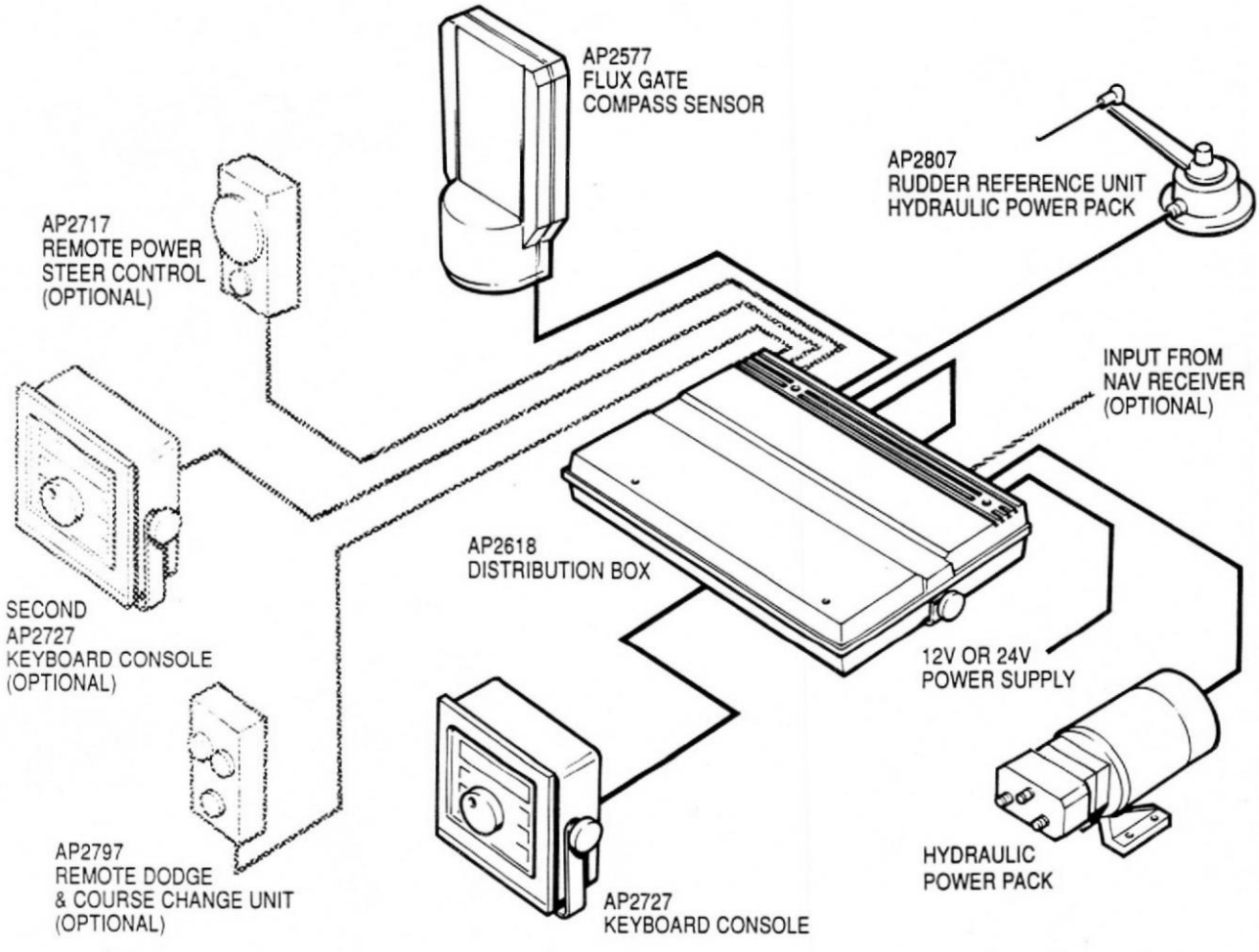
Keyboard Console.

Rudder Reference Unit providing rudder position information.

Distribution Box.

Drive motor or solenoids to activate the vessel's steering system (hydraulic or mechanical).

In addition, there are remote controls for power steering, dodge and course change. The distribution box includes inputs for a Navigation Receiver and a second Keyboard Console.



