

FURUNO

OPERATOR'S MANUAL

AUTOPILOT

MODEL FAP-300

This manual contains only operating information.
For other information, please refer to the following manuals:

- Quick Reference Shortform Instructions
- Installation Installation Manual



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SAFETY INFORMATION

"WARNING", "CAUTION" and "NOTICE" signs appear throughout this manual. It is the responsibility of the operator of the equipment to read, understand and follow these notices. If you have any questions regarding these safety instructions, please contact a FURUNO agent or dealer.



DANGER

This notice indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

This notice indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

This notice indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or property damage.

WARNING



Do not open the cover of the equipment.

This equipment uses high voltage electricity which can shock, burn, or cause death. Only qualified personnel should work inside the equipment.

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can result.

Immediately turn off the power at the ship's mains switchboard if water or foreign object falls into the equipment or the equipment is emitting smoke or fire.

Continued use of the equipment can cause fire, electrical shock or serious injury.

CAUTION

Do not place liquid-filled containers on the top of the equipment.

Fire or electrical shock can result if a liquid spills into the equipment.

Do not place heater near the equipment.

Heat can melt the power cord, which can result in fire or electrical shock.

Use the correct fuse.

Use of the wrong fuse can cause fire or equipment damage.

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1. INTRODUCTION

An autopilot is a system connected to the ship's steering gear to automatically control rudder movement in order to steer the ship on a set course. Anyone can appreciate the advantages of the autopilot — being free to carry out navigational checks, trim adjustments, or simply to relax and enjoy.

1. History of the autopilot

First generation

The first generation autopilot was developed in the 1930's. Off-course error was detected by a contact wire. The contact is made when the boat moves to one side of the desired course, the contact is broken when the boat moves to the other side. This causes the boat to continually "hunt" back and forth across the correct heading. Hence, the name hunting autopilot.

Although the components in this type of autopilot are relatively simple, the constant zig-zagging across the correct heading decreases fuel economy and increases wear and tear on the autopilot and the steering system.

Second generation

The second type of autopilot, which was developed in the late 1940's, utilizes two contacts, one for port off-course, and one for starboard off-course. If the boat is on course neither contact is made, resulting in a small arc, or deadband. When a heading error greater than the deadband is detected, the helm is moved in the appropriate direction in an amount proportional to the heading error. As long as the boat remains on a course within this deadband, the helm is at rest.

One of the advantages of this type of autopilot is that it eliminates the constant zig-zagging across the heading. However the boat still may wander within the deadband, thus the course is usually not as tight as desirable.

Third generation (latest)

The latest generation of autopilots, the FAP-300 included, utilizes a proportional rate system to steer the boat. The proportional rate system is similar to the highly accurate and reliable system used on aircraft, missiles, and space vehicles. The proportional rate autopilot provides the necessary course correction to the helm proportional to the speed and the amount the boat moved off-course.

With the removal of the deadband, the autopilot no longer wanders within a deadband but now steers a prescribed course, taking action within the presence of even a minute course

error. The amount of action depends on the course error detected; that is, when the course error rate is small a very low helm correction rate is applied.

Because the wandering is eliminated, the proportional rate autopilot has the advantages of low power consumption and low wear and tear on the autopilot and the steering system. Off-course correction is smooth, not jerking back and forth at full speed.

The force necessary to steer the boat back onto the set course is provided by a power or drive unit.

2. Principle of operation

Now let's see how an off-course error is detected and how the boat is steered back onto the set course. Figure 1-1 shows a simplified block diagram of the autopilot.

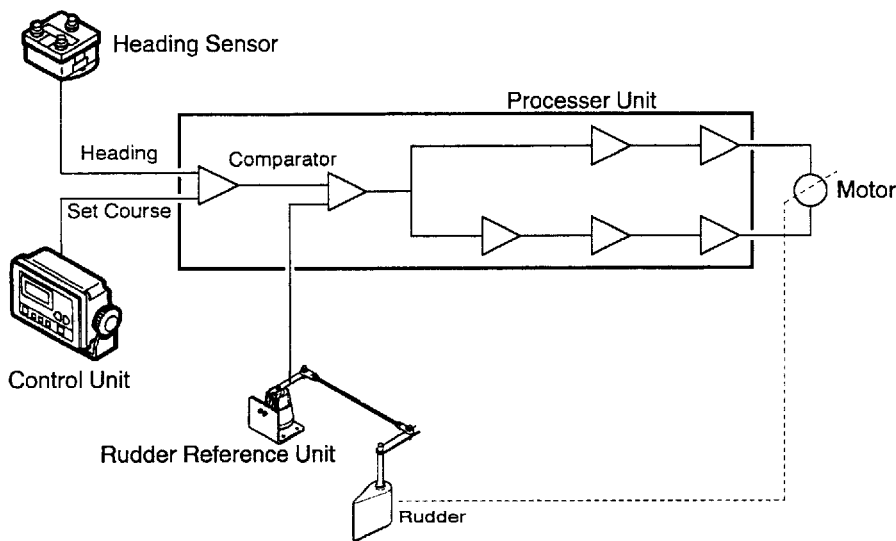


Fig. 1-1 Simplified block diagram of the autopilot

In the AUTO mode, the primary heading information from the (heading sensor) is continuously compared with the set course. With the boat on course, the two signals are equal.

Once the boat goes off course, the difference between the primary heading and the set course will change proportionally and there will be an imbalance at the comparator, whose output will move up or down depending on whether the course error is to the left or right of the set heading.

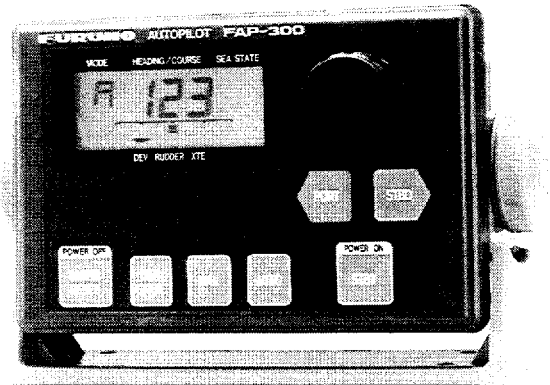
The rudder continues to move until a balanced condition is obtained at the comparator, at which point the drive switches off.

To set the rudder when the boat is off-course, the rudder angle is generated at the rudder reference unit, then fed back to the processor unit.

3. Operating precautions

Although the autopilot is capable of steering a steady course for the helmsman, it cannot think for him. Always post a lookout while underway and never use the autopilot in congested harbors or areas of heavy traffic.

As a final note of caution, it must be remembered that no machine can perform to the utmost of its ability unless it is installed and maintained properly. The reliability and performance of your autopilot is directly related to the quality of the installation. The installation is one of the most complicated of all marine electronics equipment and is best left to a qualified technician. Happy sailing.



2. CONTROL PANEL LAYOUT

Operation of the FAP-300 may be done from the control unit or a remote controller.

