

FURUNO

OPERATOR'S MANUAL

AUTOPILOT

MODEL FAP-55



FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

WARNING AND CAUTION

An autopilot is a very convenient and useful piece of equipment if it is used properly. Accidents and collisions are usually due to misuse and misunderstanding of the system.

When using the autopilot, the following precautions should be taken.

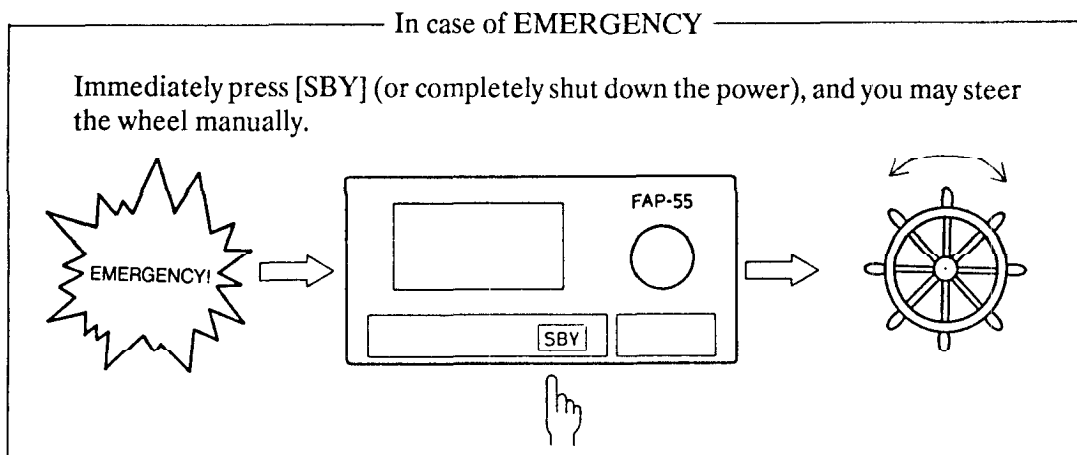
1) DO NOT USE AUTO/NAV MODES IN THE FOLLOWING CASES. (Operate in SBY mode in the following cases.)

- (1) In heavy traffic areas and narrow channels.
- (2) In bad weather conditions, such as poor visibility, strong wind and current, rough sea, etc.
- (3) When changing course to avoid collision with other vessels.
- (4) In the areas where local laws prohibit use of an autopilot.

2) Keep the following points in mind when sailing in the AUTO/NAV modes.

- (1) DO NOT LEAVE THE HELM UNATTENDED.
- (2) Do not place magnetic materials or magnetic field generating equipment near the heading sensor.
- (3) Verify the course and position of the vessel, both before engaging the autopilot and while using it.

3) No one navigational aid should be relied upon exclusively for the safety of vessel and crew. The navigator has the responsibility to check all aids available to confirm his position. Electronic aids are not a substitute for basic navigational principles and common sense.



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1. PRINCIPLE OF OPERATION

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 being free to carry out navigational checks, trim adjustments, or simply to relax and enjoy himself.

To better understand how the autopilot system works, a brief knowledge of the history of the autopilot is necessary.

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.

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.

The latest generation of autopilots, the FAP-55 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 (NAV Mode), 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; i.e., 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.

Now let's see how an off-course error is detected and how the boat is steered back onto the set course. Figure A on the next page shows the symplified block diagram of the autopilot.

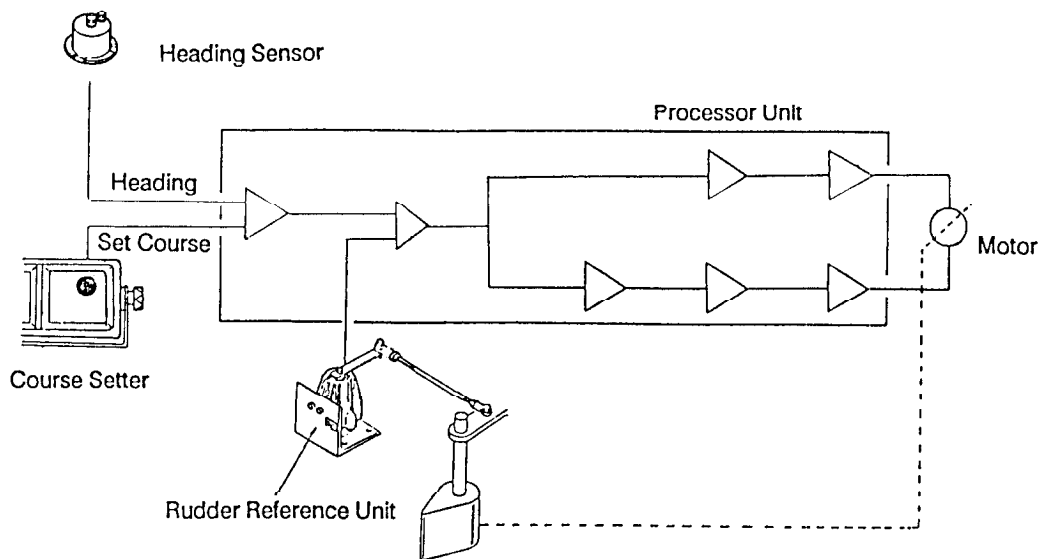


Fig. A simplified Block Diagram of Autopilot

In the AUTO mode, the primary heading information (fluxgate 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.