TROUBLESHOOTING

If the problem component cannot be identified from the following information, the owner should consult a Teleflex autopilot dealer or if no dealer is available call customer service at (604) 270-6899 Pacific time from 9:00 AM to 4:30 PM.

GENERAL PRINCIPLES AND CAUTIONS

1. Before you attempt to connect or disconnect any wiring to the system, first turn off the DC power supply at the power distribution panel. The line drivers in particular may be damaged if any of the wires are shorted to each other with the power on.

2. When installing or updating wiring, always double check the colour coding before switching on the power.

3. A Keyboard Console must be connected to Port A for correct operation. Double check to make sure the brown and violet wires are connected to the ON and OFF terminals.

4. Do not use a simple VOM type analog meter to check powered up digital logic lines or signal lines. Use a DVM or an oscilloscope.

5. **NEVER unplug boards with the power on.**

6. Do not use an analog VOM or multimeter on the R X 1 range to test the Rudder Reference Unit. These can put out enough current to damage the potentiometer. Instead, use a digital volt meter.

7. Never attempt to repair a board. Your full service dealer can arrange for a replacement with a factory rebuilt board or for repair if time permits.

ALARM AND FAULT DISPLAYS

These messages may appear on Keyboard Console display when there is a fault.

KEYBOARD CONSOLE FAULTS

No data from Distribution Box: Usually a wiring fault.

Corrupted data : The microprocessor has been unable to complete the necessary calculations. Press "POWER OFF" then "STANDBY/ON".

Bad Cheksum : Usually a power disturbance has affected the internal data. If the fault is not cleared by pressing "POWER OFF" then "STANDBY/ON" you may have bad connections or a major system failure.

SYSTEM FAULTS

In many cases, a message describing the fault may be accessed by pressing the DISPLAY/SET button. See page 12 Section C for more information on NAV alarms.

No navigator data available: NAV receiver may not be switched on. Also check the navigator connections and make sure the nav receiver is programmed correctly.

Navigator data timed out : This means that the nav receiver has stopped sending data. Try pressing "NAV PILOT" to clear the alarm. If this does not help, check that the Navigation Receiver is working properly and that the nav connections in the distribution box are secure. If not, If not select compass control by pressing "AUTOPILOT".

Navigator alarm condition: This means that the data sent by the nav receiver is unintelligible to the autopilot. Try pressing "NAV PILOT" to clear the alarm. If this does not help, switch to compass control by pressing "AUTOPILOT". Check the nav receiver's programming. Navigator control can only be resumed when alarm condition is removed.

Incorrect navigator message: This means that the data sent by the nav receiver cannot be interpreted by the autopilot. Try pressing "NAV PILOT" to clear the alarm. If this does not help, switch to compass control by pressing "AUTOPILOT". Check the nav receiver's programming. Navigator control can only be resumed when the alarm condition is removed.

Data overflow: This means that the autopilot's microprocessor has become confused, usually by extreme system power surges or RF interference. To clear the alarm, try pressing "NAV PILOT" key. If this does not help, press "POWER OFF" then "STANDBY/ON" to reinitialize the system

Battery voltage to low for proper autopilot operation: To clear the alarm, press the key for your present operating mode. Check the voltage of the vessel's power system.

Intermittent power disconnection: To clear the alarm, press the key for your present operating mode. Check the power wiring to autopilot. Caution: any data changes you have made to pilot memory, since pilot was last switched off using the "POWER OFF" button may be lost.

Failure of motor power supply: Check DC power supply to the MOTOR SUPPLY + & - terminals in the distribution box.

SYSTEM FAULT (SFLT) CODES

Certain faults as described on the next page are indicated by a fault number and an audible alarm is sounded. The display shows "SFLT 000".

If system fault codes appear:

1. Press DISPLAY/ SET. A help message may be displayed indicating possible action to be taken.

2. Press the key for your present operating mode. If the fault was only a temporary fault, the alarm will be cleared. Otherwise refer to the troubleshooting guide starting on page 8 Section C.

* This error occurs when one Keyboard Console in a multi-Keyboard Console system fails. It can be temporarily cleared to allow system operation by disconnecting the faulty Keyboard Console after shutting off the power.