1. Control Unit (FAP-3001)

LCD indications

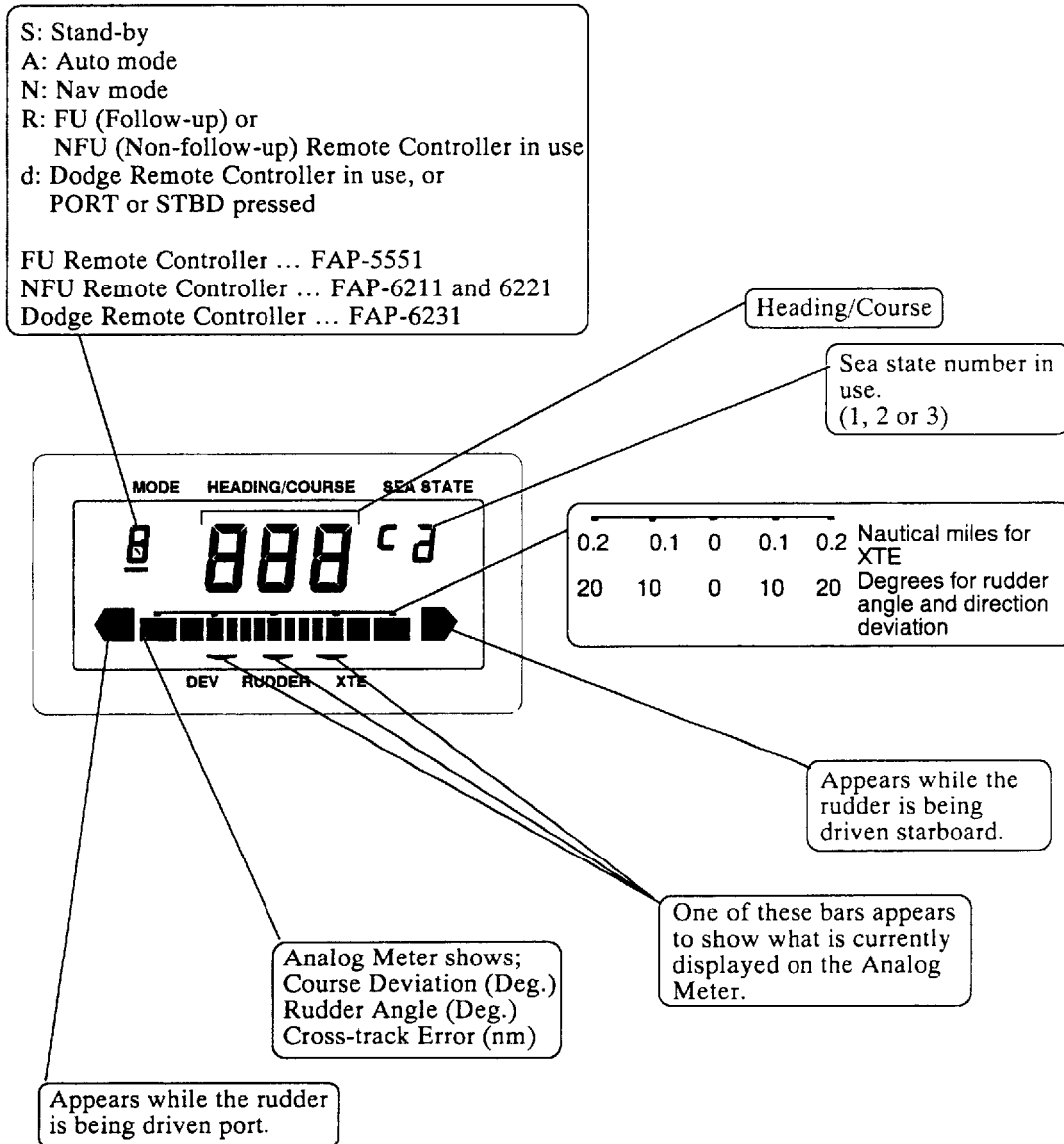


Fig. 2-1 LCD indications on the control unit

Keys

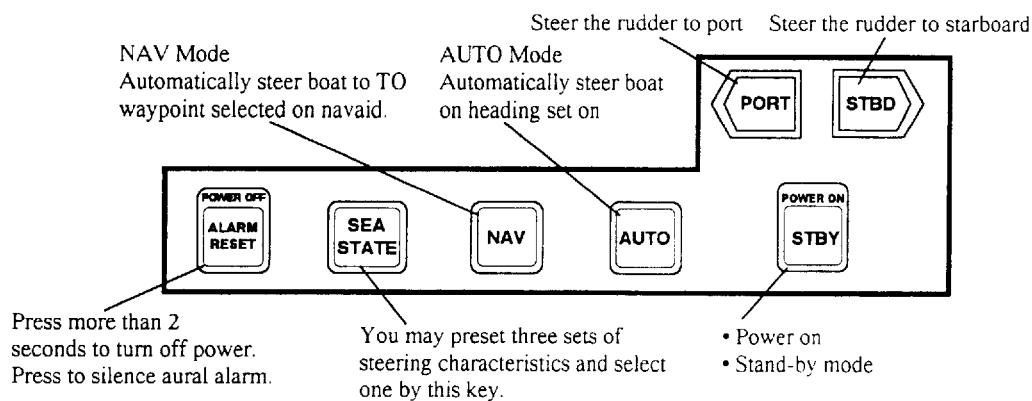


Fig. 2-2 Showing functions of the key

Key-pressing Acknowledgment Beep

When you correctly change a setting, the unit "beeps" to acknowledge it has received your command. Invalid input generates two beeps. In this case press key(s) again.

Course control

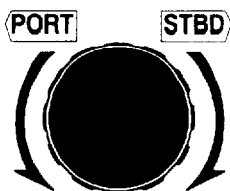


Fig. 2-3 Course control dial

Turn the dial to change the course in the AUTO mode. The course may be set in increments of one degree

2. Rudder Telltale Unit (FAP-6501)

(Optional supply)

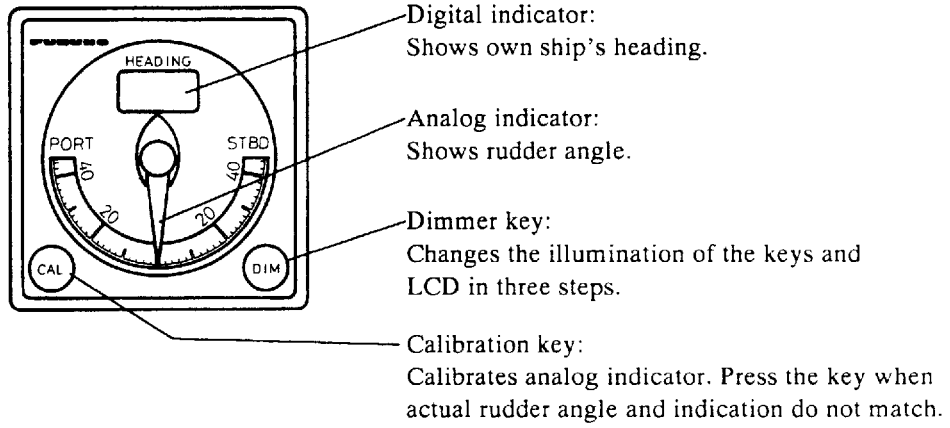


Fig. 2-4 FAP-6501

3. OPERATING PROCEDURE


This chapter gets you started in operation. The FAP-300 provides two ways to automatically steer your boat a destination: by following the heading set on the FAP-300 (AUTO mode), or by following TO waypoint information fed from a navaid (NAV mode). It is assumed that your autopilot has been.

- properly installed
- adjusted to match steering characteristics of your boat, and
- checked for proper operation.

1. From departure to arrival (1) (By the AUTO mode)

Turning on the FAP-300

Procedure

Press  key to turn on the FAP-300. Then, the following occurs.

- A long beep is generated.
- The self-test conducted (for 5 seconds).
- The FAP-300 goes into the STBY mode. (The boat's wheel may be turned manually when in the STBY mode.)