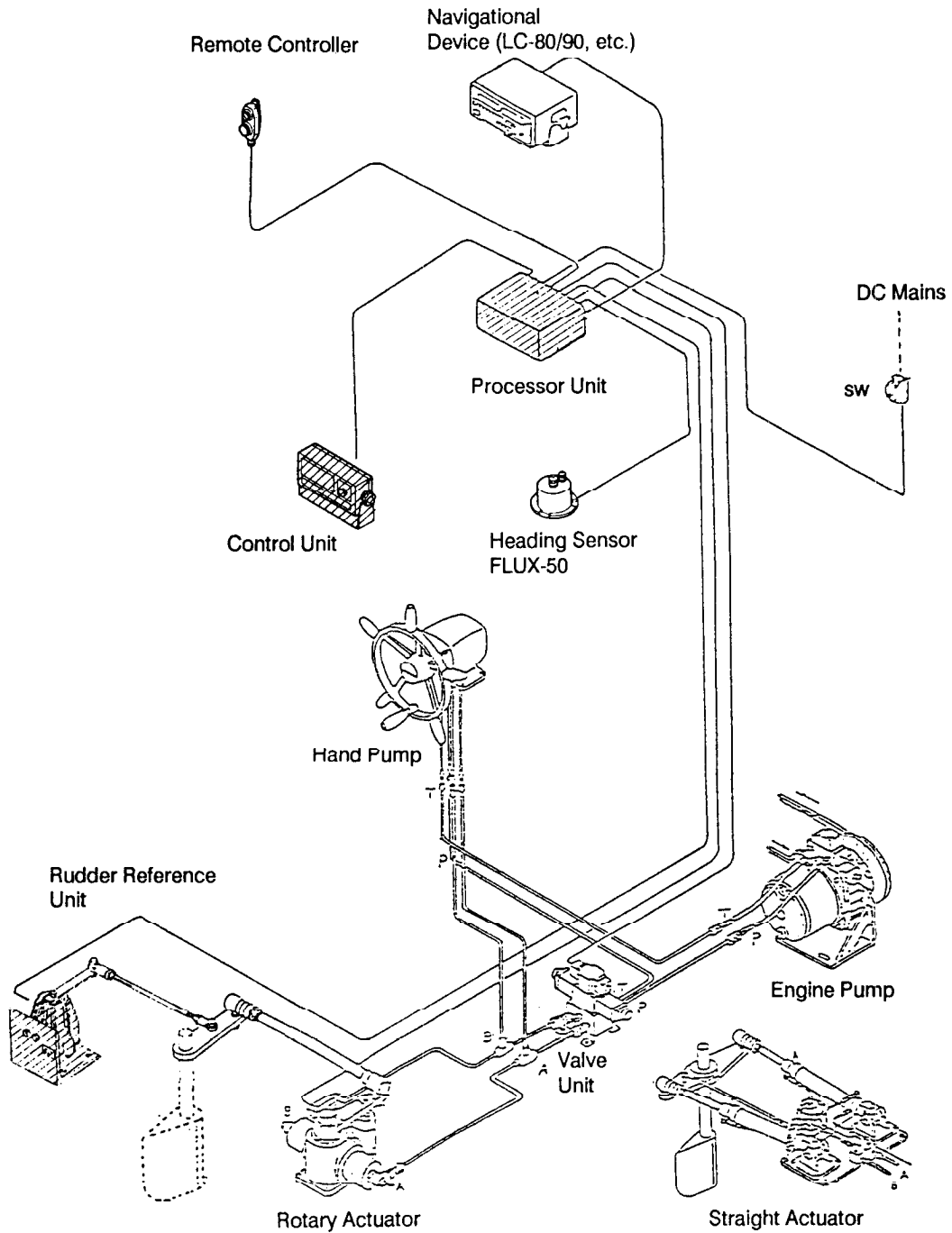
The rudder continues to move until a balanced condition is obtained at the comparator, at which point the drive switches off.

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.