**** These faults indicate serious hardware malfunction. If this condition persists and cannot be cleared, consult a Teleflex distributor.**

DISP.	FAULT	SEE ITEM IN TROUBLESHOOTING GUIDE
002	Backup memory fault	**
032	Timeout for port read	3 or 4 *
033	Timeout for port read	3 or 4 *
034	Timeout for port read	3 or 4 *
036	Compass message fault-bad format	4
064	Internal malfunction	**
065	Message run over of port input buffer	3
066	Port message checksum error	4
067	Encoder line failure	**
128	RAM memory error	**
129	EPROM checksum error	**
160	Compass timeout	**
161	Timeout. No message received	**
162	Bad message after 10 tries	**
163	Command length error	**
164	Compass error. No valid data	6
165	Compass error. No valid data	6
192	Internal malfunction	**
193	ADC timeout for rudder reference.	**
196	ADC clock overrun error. Clock elapsed before ADC read complete	7
197	Ghost rudder requested on a spool valve system	8
224	No rudder movement detected. Possible actuator or rudder reference unit failure	9

TROUBLESHOOTING GUIDE

Some of these checks require the use of a meter. The operator may do them himself if he has a digital voltmeter. Consult a technician if you are unsure of what to do.

1

System will not power up

Check that DC power is available and check fuses.

Check wiring to ON (Brown) and OFF (Violet) terminals in the distribution box on port A.

Check that the Distribution Box ON (Brown) terminal has +4 to +5 volts present and that it changes to 0 volts when the Keyboard Console's STANDBY/ON button is pressed.

Check that the OFF (Violet) terminal goes to +5 V when STANDBY/ON is pressed. If not, the fault may lie in the power supply in the distribution box or the Keyboard Console. Check that DC voltage appears on Terminal V+ when STANDBY/ON is pressed.

If not then a power supply section fault in the distribution box is likely. Retest the system. If the symptom persists, replace the distribution box's board.

2

The display on the keyboard console activates momentarily then goes blank and the system shuts down

The automatic test circuit is causing system shutdown. A fatal flaw has been detected in the Distribution Box.

Remove the cover and internal shield from the Distribution Box and check that the large ICs are fully seated in their sockets.

Check for any loose material that could be causing short circuits on the board.

Retest the system. If the symptom persists, replace the distribution box's board.

3

Pilot powers up but displays "SFLT 032, 033 OR 065"

Try turning the system off, then on again. This display is often caused by power glitches. If the system powers up OK on the second try, don't worry about it unless it happens repeatedly.

4

Pilot completes power up sequence but displays an SFLT fault code which cannot be reset

Normally this can be traced to a wiring error. Make sure there is a Keyboard Console connected to Port A.

Make sure power is being supplied to the Keyboard Console and the Compass Sensor. Check the V+ terminals

SFLT 066 often indicates missing or incomplete data from the compass. Open the compass and check that the connectors are fully seated. If you see a loose wire in one of the white nylon AMP connectors, you can usually reseat it in the connector using a very small flat blade screwdriver. If there is no obvious fault, try another compass if you have one available,.

SFLT 036 usually indicates a cable or wiring fault.

SFLT 032, 070 or 072 usually indicates a faulty Keyboard Console UNIT. In a multi-console system, remove all but one Keyboard Console and try each in turn on port A to isolate a faulty unit. Open the faulty unit and check that all the plugs and ICs are properly seated in their sockets. Also check for shorts or water contamination.

5

SFLT 033, 034, 070, 071 or 072 Occur during normal operation

This indicates a Keyboard Console fault has occurred. Proceed as for SFLT 032 (see 4 above).

6

SFLT 164 or 165

This indicates a Compass Sensor output fault that might be caused by a wiring error or compass failure. Check the compass connections in the distribution box and in the compass.

7

SFLT 196 Occurs during normal operation

This indicates a possible component failure, possibly the A/D converter. Excess electrical noise problems can also cause this error. If it persists, a new distribution box circuit board should be installed. Also see item 10.

8

SFLT 197 or 224 Occur after the power up sequence. System powers down for no apparent reason and cannot be restarted

These messages indicate loss of rudder reference. Check the connections to the rudder reference unit.

Use a DVM to check for approximately 2.5 Volts at the rudder reference SIG terminal (white wire) when the rudder is centred.