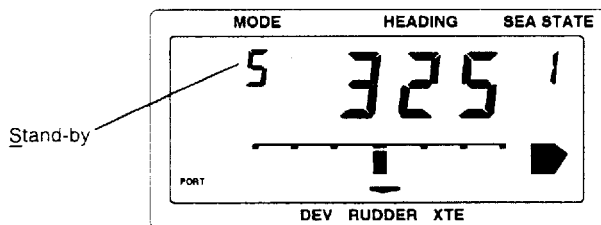


Fig. 3-1 STBY mode indication


NOTE:

The indication "E02" (power failure) at power on does not mean power failure.

Selecting a SEA STATE setting

As detailed in chapter 4, you may preset three sets (1, 2 and 3) of autopilot steering characteristics, called SEA STATE. Select one of the sets in accordance with the present sea and vessel loading conditions.

Procedure

Press  to select a set number. The selected SEA STATE number appears on the display.

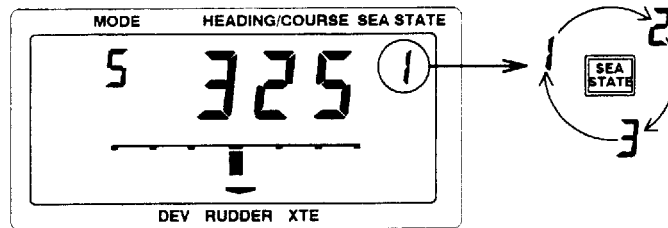


Fig. 3-2 Sea state number selection

The default settings of steering characteristics assigned to each sea state number are as follows.

- Sea state 1: AUTO + Calm Sea
- 2: AUTO + Normal Sea
- 3: AUTO + Rough Sea

Manually steer the vessel out of the harbor


1. Manually sail your vessel out of the harbor. Do not use the AUTO or NAV mode (mentioned later on) in a congested area.
2. When your vessel enters the open sea, steer it toward the desired destination.

NOTE:

If the STBY mode is selected when the FAP-5551 (remote controller) is turned on, code "E83" appears and blinks. In this case, turn the remote controller off.

Heading to the destination by the AUTO mode

Procedure

1. Press .

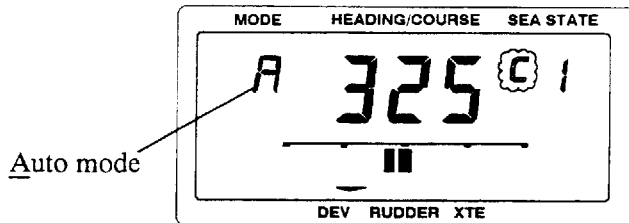


Fig. 3-3 AUTO mode indication

2. Set the desired course by turning the course control dial left or right.

Whenever the heading deviates from the set course, the FAP-300 automatically adjusts the rudder to return the vessel to the set course. To change the course setting in the AUTO mode, simply turn the course control dial.





Fig. 3-4 Setting the course by the course control dial

Dodging other boats or objects in the course

1) By manually steering the wheel (STBY mode)

Procedure

1. Press .
2. Steering the wheel manually, dodge other boat or object and then steer your vessel toward the destination.
3. Return to the AUTO mode by pressing , and then adjust the course control dial to show the desired course on the display.

2) By using the remote controller (REM mode)

Procedure

1. Turn on the remote controller switch. The FAP-300 goes into the REM (Remote) mode which is similar to the STBY mode.

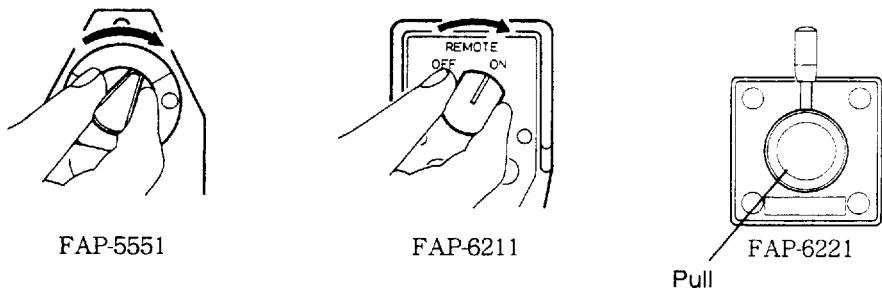


Fig. 3-5 Turning on the remote controller

2. Operate the remote controller to dodge other boat or object, and then steer your vessel toward the destination.;

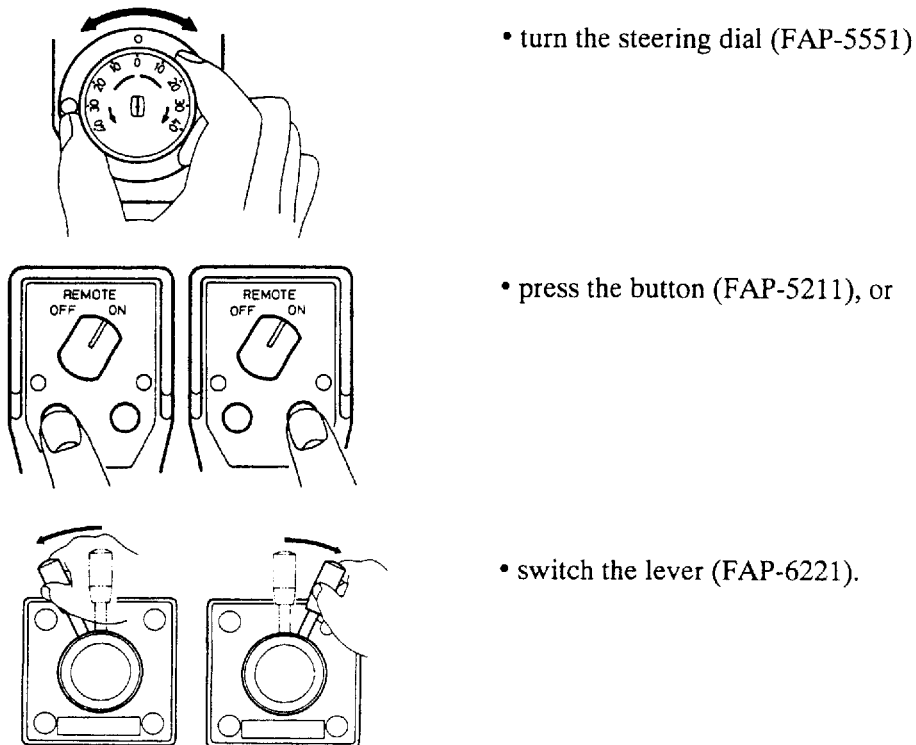


Fig. 3-6 Dodging by the remote controller

3. Turn off the remote controller The unit returns control to the AUTO mode. Adjust the course control dial to show the desired course on the display.

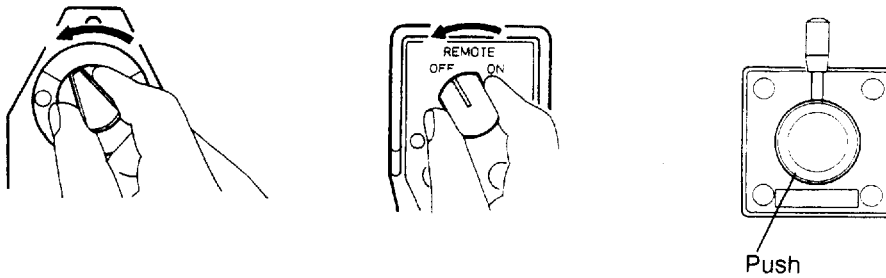


Fig. 3-7 Turning off the remote controller



The heading to be used after using the remote controller can be one of the followings:

- a) the heading before using the remote controller, or
- b) the heading at the moment the remote controller is turned off.