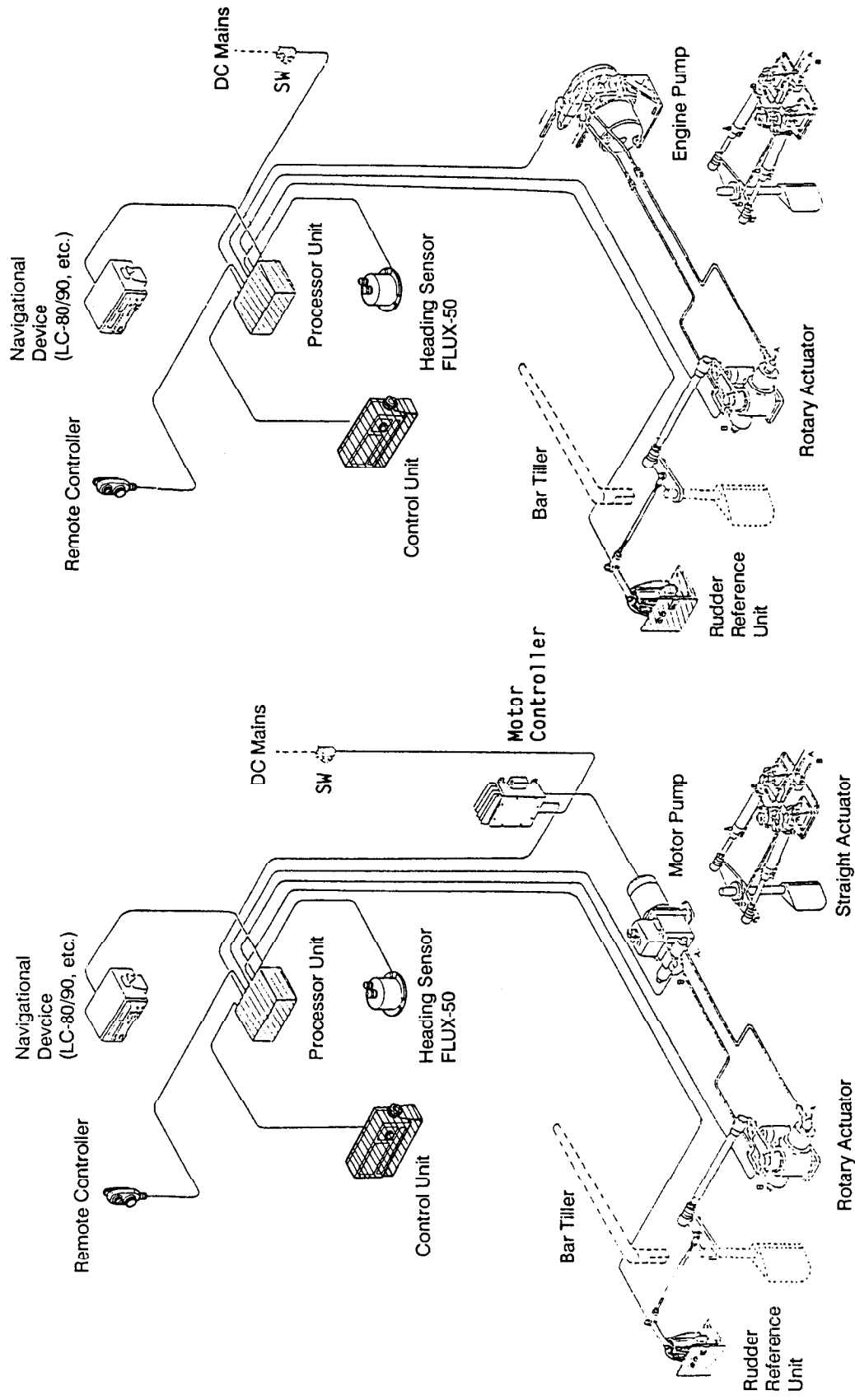
Although the autopilot is capable of steering a steady course for the helmsman, it cannot think for him. Always post a lookout while under way and never use the autopilot in congested harbors or areas of heavy traffic.

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.