Check for 5 volts between the Red and Black wires. See items 1 and 2 as well.

9

SFLT 224 Occurs anytime

This could mean actuator failture. Check it and the connections on the rudder reference unit. See also Item 8

10

System powers down when a transmitter or other RF device (radar, etc.) is keyed , or if anothe device using high current such as winches, appliances etc. are operated

This could occur if RF energy is being injected into the power cables or the system components at very high levels. The Teleflex 301 autopilot has been exhaustively tested to withstand RF injection and radiation at levels far above those considered safe. Antenna mismatch with high SWR can cause dangerous conditions. In the interest of operator safety the radio installation should be inspected immediately.

A more normal situation can occur if the transmitter or other high current unit is being supplied from the same battery as the pilot. When the device is operated, the battery voltage may drop below the level required to maintain the pilot. This would be particularly noticeable if the battery has a bad cell or corroded connections. Check the batteries, including specific gravity of each cell. Separate batteries are recommended for the transmitter.

11

Pilot engages but motor does not drive

Check supply to motor controller.

Check fuses in the Distribution Box. They are type "GMA". The amperage is marked on each fuse.

Check that the relay in the distribution box switches when going from STANDBY to AUTO mode.

If not, suspect a fault in the 8 V logic supply in the FET drive circuit. If this is missing, replace the board.

With a DVM, check the voltages on the PORTU and STBDU lines. They are on "IC5", a TL504 optocoupler, pins 2 and 4. These are the drive commands to the FETs.

Pin	2	4
ON course	+5V	+5V
Port drive	0V	+5V
Starboard drive	+5V	0V

If these voltages are not correct within 1 volt, then suspect a fault in the opto couplers or a component failure on the main board.

If they are correct, the current limit may be set too low, especially if a non Teleflex motor is used. See current limit setting on page 18 section C.

12

Motor will only drive one way

Current limit may be set too low. See current limit setting on page 18 section C.

If adjusting the current limit makes no different one or more FETs may have failed. Replace the circuit board in the distribution box.

13

Motor drives both ways but lacks power

Current limit may be set too low. See the section on current limit setting.

Motor may be faulty. Check the brushes, etc.

On hydraulic systems, check fluid level.

Motor cable or heavy-duty supply cable is too light. Rewire with heavier gauge wire.

14

Motor drives but relay clicks out repeatedly

Indicates excessive voltage drop in motor supply. Check cable connections.

Make sure the terminal strip motor terminal screws are tight.

Insufficiently charged or defective battery.

Faulty motor. Check brushes, etc.

Faulty voltage regulator or alternator on vessel.

15

Motor drives rudder hard over when pilot is engaged

Rudder reference red and black wires reversed.

Motor wires reversed.

16

Error messages appear when NAV PILOT pressed

◁ NO NAVGR ▷

Indicates that no signals have been received on the NAV port. Check the NAV LED on the Distribution Box PC Board which flashes to indicate incoming data.

If possible, check that the navigation receiver is sending data.

Check wiring. A two wire cable should be connected to SIG+ and SIG-. If you are unsure of the polarity, reverse the cable. The centre conductor should be connected to SIG+ and the shield to SIG-.

◁ NAV TIME ▷

Indicates a loss of navigator signal or incorrect format. The time out period for loss of cross track error information is 60 seconds.

Check that correct format is entered on the Nav.

Check navigator wiring.

The comments that follow also apply.

◁ NAV DATA ▷

Indicates that the navigation receiver has sent an invalid character or statement.

This may be caused by turning on the navigation receiver with the pilot already turned on. Reset the error on the navigation receiver and continue. Consult your nav receiver's manual.

If this message occurs repeatedly, suspect intermittent wiring, noise on the line or a defective navigation receiver.

Nav receiver defective on that data format. If the navigator can be changed to another format, try it. If on NMEA 0183, try NMEA 0182. If this does not correct the fault you may have a defective nav receiver.

Navigation receiver does not fully adhere to NMEA standards. If you suspect this is the problem, consult the nav receiver manufacturer.

17

Display difficult to see

The display has a viewing angle of 45 degrees. If the display is mounted overhead, it may be hard to read. The display may be removed and reversed in its socket to cure this. However, the decimal points will be at the top of the display rather than the bottom.