For further details refer to the Installation Manual.

3) By using dodge remote controller (DODGE mode)

Procedure

1. Dodge other boat or object by steering the rudder with  or .
2. The LCD reflects the change in heading.
3. Release the key. The FAP-300 returns control to the AUTO mode.

When the heading to be used after using the remote controller is “Heading at the moment remote controller is turned off”, press HDG KEEP on the remote controller to maintain the current heading.



The heading to be used after using the remote controller can be one of the following:

- a) the heading before using the remote controller, or
- b) the heading at the moment the remote controller is turned off.

For further details refer to the Installation Manual.

4) By using PORT/STBD keys (DODGE mode)

Procedure

1. Dodge other boat or object by steering the rudder with  or . Keep both key held down to maintain “dodge heading”.
2. The course deviation appears on the bar indicator.

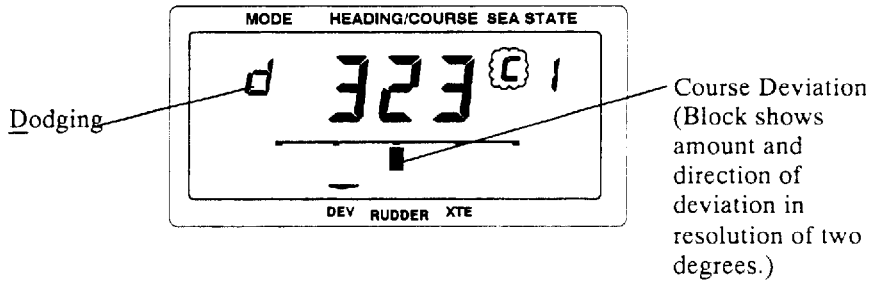




Fig. 3-8 Indication while dodging

3. Release the keys to return to original heading and AUTO mode.

Arrival by manually steering the vessel

When approaching the destination, press  and manually steer the vessel.

Turning off the FAP-300

Press  to turn off the FAP-300.

WHEN THE BOAT IS NOT RUNNING

When the mode is AUTO or NAV, the rudder is continually driven even if the boat is not running. In order to conserve battery power and prevent rudder driving mechanism wear, you should place the FAP-300 in the STBY mode or turn off the power when your vessel is at rest.


2. From departure to arrival (2) (By the NAV mode)


NOTE:

The NAV mode requires connection of an external navaid to the FAP-300. Turn it on and select a TO WAYPOINT beforehand.

The navaid knows the present position and the TO WAYPOINT location. The FAP-300, while receiving that information, automatically adjusts the course direction and guides the boat to the TO WAYPOINT. The operating procedure from departure to arrival is basically the same as described in section 1 of this Chapter. Follow the first three steps in section 1 and then do the following.

Heading to the destination by the NAV mode

Steer the boat toward the destination, and then press . The FAP-300 goes into the NAV mode.

The Course is automatically set so that the boat sails on the intended track. When  is pressed, the heading at that moment becomes the course, and thereafter the heading changes automatically in order to follow the intended trackline.

The course reading on the FAP-300 is not always the same as the waypoint direction which appears on the navaid.

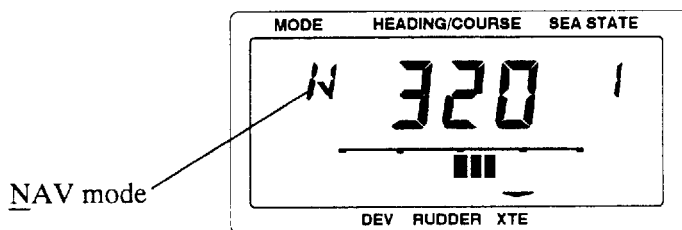



Fig. 3-9 NAV mode indication

NOTE:

1. If navigation information is not being received code "E51" appears and then the previously used mode is recalled. Check the navaid for proper operation.
2. If the boat's position is far away from the intended trackline, the FAP-300 releases the CROSS-TRACK ERROR WARNING alarm; code "E57" appears and a beep is generated. See next page.

The FAP-300 automatically adjusts the rudder so that the boat follows the intended trackline connecting the FROM and TO WAYPOINTS.


About CROSS TRACK ERROR WARNING

When the cross track error exceeds 0.4 nautical miles, code "E57" appears and a beep is generated. Press  to silence the beep.

Dodging other boats or objects in the course

The procedure for dodging in the NAV mode is the same as in the AUTO mode. After dodging (in the REM or DODGE mode), control is returned to the NAV mode.

Arrival by manually steering the vessel

When the FAP-300 nears a TO waypoint by the arrival alarm distance set on the navaid, code “E56” appears and a beep is generated. Press  to silence the beep.

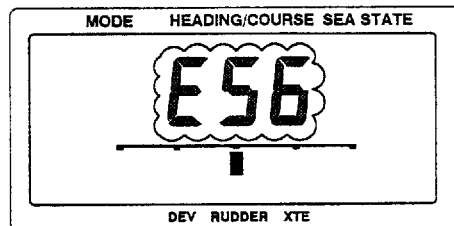



Fig. 3-10 Arrival alarm indication


If the TO waypoint is your ultimate destination, press  and steer the vessel manually.

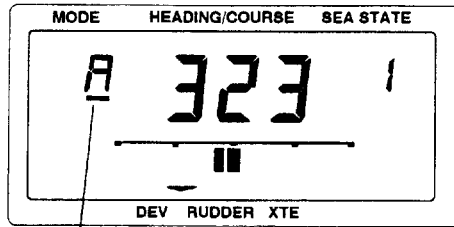
3. About “ADVANCED AUTO” mode

Introduction

The AUTO mode maintains set course but the track may be shifted by current or wind. The ADVANCED AUTO mode maintains set course without deviating from track. This mode can be enabled by connecting a navaid which can output position data (GLL sentence) in NMEA 0183 format to the FAP-300. For further details, see the Installation Manual.

Procedure

1. Press  for AUTO mode operation.
2. FAP-300 calculates the course based on the present position (GLL) and heading.
3. FAP-300 changes the mode to “ADVANCED AUTO” mode automatically.
4. The display looks something like Fig. 3-11.



The cursor shows "ADVANCED AUTO" mode is enabled.

Fig. 3-11 ADVANCED AUTO mode indication

5. FAP-300 compares the present position and intended track to determine cross track error.
6. FAP-300 controls the boat to minimize cross track error.

Step 5 and 6 are repeated every second.

Difference between "NAV" and "ADVANCED AUTO" modes

Both modes control the boat to minimize cross track error. They are similar, but do have differences.

1. The NAV mode handles bearing to TO waypoint and cross track error. This enables smoother control of the boat.
2. The data "bearing to waypoint" turns the boat back toward an oversailed TO waypoint in the NAV mode.
3. The ADVANCED AUTO mode does not require setting of TO waypoint. Any navigational equipment transmitting position data may be connected.



4. About "Net towing AUTO" mode

Introduction

When a boat tows a net its stern is "dragged" by the net. This causes the boat to stray from its intended course. To keep the boat on course, you need to adjust the trim manually, which can be bothersome. If you do not want to be bothered with trim adjustments, you can enable the net towing AUTO steering feature. It is indispensable for trawlers and purse seiners.