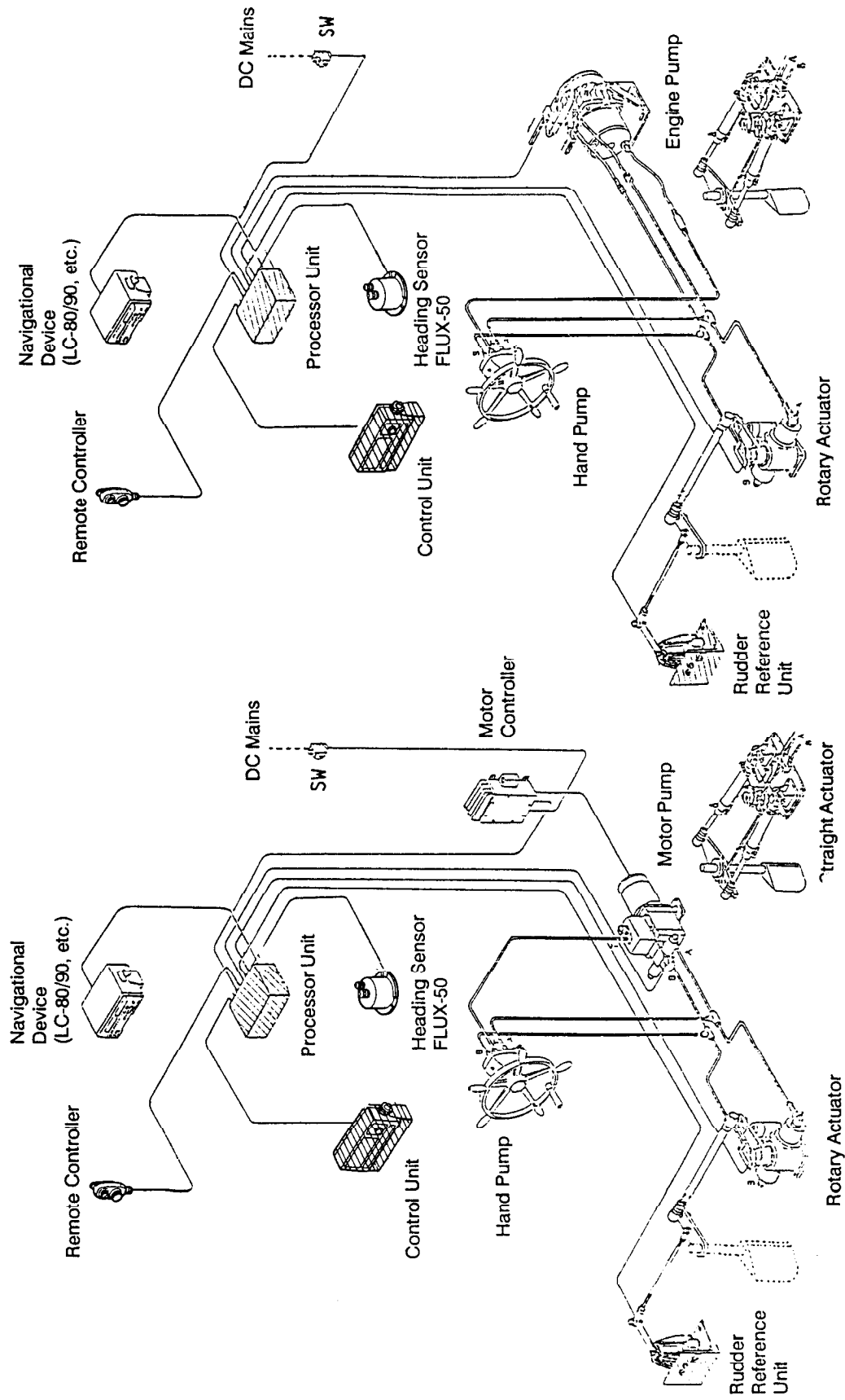
2. SYSTEM CONFIGURATIONS



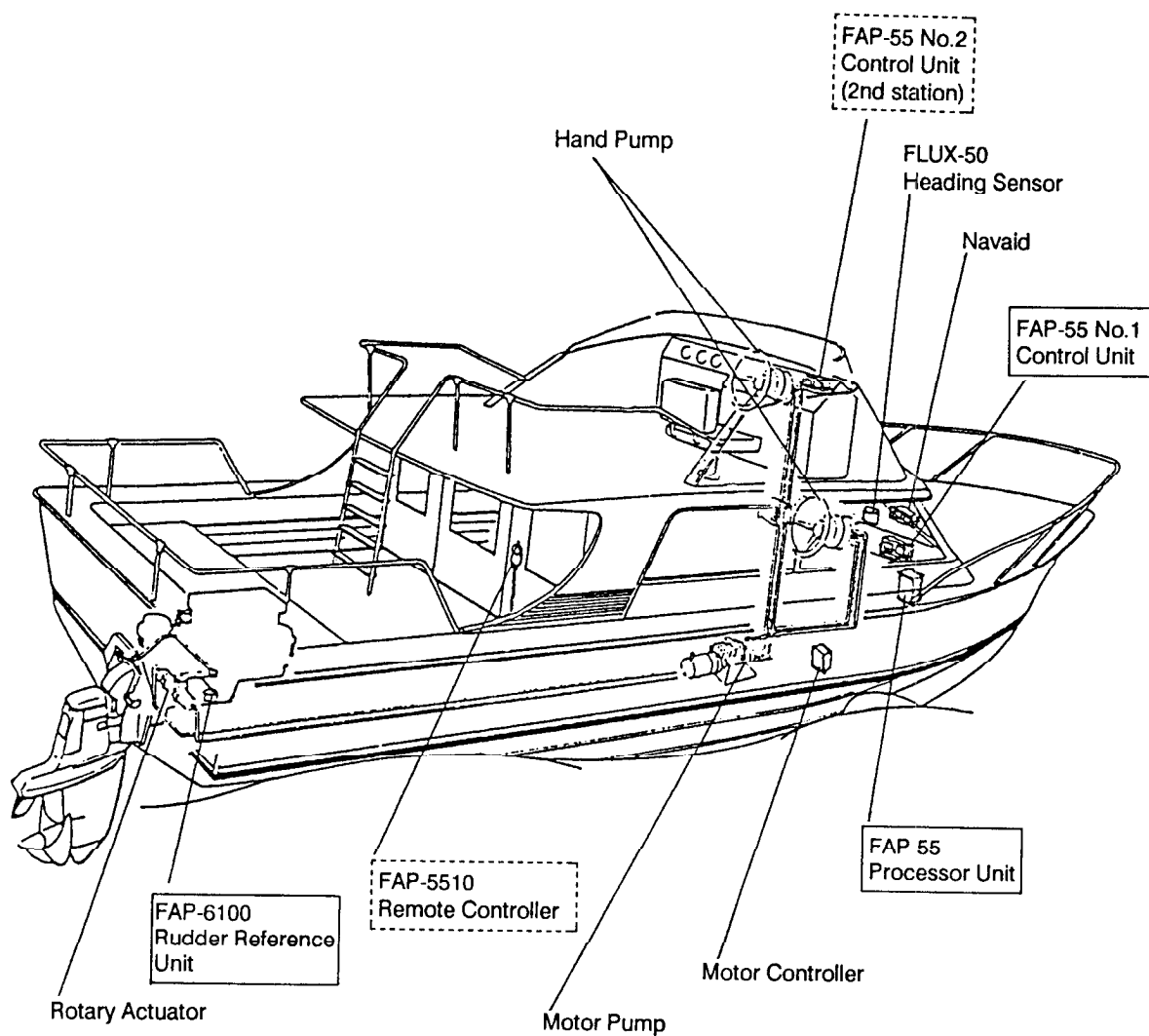
Hydraulic Steering Boat with Valve Unit



Hydraulic Steering Boats with Bar Tiller



Hydraulic Steering Boats with Hand Pump

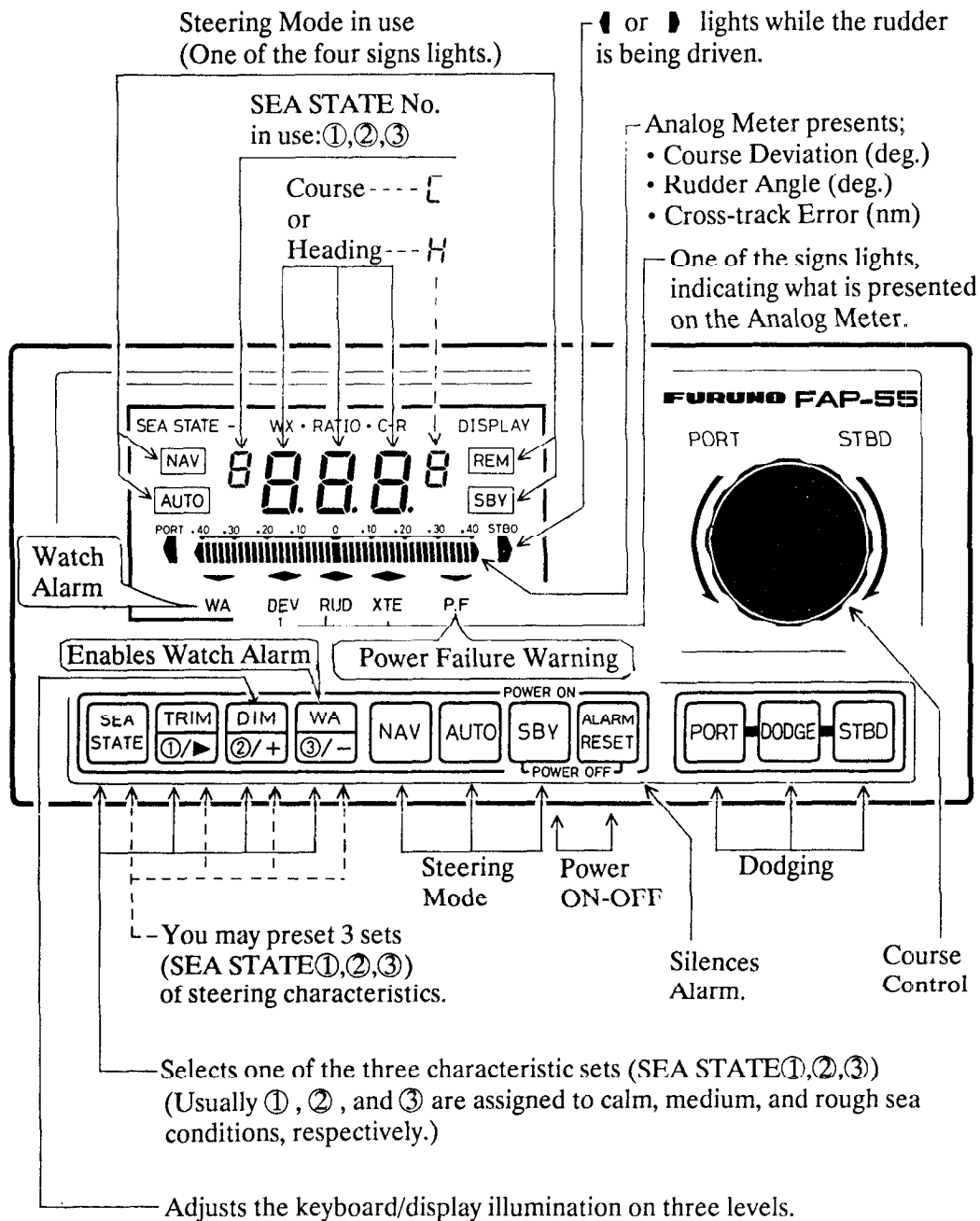


Typical Installation on a Hydraulic Steering Boat

3. CONTROL PANEL LAYOUT

Operation of the FAP-55 may be done from the control unit or the remote controller.

FAP-55 CONTROL UNIT

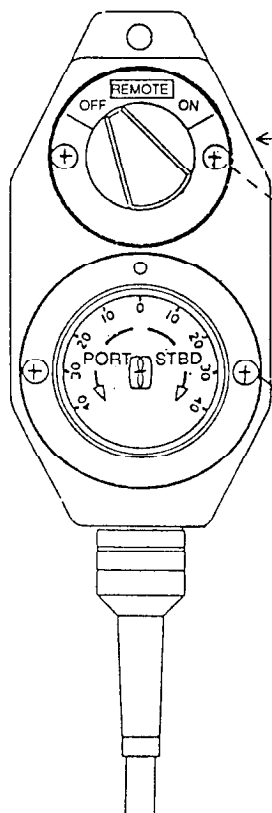


Key-pressing Acknowledgment Beep

A press of any key is acknowledged by a short beep. When an illegal key stroke is detected, two short beeps will be generated. In this case press key(s) again.

CAUTION: When No.1 and No.2 control units are connected, do not operate from the two units simultaneously. If this is done, the operation from either control unit will be accepted, while the one from the other unit will be totally disregarded.

REMOTE CONTROLLER (Optional)



Enables/disables the remote controller.

ON: The FAP-55 goes into the REMOTE mode, and the rudder may be steered by the steering dial.