18

Keyboard console malfunction

If the keyboard/display unit appears to be malfunctioning, first check that the wires are firmly seated in the white AMP style connector. If any appear to be loose, reseat them with a very narrow slot type screwdriver. Also check the flexible strip from the keyboard to the printed circuit.

A technician may try a new 74AC240 IC.

19

Compass sensor malfunction

If the compass unit appears to be malfunctioning, check that the wires are firmly seated in the white AMP connector. If any appear to be loose, reseat them with a very narrow slot type screwdriver.

A technician may try a new 74AC240 IC.

20

Intermittent NAV

POWER LINE INTERFERENCE: Make sure the navigator is operated from a different power source than the actuator motor. On vessels with two battery systems, the actuator motor should be wired to the battery normally reserved for starting the engines. This is allowable as the actuator is never used unless the engine is running and it will not drain the battery.

21

Handling problems

If the vessel is not holding course well on any heading, you should consider the following possibilities.

SETTINGS WRONG: You may be operating the pilot with the response or rudder settings turned up too high. Review the operating instructions in Section A.

COMPASS SENSOR: Your Compass is in a location where it cannot detect the earth's magnetic field properly. This may be a problem if it is mounted low in a steel hull. Check it for deviation with a hand held compass.

If the heading seems to go to port, then starboard, or vice versa, or the compass display goes up, then down, or the vessel wants to turn in only one direction, this is often caused by breakage of one of the flexible connecting wires in the compass sensor between the flux gate coils and the pendulum mounting board.

COUNTER RUDDER: You may have the counter rudder set too low.

RUDDER DEADBAND: You may have the rudder deadband set too high.

TRIM: You may have the trim set too high. At low rudder settings, high trim settings can make the trim take over the steering of the boat. The result may be a slow variation of the course, back and forth. Adjust the trim setting so that it is not much greater than the rudder setting.

RUDDER GAIN: To prevent oversteering you may require less rudder gain if the craft has a very efficient rudder. See the illustration on page 9 Section B. Reducing "X" has the same effect as reducing the rudder gain if this has already been set on 01. See pages 28 and 36, Section B for setup information.

PUMPSET: The hard-over to hard-over time may be too slow. You may notice the vessel drifting off course then overshooting badly. Best performance is when the hard-over to hard-over time is in the range of 10 to 14 seconds.

SLOPPY STEERING GEAR: There is excessive slop in the steering gear. There should be little or no backlash in the system.

SHROUDED PROPELLER: You may have a shrouded prop that causes the rudder to be located in a zone of deadwater. The rudder turns a lot around the centre position with little effect. Then, when it reaches a certain point, the vessel suddenly turns. Try operating with the PWM turned off.

LOOSE BALL JOINTS: You may notice oversteering that comes if the ball joint on the rudder reference unit has come loose. This, or any other cause of backlash between the actuator and the rudder reference unit can cause problems. These conditions usually show when you have to set the rudder deadband (RDB) adjustment to values greater than 5 to prevent the rudder from hunting while at dockside.

STEERING WHEEL DEVIATION: If you notice course deviation at some times but not at others, check that your compass is not too close to the steering wheel. Sometimes, a wheel with metal spokes can alter the deviation on a compass mounted nearby.

OPENING THE UNITS

KEYBOARD CONSOLE

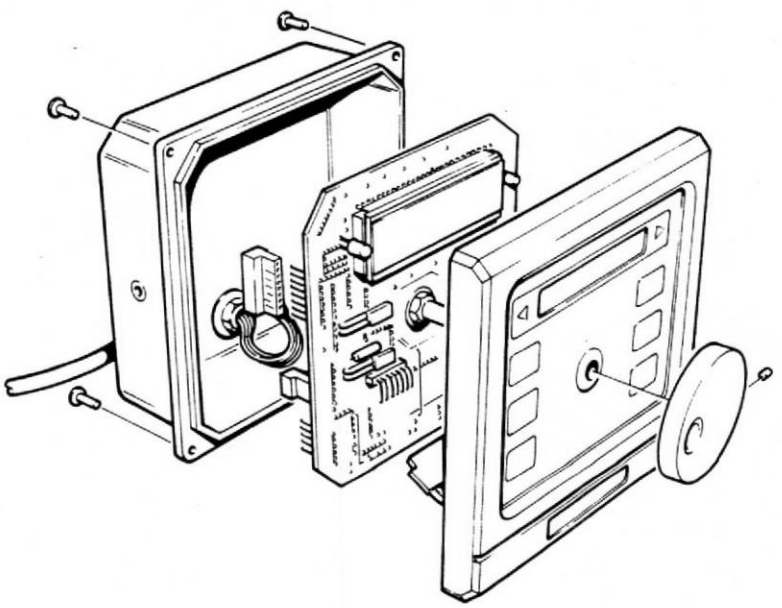
1. Remove the Keyboard Console from its bracket or from the instrument panel. When it is flush mounted the unit will pass through the hole in the instrument panel for removal.