To enable this mode, refer to the Installation Manual.

Procedure

1. Press  for Stand-by (manual steering) mode.
2. Manually run the boat straightly.
3. Press  for AUTO mode operation.

The FAP-300 goes into the “Net towing AUTO” mode.

4. MODIFYING STEERING CHARACTERISTICS

The steering characteristics are preset during installation and normally do not require frequent adjustment. However, when using the FAP-300 during an actual voyage it may be necessary to modify them. This chapter provides the operating procedures and guidance for adjusting the steering characteristics.

1. List of Adjustments

Item	Adjustment	Default		
		①	②	③
Rudder Ratio	Adjust the amount of rudder reaction versus course deviation.	5	6	7
Weather	Prevent frequent steering in bad weather.	2	4	6
Counter Rudder	Prevent excessive turning by inertia when changing course.	0	0	2
Dimmer	Adjusts the illumination of keys and LCD.	1		
Automatic Trim Sensitivity	Adjust the sensitivity for monitoring the boat's trim.	6		

Sea State 1, 2, 3:

As shown in the table above, three sets (①, ② and ③) of RUDDER RATIO, WEATHER and COUNTER RUDDER settings may be preset. They are collectively known as "sea state". In a voyage, you may use one of the three sets in accordance with sea and vessel loading conditions.

Setting for SEA STATES ①, ② and ③

First set the steering characteristics (WEATHER, RUDDER RATIO and COUNTER RUDDER) for sea state ①. Then set them for SEA STATES ② and ③.

Assign any sea and vessel loading conditions to ② and ③, such as “AUTO+Heavy Load” and “NAV”. Enter setting referring to the table below. When sea/loading condition changes, use the appropriate SEA STATE (② or ③). Modify the settings to suit the actual situation.

The default settings for the steering characteristics are for the following sea states.

SEA STATE ① AUTO+Calm sea
 SEA STATE ② AUTO+Normal sea
 SEA STATE ③ AUTO+Rough sea

The settings for sea states ② and ③ may be changed, for example;

SEA STATE ① AUTO+Calm sea
 SEA STATE ② AUTO+Rough sea
 SEA STATE ③ AUTO+Full load

or

SEA STATE ① AUTO+Calm sea
 SEA STATE ② AUTO+Full load
 SEA STATE ③ NAV



Guidelines for setting sea states ② and ③

Item	If “AUTO+Rough sea” is assigned to ② or ③;	If “AUTO+Full load” is assigned to ② or ③;	If “NAV” is assigned to ② or ③;
WEATHER	Set the value 1 to 2 settings higher than ①.	Set the value 1 to 2 settings higher than ①.	Set the value 1 to 2 settings higher than ①.
RUDDER RATIO			Set the same value as ①.
COUNTER RUDDER	Set the same value as ①.		Set the same value as ①. (See note below).

Note: In case of route navigation, non-zero setting should be used to prevent over-turning to return to course.

2. Adjustments

Basic procedure for setting steering characteristics

1. Press  to select sea state number.
2. Hold down the  key more than 2 seconds to go into the USER'S mode.

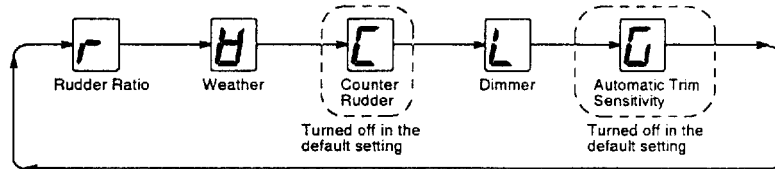




Fig. 4-1 Display for adjusting rudder ratio

3. Press the  key to select item to adjust. Fig 4-2 shows the items available and the selection sequence when pressing the  key.

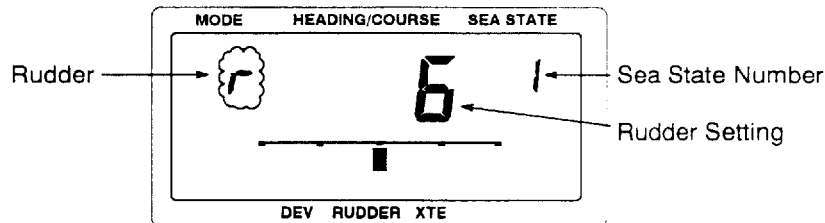







Fig. 4-2 Items in the user's mode

4. Operate the course control dial to select settings by referring to next pages.
5. Repeat the above steps 3 on 4 to adjust other items.
6. Press  to escape.

Enabling/disabling items in USER'S mode

As shown in Fig.4-2 the USER'S mode contains five items. In the default setting, counter rudder and automatic trim sensitivity are disabled since frequent adjustment of them is usually not required. You can enable them, or disable other items, by doing the following.

1. Hold down  more than 2 seconds until the display of Fig.4-1 appears
2. Press  to select item. Each pressing this key changes item as shown in Fig.4-2.

3. Press  to erase or display underline. (The underline beneath the character of mode shows the item is enabled.)
4. Repeat above step 2 and 3 for other items.
5. Press  to escape.

Rudder ratio (Adjust the amount of rudder reaction versus course deviation.)

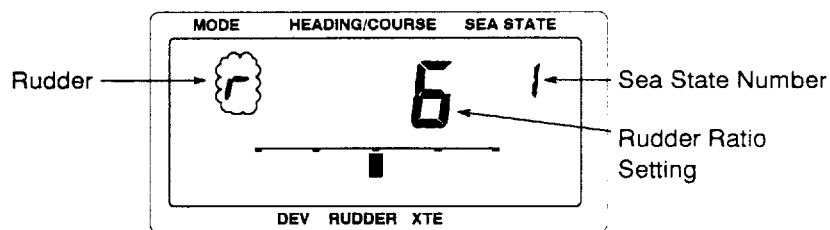


Fig. 4-3 Display for adjusting rudder ratio

About rudder ratio

When the boat's heading deviates from the set course, the FAP-300 adjusts the rudder to correct it. The rudder angle (number of degrees) which is steered against every degree of course deviation is known as the rudder ratio. Nine rudder ratio settings are available as tabulated below.

Setting	1	2	3	4	5	6	7	8	9
Rudder Ratio	0.1	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.5

The following illustrations show how many degrees the FAP-300 adjusts the rudder in order to nullify 10 degrees of course deviation with various settings of the rudder ratio :

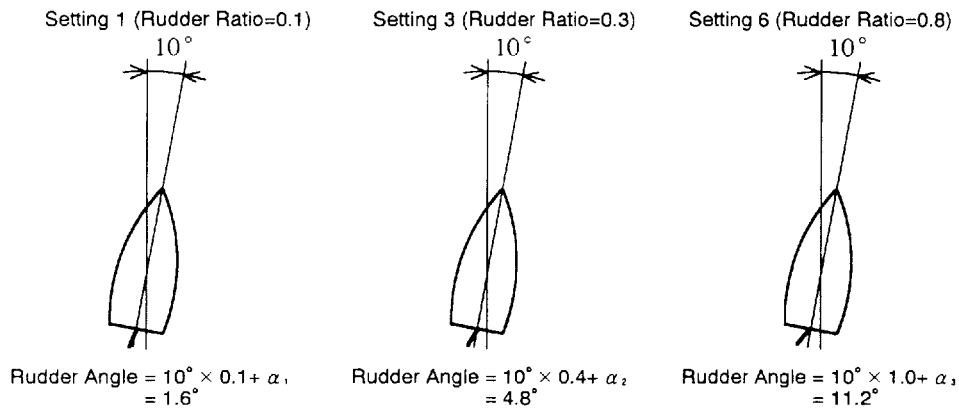
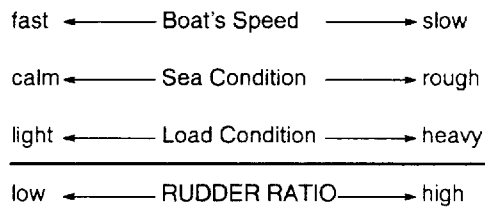


Fig. 4-4 Rudder angle and rudder ratio setting

Increase the setting until over-steering occurs, then reduce it by one. (Setting of “4” is commonly used.) The following figure provides general guidelines for setting rudder ratio.