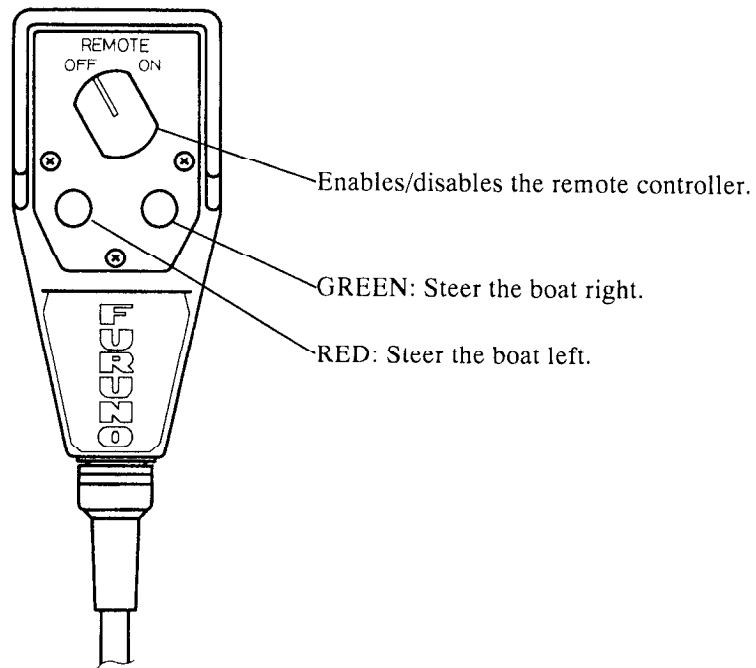
OFF: The previously used mode is recalled.

Steering Dial

The remote controller is usually fixed onto the bulkhead. If you want to use it in your hand, you may re-install the switch/dial blocks upside down in order that the dial is readable. In this case loosen the four screws shown left. Note that the switch/dial blocks are inserted into the controller body tightly with O-rings. Be careful not to damage them.

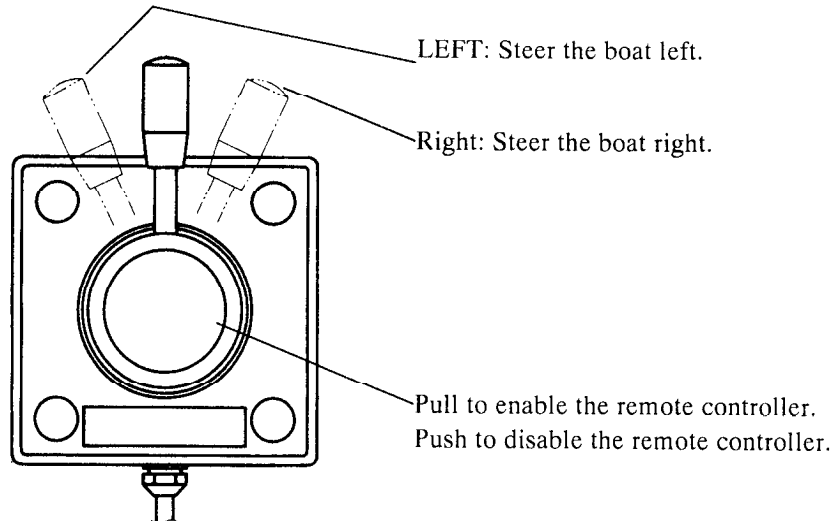
REMOTE CONTROLLER

FAP-6210 (Optional supply)



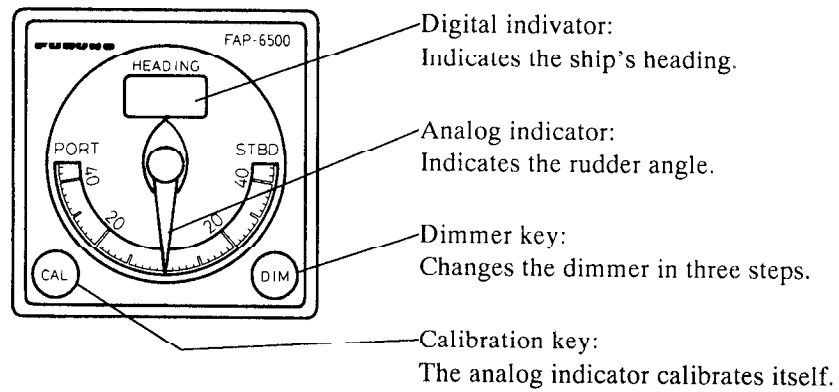
REMOTE CONTROLLER

FAP-6220 (Optional supply)



RUDDER ANGLE INDICATOR

FAP-6500 (Optional supply)



NOTE

The power is interlocked with the FAP-5520 (processor unit).

4. OPERATING PROCEDURE

From Departure to Arrival (How to use the AUTO mode)

(1) Turning on the FAP-55

Press [SBY] (Stand-by) key. ----->

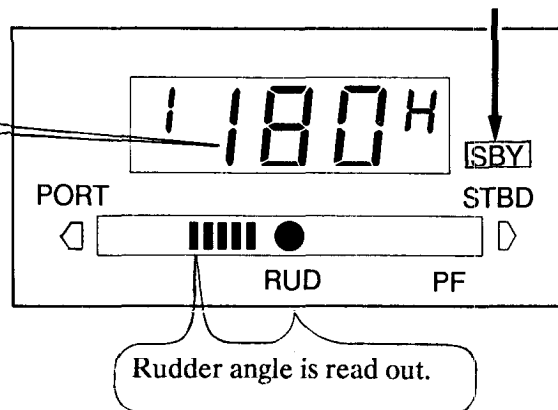
NOTE:
"PF" sign presentation at power on does not indicate power failure. Ignore it.

The FAP-55 is turned on, and a long peep sound is generated.

Self-check is conducted for 10 seconds.
(See page M-4.)