2. Remove the four screws from the rear of the case.

3. Remove the knob with a 1.5 mm Allen wrench. Ease the front panel away from the rear and unplug it from the printed circuit.

4. To remove the circuitry for service, remove the two screws holding the printed circuit then unplug the input cable's connector from the printed circuit.

5. When re-assembling the unit, reverse the above procedure and make sure that the flexible strip to the Keyboard is not pinched between the case halves and remember to install the ring around the course change encoder.

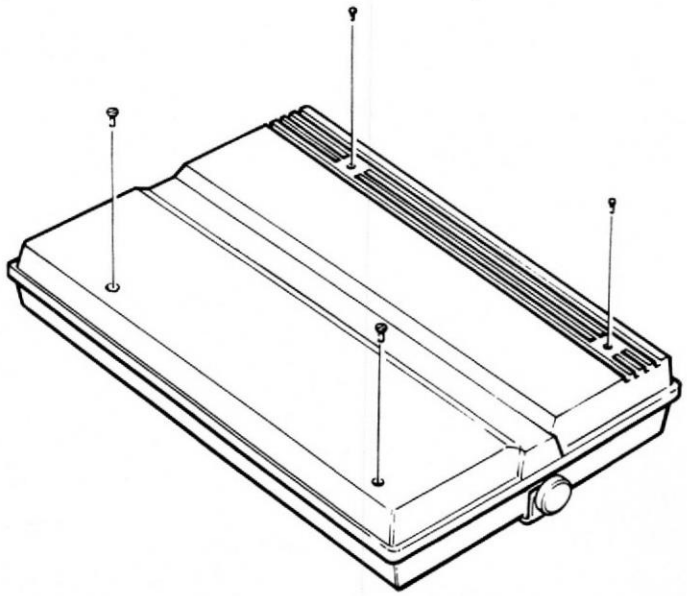


DISTRIBUTION BOX

1. The top cover is held on by four screws. Remove these screws to completely remove this cover. This is all that is required to connect the wires. Proceed further only if troubleshooting the unit.

2. Remove the cable clamps to allow cable removal. See the drawing on page 6 Section B for the wiring layout.

3. Remove the knobs from the side to remove the entire distribution box for service, leaving the bracket in place.



ADJUSTING THE CURRENT LIMIT

The Teleflex 301 Autopilot has an adjustable current limit that is preset at 26 amps to accommodate Teleflex motors and should NOT be adjusted except by trained personnel. Serious damage to the motor control circuit can occur if the limit is set too high. This adjustment should only be made after all other options have been examined.

The adjustment is made with the trim pot VR1 to the upper right of the large terminal block. Remove the sealing sticker from it before adjusting and replace it afterwards.

Turn the trim pot clockwise to increase the current limit and counter clockwise to reduce the limit.

1. Push the AUTO button to engage the relay.

2. Turn the course setting knob to turn over the motor.

3. In 1/10 turn increments, counter clockwise, reduce the current limit until the motor stops running when the course knob is turned.

4. Now, increase the current limit by 1/10 turn increments until the motor just runs freely both ways. Note: the point of free running may be slightly different in the two directions due to component tolerances. However, if it is appreciably different (more than 1/10 of a turn) suspect a fault in the FET drive circuit. FET failure is possible.

5. To allow for added rudder loading at speed, turn the trimmer an additional 20° or 30° clockwise.

6. The motor should now run freely both ways with adequate power while allowing for reasonable circuit protection.

SALT WATER ENTRY

While the Teleflex 301 system components are water resistant and some parts, such as the Compass Sensor and remotes, are even classed as waterproof, they are not rated as submersible. Salt water exposure must be minimized.