Procedure




1. In the USER'S mode, select “rudder ratio” by pressing the  key.
2. Change the setting with the course control dial.



Fig. 4-5 Cours control dial

3. Press  to select another item, or press  to escape.

Weather (Prevent frequent steering in bad weather)

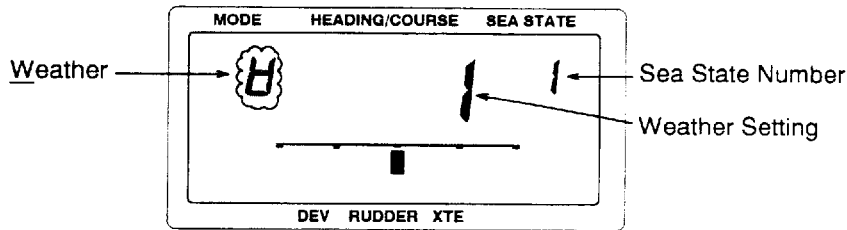


Fig. 4-6 Display for adjusting weather

About weather

When the sea is rough, the boat's heading wanders between port and starboard. If the rudder is driven very often to maintain the set course, the helm mechanism may wear out. To prevent this, the weather adjustment makes the FAP-300 insensitive to minute course deviations.

You may choose a setting among the following ten. Until the course deviation exceeds the selected setting value, steering to correct the heading will not be initiated.

Setting	0	1	2	3	4	5	6	7	8	9
Value	0	$\pm 0.5^\circ$	$\pm 1.0^\circ$	$\pm 1.5^\circ$	$\pm 2.0^\circ$	$\pm 2.5^\circ$	$\pm 3.0^\circ$	$\pm 3.5^\circ$	$\pm 4.0^\circ$	$\pm 4.5^\circ$

The following illustrations show boat's tracklines with weather settings 3 and 7. When 7 is set, for example, the rudder is not driven until the course deviation exceeds 3.5 degrees. Increasing the setting reduces chattering of the rudder, however the boat tends to zigzag.

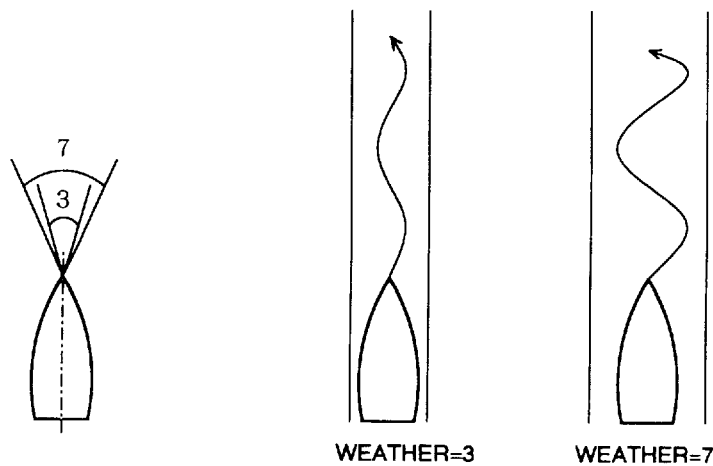





Fig. 4-7 Trackline and weather setting value

When favorable sea conditions exist, a setting of “1” or “2” is appropriate. For rough seas, a higher setting is required.

Procedure

1. In the USER’S mode, select “weather” by .
2. Change the setting with the course control dial.
3. Press  to select another item, or press  to escape.

Counter rudder (Prevent excessive turning by inertia when changing course.)

Turned off in default setting.

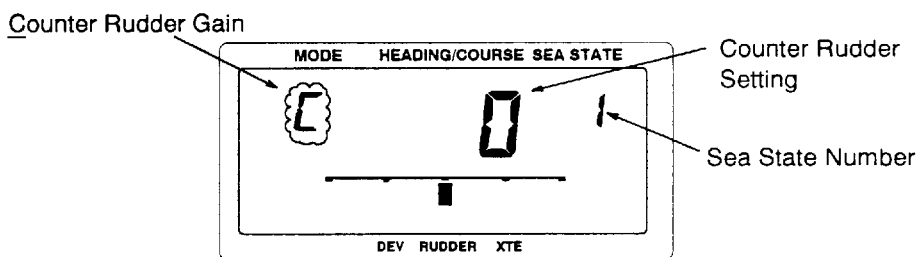


Fig. 4-8 Display for adjusting counter rudder gain

About counter rudder




If the boat is heavily loaded, the heading will turn excessively by inertia, passing the new course. Then, the FAP-300 will steer the rudder to the opposite side, the heading will turn in that direction excessively again... In an extreme case the heading oscillates several times until it finally settles in the new course. An adjustment known as “counter rudder” prevents this kind of oscillation.

Choose a counter rudder setting from “0” to “9”; the higher the setting, the more counter rudder is steered by the FAP-300. (“0” = no counter rudder)

Setting	0	1	2	3	4	5	6	7	8	9
Rudder Ratio	None	0.1	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.5


Counter rudder is usually not required for small boats. When your boat zigzags a lot before setting into the new course, increase the setting.

Procedure

1. In the USER'S mode, select "counter rudder" by .
2. Change the setting with the course control dial.
3. Press  to select another item, or press  to escape.

Dimmer (Adjust the illumination of keys and LCD.)

Procedure

1. In the USER'S mode, select "dimmer" by .

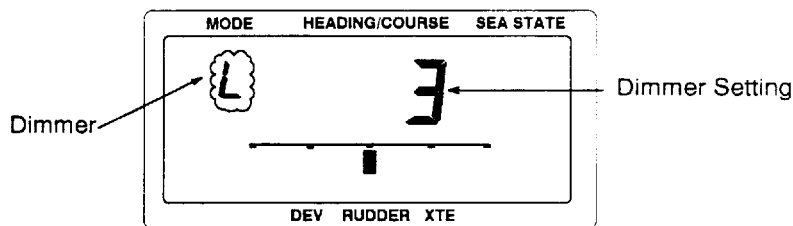




Fig. 4-9 Display for adjusting dimmer

2. Change the illumination with the course control dial. Three levels are available: The higher the number the higher the illumination.
3. Press  to select another item, or press  to escape.

Auto trim sensitivity (Adjust the sensitivity for monitoring the boat's trim)

Turn off in default setting.