The FAP-55 goes into the [SBY mode];
(Ship's wheel may be steered manually.)

Check if the HEADING DIRECTION is reasonable. (Compare with the compass reading.)



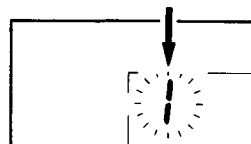
NOTE: 1. When the SBY mode is selected with a remote controller turned on, the "REM" indication blinks. In this case turn the remote controller off.
2. If the FAP-55 does not go into the SBY mode, see page M-4.

(2) Selecting a SEA STATE

As detailed from page 27, you may preset three sets of steering characteristics. Select one of the characteristic sets (①, ② or ③) in accordance with the sea/loading conditions, etc.

Press [SEA STATE]. ----->

The sea state number (①, ② or ③) in use blinks;

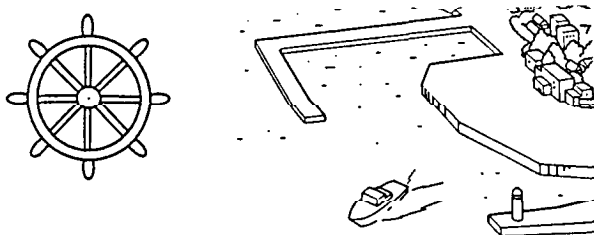


Select a set number by pressing [TRIM①/▶], [DIM②/+] or [WA③/-]. ----->

The selected SEA STATE number is presented without blinking.

(3) Sailing out by steering the wheel manually

Sail out of the harbor by steering the wheel manually. Do not use the AUTO or NAV mode (mentioned later on) in a congested area.



When the boat enters the open sea, direct the heading to the destination. ----->

Steer the wheel so that the HEADING nears the destination course.

120^H

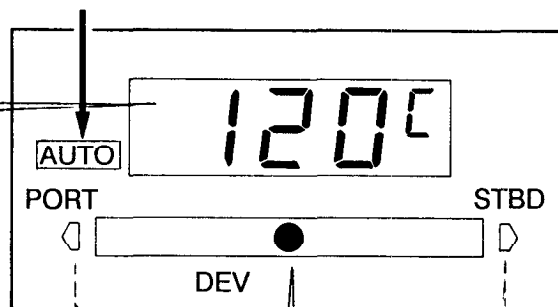
(4) Heading for the destination by AUTO mode.

Press [AUTO].----->

The FAP-55 goes into the [AUTO mode];

Course to Destination

When [AUTO] is pressed, the HEADING at that moment is set as the course.



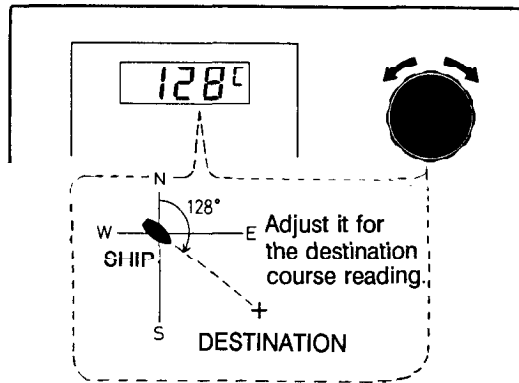
Press [WA] to change the display H (heading) or C (course).

Course Deviation

Indicates to which side (port or starboard) the course (destination) exists.

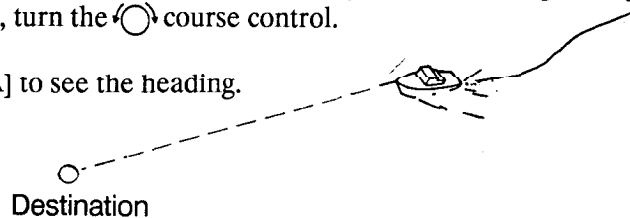
◁ or ▷ lights while the rudder is being driven.

Adjust the course reading by turning the  course control.



Whenever the heading deviates from the set course, the FAP-55 automatically steers the rudder to return to the set course. When you want to change/readjust the course setting during navigation, turn the  course control.

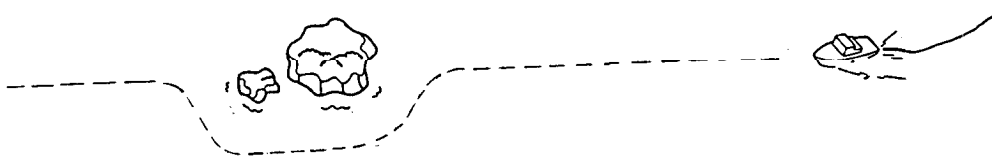
Press [WA] to see the heading.



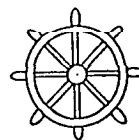
----- about COURSE DEVIATION WARNING -----

When a course deviation exceeding 30° is detected, the **[DEV]** indication blinks, and a 2-second peep is repeated. Press [ALARM RESET] to silence the peep.