If the Keyboard Console, Distribution Box or motor are ever immersed in salt water of if you know for sure that salt water has entered any component, it will become a write off if immediate action is not taken.

In these cases, immediately cut the power to the system and remove the affected component. If it is the Keyboard Console, remove the back.

Immediately plunge it into fresh water and rinse, rinse and re-rinse it again. At sea, rain water may not be fresh enough since in stormy conditions, sea spray contaminates rain water.

After rinsing, if possible, blow out the rinse water with compressed air. Failing that, blow the water out yourself. Use a drinking straw to direct the air. Use a hair dryer, if you have one, but don't heat the unit you are drying greater than 120° F or 50° C.

If it is sunny, use the heat of the sun to dry out the unit.

Do NOT re-connect or attempt to use the component until it is checked out by a qualified technician. You won't be able to use it in the meantime, but at least you may have saved the cost of a new one.
Note: Submersion of the product and this procedure invalidates the warranty.

SECTION D

User Parts List

COMPASS PART # AP2577

- MOUNTING BRACKET AP2014
- CABLE ASSEMBLY - 6 Conductor AP0401
- EXTRA CABLE AP1310
- CONNECTOR, 6 Way, Female AP0192
- FUSE, Type GMA0.5-500mA Box of 10 ..... AP0108
- WATERPROOFING GASKET AP2117
- PCB SET AP2557 Compass Module PCB + Coil
- (Also available as an exchange) AP0022
- SCREW KIT Lid Fixing Screw Kit AP0228
- SCREW KIT Transit Screw Kit AP0229

DISTRIBUTION BOX # AP2618

- FUSE Type GMA1.25-1.25A-SB Box of 10 ..... AP0117
- FUSE Type GMA3-3A-FB Box of 10 ..... AP0118
- FUSE Type GMA5-5A-FB Box of 10 ..... AP0120
- MOSFET IRFZ44 ..... *AP5064
- MOSFET IRFZ9523 ..... *AP5014
- WING NUT AP0409
- PCB, MAIN CONTROL
- (Also available as an exchange) AP0054

POWER STEER REMOTE # AP2717

- CABLE ASSEMBLY AP0422
- EXTRA CABLE AP1308
- CONNECTOR, 5 Way, Female AP0191
- HOLDER FOR HAND HELD UNIT AP2027
- CONTROL KNOB AP4007
- POTENTIOMETER,1000 OHM, Waterproof.... *AP2202

KEYBOARD CONSOLE # AP2727

- MOUNTING BRACKET AP2004
- CABLE ASSEMBLY AP0408
- EXTRA CABLE AP1313
- CONNECTOR, 8 Way, Female AP0193
- PROTECTION COVER,Teleflex AP5060
- LIQUID CRYSTAL DISPLAY *AP4105
- COURSE CHANGE ENCODER *AP2218
- GASKET, CASE FRONT TO CASE REAR AP2133
- COURSE CHANGE KNOB AP2410
- MOUNTING KNOB AP2411
- FRONT PANEL ,MEMBRANE,Teleflex *AP4086
- PCB, MAIN CONTROL
- (Also available as an exchange) AP2006

DODGE/ COURSE CHANGE REMOTE # AP2797

CABLE ASSEMBLY, 6 Cond,7/0.2	AP0656
EXTRA CABLE	AP1310
CONNECTOR, 6 Way, Female	AP0192
HOLDER FOR HAND HELD UNIT	AP2027

RUDDER REFERENCE UNIT # AP2807

EXTENSION ARM	AP0042
BALL SWIVEL	AP2257
CABLE ASSEMBLY, 3 Cond.	AP0669
EXTRA CABLE	AP1304
CONNECTOR,3 Way, Female	AP0189
LEVER ARM	AP5031
POTENTIOMETER, 2000 OHM,Waterproof....	*AP2205

*Requires skilled personnel to install
Other parts are available from the factory on request.
Call(604) 270-6899 for information.