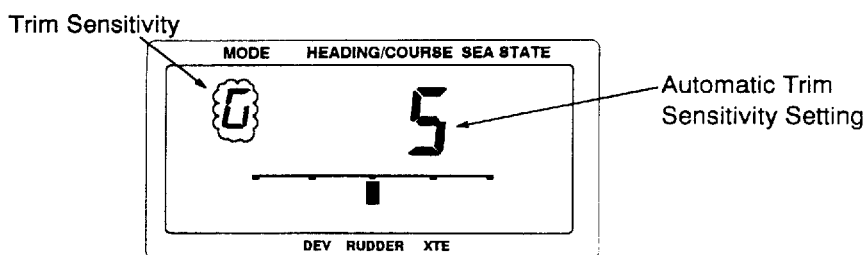


Fig.4-10 Display for adjusting trim sensitivity

About auto trim sensitivity




The FAP-300 continually monitors the boat's trim in order to keep the compensation value optimum. You may enter a number from "1" to "9". A lower setting is common because boar's trim usually does not change quickly. A large number change the trim compensation value more frequently. Too high a setting may result in the following problems.

1. Trim compensation is over-affected, resulting that a trim appears in port and starboard directions alternately.
The current trim can be shown on the LCD in the "Performance indication" mode. Refer to the Installation Manual for details.
2. A boat usually yaws due to waves. If the setting is too high, the auto trim-compensation mechanism responds to the yawing, resulting in more serious oscillation of ship's heading.

Choice of setting

Run the boat with setting "0" (auto trim sensitivity turned off), and measure the period of one yawing cycle). If the period is two to three seconds, setting "5" will be appropriate. For longer periods, lower settings should be used. If the boat "goes" and "stops" frequently, or if the ship's speed is unstable, it might be better to disable the auto trim sensitivity function by using setting "0".

Procedure

1. In the USER'S mode, select "trim sensitivity" by pressing the  key.
2. Change the setting with the course control dial.
3. Press  to select another item, or press  to escape.

3. Record of steering characteristics

Wherever the steering characteristics are entered or changed, you should record them in the following table. In the event of loss of the settings, reenter them referring to this table.

Item	Default			Settings		
	①	②	③	①	②	③
Rudder Ratio	5	6	7			
Weather	2	4	6			
Counter Rudder	0	0	2			
Dimmer	1					
Automatic Trim Sensitivity	6					
Remote Controller	H					
Course Changing Speed	3					
Rudder Neutral	000					
Rudder Angle Limitation (REM and DODGE mode)	8					



5. ALARM AND WARNINGS

This chapter mostly covers warnings which may appear on the display.

1. Watch alarm

The watch alarm periodically warns the helmsman in the NAV or AUTO mode to check the autopilot. It can be enabled or disabled by the Jumper JP2 on the CPU Board in the Processor Unit. (This should be done by a qualified technician.) It is disabled in the default setting.

Enabling the watch alarm

Press  or  (assuming the jumper is set for watch alarm “on”).


How the watch alarm works

- If no key is pressed for four minutes a preliminary warning sounds “Pip Pip Pip Pip”.
- If no key is pressed for another one minute the watch alarm sounds continually “Peep Peep Peep”.

NOTE:

When a key is pressed, the FAP-300 recognizes that a helmsman is attending, and as a result it returns to the starting point in the above sequence. When you are operating the FAP-300 by pressing keys one after another, for example, the alarm does not sound because the FAP-300 returns to the starting point at every key depression.

Silencing audible alarm

Press  to silence the beep.

2. Warnings

The FAP-300 releases an aural alarm and displays a code to alert you to equipment fault or navigation condition. This section lists those codes and the remedies necessary to restore normal operation in case of error. If you cannot restore normal operation please do not attempt to check inside the unit. Any repair is best left to a qualified technician.

Error Code	Cause	Check/Remedy
E01	No communication between the Control Unit and the Processor Unit for more than 2 seconds.	<ul style="list-style-type: none"> • Is the interconnection cable damaged? • Poor contact of signal cable?
E02	Power supply was interrupted for more than 2 seconds.	<ul style="list-style-type: none"> • Supply voltage is normal? • Poor contact of power cable? • are battery terminals corroded?
E03	The ROM or RAM in either the Control Unit or the Processor Unit is faulty.	<ul style="list-style-type: none"> • FAP-300 is inoperative; request service.
E04	All contents of the EEPROM have been destroyed. All data have been cleared and reset to default settings.	FAP-300 is operative but request service. As all the steering characteristics are reset to default settings, they are not suitable for your boat. The boat may not run straightly in the AUTO and NAV modes.
E11	The rudder angle sent from the rudder reference unit exceeded 55 degrees.	<ul style="list-style-type: none"> • Is the interconnection cable damaged? • Poor contact of signal cable?
E12	The rudder did not move more than 1.5 degrees within six seconds after the CPU sends command to move rudder.	<ul style="list-style-type: none"> • Is the tie rod firmly fixed to rudder reference unit? • Is the signal cable of the value unit loose? • Is the valve unit working properly? • Is the hydraulic actuator working properly?
E21	No heading data from the heading sensor.	<ul style="list-style-type: none"> • Is the interconnection cable damaged? • Poor contact of signal cable? • Is power supplied to heading sensor? • Poor contact of power cable of heading sensor?

Error Code	Cause	Check/Remedy
E22	The heading data from the heading sensor is not in the range of 0 degree to 359 degrees.	The heading sensor is faulty; request service.
E23	The heading data from the heading sensor abruptly changed more than 15 degrees.	<ul style="list-style-type: none"> • Is the heading data interfered by a radiotelephone? • Compare compass reading to heading indication on FAP-300. If they are the same, heading sensor is normal.
E24	The heading has deviated more than 30 degrees from the course.	Turn to the stand-by mode and check E11 and E12.
E32	The FAP-5551 is sending rudder angle of more than 55 degrees.	The FAP-5551 is faulty; request service.
E51	No navigation data (used for the NAV mode) received for more than 15 seconds.	<ul style="list-style-type: none"> • Is navaid turned on? • Is TO WAYPOINT selected on navaid? • Poor contact of signal cable?
E52	Navigation data can not be recognized as data.	Is the data format NMEA 0183?
E53	Navigation data contains an error flag.	Wait until the fixing status returns to normal. For GPS navigator, wait until fixing status is reliable.
E54	The course error exceeded 60 degrees.	Change the steering mode to STBY then to NAV.
E55	The TO WAYPOINT number (contained in navigation data) has been changed.	Check the waypoint number. If correct, the FAP-300 is normal. If wrong, select correct waypoint number on navaid.
E56	The boat arrived at a TO waypoint in the NAV mode.	If final destination, change the steering mode to STBY and manually steer to the destination.
R57	The cross track error exceeded 0.4 nautical miles.	Press "ALARM RESET" key to silence beep.
E81 E82	The "NAV", "AUTO" or "STBY" key is pressed while using the remote controller.	Turn off the non-follow-up remote controller to change the steering mode.
E83	The FAP-5551 remote controller is turned on in the STBY mode.	Turn off the remote controller.


Error Code	Cause	Check/Remedy
E84	The "NAV" or "AUTO" key is pressed while using the remote controller.	Turn off the non-follow-up remote controller to change the steering mode.
E85	The rudder angle limitation is too narrow for automatic trim.	Enter larger number for rudder angle limitation.
E91	Power supply abnormality.	<ul style="list-style-type: none"> • Is the battery dead? • Are battery terminals corroded? • Poor contact on power cable?
E92	The watch function is activated and no key was pressed for four minutes.	Press "ALARM RESET" key to silence alarm and erase indication.
E93	The watch function is activated and no key was pressed for five minutes.	Press "ALARM RESET" key to silence alarm and erase indication.

6. MAINTENANCE

1. Check before leaving port

The FAP-300 should be checked for proper operation before every voyage, with your boat moored in a harbor.


IMPORTANT

1. The FUNCTION TEST must be conducted by a person who has thorough knowledge of the autopilot's operation.
2. Make sure that there is no one nor any obstruction in the area near the rudder when performing the test.
3. If the rudder is driven continually, immediately turn off the FAP-300 or press . The FA-300 may be faulty or not installed properly.

Procedure

1. Turn off the FAP-300. Steer the wheel from hard over to hard over, then return it to neutral.

The rudder shall move smoothly without undue stiffness.

2. Turn on the FAP-300 by pressing .

The STBY mode indication "S" shall appear.

3. Steer the wheel from hard over to hard over, then return it to neutral.

The rudder angle indication shall change accordingly.

4. Compare the heading indication (digital) with the compass reading.


The heading indication shall be close to that of the compass reading.

5. Press .


The AUTO mode indication shall appear.

6. By adjusting the course control dial, increase the course reading by 10 degrees in the starboard direction.

The analog meter shall indicate a 10 degree course change to starboard direction.


7. Press .

The analog meter shall indicate correct rudder angle in starboard direction.


8. Press .

9. By adjusting the course control dial, decrease the course reading by 10 degrees in the port direction.

The analog meter shall indicate 10 degree course deviation to port.

10. Press .

The analog meter shall indicate correct rudder angle in port direction.

11. Press .

12. Turn on the remote controller.


The indication "R " shall appear.

13. Slowly turn the steering control on the remote controller from hard over to hard over.

The rudder angle (analog) indication shall change accordingly. The appropriate rudder direction indication shall light.

14. Turn off the remote controller.

The AUTO mode shall be recalled.

15. If a navaid is connected to the FAP-300, place the navaid in the fully operating condition and select a TO WAYPOINT. (Assign the present position to FROM WAYPOINT.) Press .

The indication "NAV " shall appear. (The "N" shall not be blinking). The course reading on the FAP-300 shall be the same as the one presented on the navaid.

16. Turn off the FAP-300.

In addition to the function test, it is always a good idea to proceed out of the harbor and check the FAP-300's performance in every mode.

2. Power on self-test

Every time you turn on the FAP-300 it automatically checks the memories (ROM/RAM) for proper operation. If an abnormal memory is detected, the faulty memory is identified with a numeric code and the FAP-300 is made inoperative. If normal, the FAP-300 is fully operational.

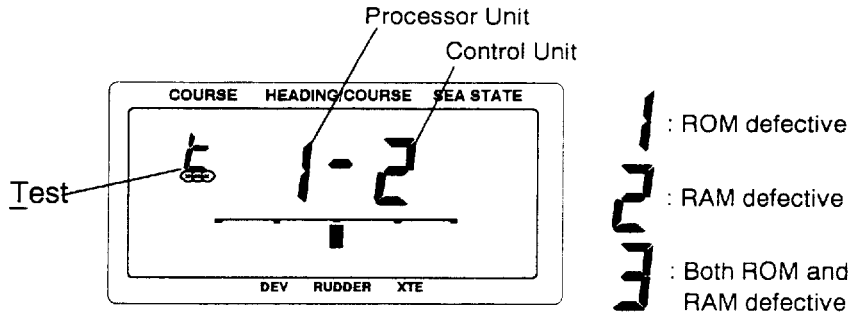


Fig. 6-1 Sample result of memory test

3. Clearing the memory

You can clear all the internal settings memorized in the EEPROM. This is useful when all data had been corrupted.

1. Turn on the equipment while holding down . Press  twice. The display should look like Fig. 6-2.

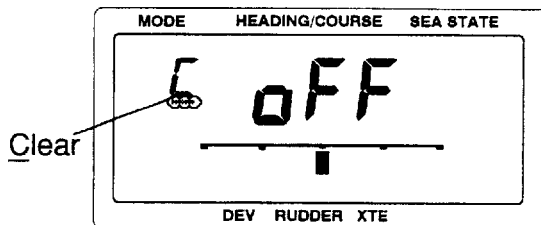



Fig. 6-2 Indication before clearing the memory

2. Press  to clear the memory. Fig. 6-3 shows display appearance while the memory is being cleared.

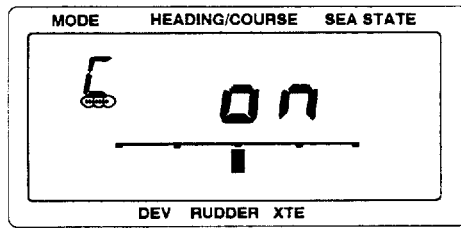


Fig. 6-3 Indication while clearing the memory

- When the memory has cleared the display looks like Fig 6-4.

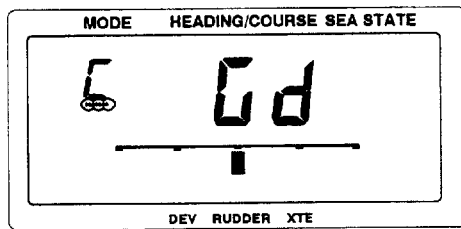


Fig. 6-4 Indication after clearing the memory

- The display looks like Fig. 6-5 if the memory could not be cleared. The EEPROM may be defective.

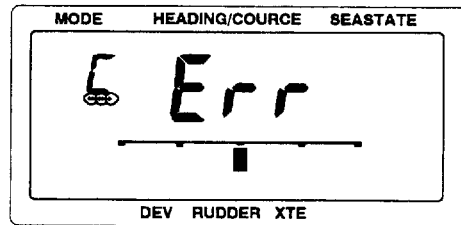



Fig. 6-5 Indication when memory could not be cleared

3. To escape, press .

SPECIFICATIONS

1. Operating Mode
 - Manual (STBY)
 - Automatic (AUTO)
 - Navigational (NAV)
 - Remote (REM)
 - Dodge (DODGE)
2. Controls
 - Course setting by knob (1° step)
 - others by touchpad key
3. Setting of Steering Characteristics
 - Rudder Ratio . . . from 0.1 to 1.5 (9 steps)
 - Weather . . . from 0° to $\pm 4.5^\circ$ (10 steps)
 - Counter Rudder . . . 9 steps + OFF
 - Auto Trim Sensitivity . . . 9 steps + OFF
 - Course Changing Speed . . . from 1°/sec to 7°/sec (7 steps)
 - Rudder Limit Angle . . . from 10° to 45° (8 steps)
(For AUTO/NAV 10° or 20° selectable.)

NOTE: 3 sets of the characteristics may be set, and one set may be used in accordance with sea conditions.
4. LCD Display
 - with backlight dimmer (common to keyboard dimmer)
5. Presentations
 - 7 segment Digital . . . Heading or Course and Sea State
 - Bar . . . Rudder angle, Course deviation or Cross track error
 - Warnings . . . Watch alarm, Power failure, Inter-unit signal failure, and others.
6. Heading Sensor
 - Fluxgate Heading Sensor (C-2000)
 - Gyrocompass (Gyro Converter AD-100 required)
7. Steering Unit
 - Hydraulic or mechanical steering system
8. Navaid
 - NMEA0183 (V. 1.5) output format (Ex. GP-50, GP-70 MARK-2, LP-1200/1300, GP-3100) connectable
9. Power Supply
 - Control and Processor Units . . . 12Vdc, 2.5W
24 Vdc, 5W
 - Valve Unit (optional) . . . 12/24/32 Vdc, 24W