WARRANTY

TELEFLEX (CANADA) LTD. MARINE ELECTRONIC PRODUCTS LIMITED WARRANTY

Teleflex (Canada) Ltd. warrants, to the original retail purchaser,that Marine Electronic Products, supplied by Teleflex (Canada) Ltd. have been manufactured free from defects in materials and workmanship.

WARRANTY TERMS

For six (6) months from date of purchase, Teleflex (Canada) Ltd. will provide replacement or exchange of defective parts or assemblies at no cost to the original purchaser, including labour through their original selling dealer or other authorized full service Teleflex Autopilots dealer.

For an additional six months, for a total warranty period of one (1) year from date of purchase, Teleflex (Canada) Ltd. will provide replacement or exchange of defective parts or assemblies at no cost to the original purchaser, excepting labour, through their original selling dealer or other authorized full service Teleflex Autopilots dealer.

Teleflex (Canada) Ltd.'s responsibility under this warranty is limited to repair or replacement of product or assemblies, which in the opinion of Teleflex (Canada) Ltd. are defective.

This warranty excludes:

* Sea trials, installation, testing where no fault is found and customer or user instruction.

* Any product which has been improperly installed, damaged by improper installation or installed by other than an authorized Teleflex Autopilots dealer.

* Any product damaged by water immersion, liquid entry, impact, reverse power polarity, voltage surges or any other problem due to causes beyond the control of Teleflex (Canada) Ltd.

* Any product which has failed or has been damaged due to accident or abnormal conditions including misuse as well as modifications or alterations outside our factory.

* Any product that has been repaired by other than Teleflex or an authorized Teleflex Autopilots full service dealer.

* Any product which has been used with other products which, in our opinion, are incompatible with the Teleflex product.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, OBLIGATIONS OR LIABILITIES ON THE PART OF TELEFLEX (CANADA) LTD. AND WILL BE THE CUSTOMER'S EXCLUSIVE REMEDY EXCEPT FOR ANY APPLICABLE IMPLIED WARRANTIES UNDER STATE OR PROVINCIAL LAW WHICH ARE HEREBY LIMITED IN DURATION TO THE TERMS STATED ABOVE. IN NO EVENT WILL TELEFLEX (CANADA) LTD. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE PRODUCTS. Some states or provinces do not allow limitations on an implied warranty, or the exclusion of consequential damages, so the above exclusions may not apply to you. You may also have other rights which vary from state to state or province to province.

CLAIMS

Before making a warranty claim, read through the trouble-shooting section of your owners manual. If you cannot resolve the problem, contact your selling dealer or other authorized Teleflex Autopilots full service dealer. Contact Teleflex (Canada) Ltd. at (604) 270-6899 for the location of the nearest full service dealer to you.

If it is not possible to use the nearest full service dealer, the product may be sent to the factory for service. Call Teleflex (Canada) Ltd. at (604) 270-6899 to obtain a Return Authorization Number. Then, ship the product freight prepaid in the original shipping boxes or equivalent to:

Canadian customers	U.S. Customers
Teleflex (Canada) Ltd.	Teleflex (Canada) Ltd.
3831 #6 Road	c/o PAC-EX Services Ltd.
Richmond, B.C.V6V 1P6	1122 Fir St.
	Blaine, Washington 98230

Ensure the product is packed securely. Teleflex (Canada) Ltd. cannot accept responsibility for damage incurred during shipping. Product will be returned freight collect by the most economical means unless unless otherwise arranged.

For faster service, please include:

1. Your Return Authorization Number.

2. A copy of your original bill of sale or invoice from an authorized Teleflex dealer or distributor.

3. A statement describing the defect and the steps taken to conclude the unit is defective.

4. Return shipping information including owner's name, full street address and telephone number as well as the dealer's name, address and phone number along with the name of a contact person at the dealer involved if the unit is being shipped by a dealer on behalf of the customer.

5. Packages from U.S. customers must attach a packing list including Teleflex model numbers to the outside of the box. It must state that the country of origin is Canada and the goods are defective products being returned.

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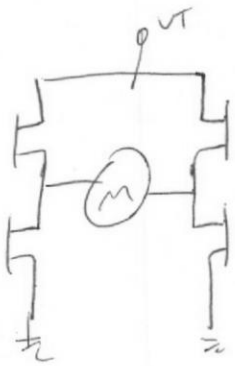

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