(5) Dodging other boat/object in the course



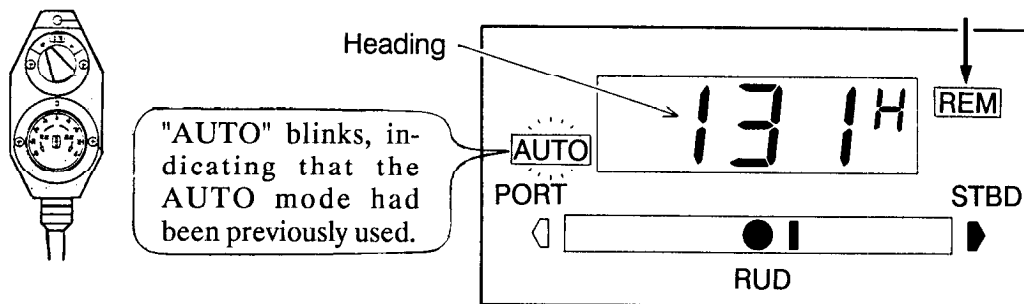
By steering the wheel manually (SBY mode)



1. Press [SBY].
2. Dodge other boat/object, then direct the heading to the destination by steering the wheel manually.
3. Recall the auto mode by pressing [AUTO], and adjust the  course control for the correct course reading on the digital display.

By using the remote controller (REM mode)

1. Turn on the remote controller switch.--> The FAP-55 goes into the **REM mode** which is similar to the SBY mode.



2. Dodge other boat/object, then direct the heading to the destination by turning the steering dial.
3. Turn off the remote controller, and the previously used mode (AUTO) is recalled. Adjust the  course control for the correct course reading on the digital display.

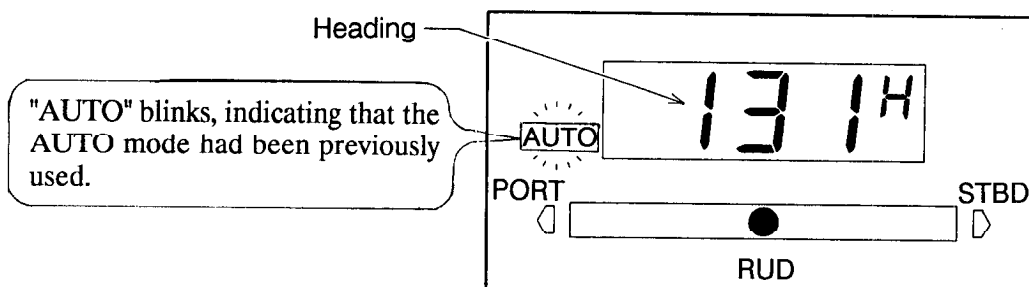
The course when the remote controller is turned off can be selected between a) or b).

- a) The course does not change from the one before using the remote controller.
- b) The course changes to the heading at the moment remote controller is turned off.

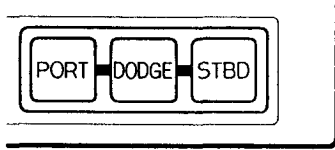
NOTE 1. FU Remote controller does not work when the SBY or DODGE mode (mentioned below) is selected. Use it in the AUTO or NAV mode only.

By using the DODGE mode

1. Press [DODGE]. -----> FAP-55 goes into the **DODGE mode** ; the buzzer sounds continually "PipPip PipPip --- ", and presentation similar to the SBY mode appears;



2. Dodge other boat/object by steering the rudder with [PORT] and [STBD].



When both [PORT] and [STBD] are pressed simultaneously, the rudder returns to the zero degree position.

3. Press [DODGE]. ----->

The FAP-55 returns to the previously used mode, e.g., AUTO.

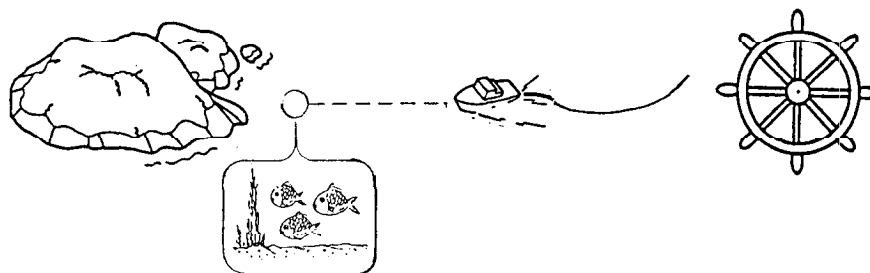
NOTE: 1. Press [DODGE] after having left the boat/object completely, because the original course setting is restored and the boat will turn to that direction automatically upon pressing [DODGE].

2. The DODGE mode can not be called up from the SBY mode. Call it up from the AUTO, REM or NAV mode only.

3. Leave dodge mode by pressing [AUTO] when changing the course.

(6) Arrival by steering the wheel manually

When approaching the destination, press [SBY] and steer the wheel manually.



(7) Turning off the FAP-55

Press both [SBY] and [ALARM RESET] simultaneously. ----->

The FAP-55 is turned off.
(Manual steering is available.)



— A note when the boat is stopped —

If the AUTO or NAV mode is used, the rudder is continually driven even when the boat is stopped. In order to save the battery power and prevent the rudder driving mechanism wear, it is recommended to place the FAP-55 in the SBY mode or shut down the power.

How to use the NAV mode

NOTE: 1. For the NAV mode operation, an external navaid must be connected to FAP-55. Turn it on and select a TO WAYPOINT beforehand.

2. In case of NMEA 0183, set an ARRIVAL ALARM RANGE, referring to page 46.

The navaid knows the present position and the TO WAYPOINT location. The FAP-55, while receiving those information, adjusts the course direction automatically in order to guide the boat to the TO WAYPOINT. The operating procedure from the departure to arrival is basically the same as (1) thru (7) described from page 9, but conduct the following operation in the place of (4) Heading for the destination by AUTO mode and (5) Dodging other boat/object in the course described from page 10.

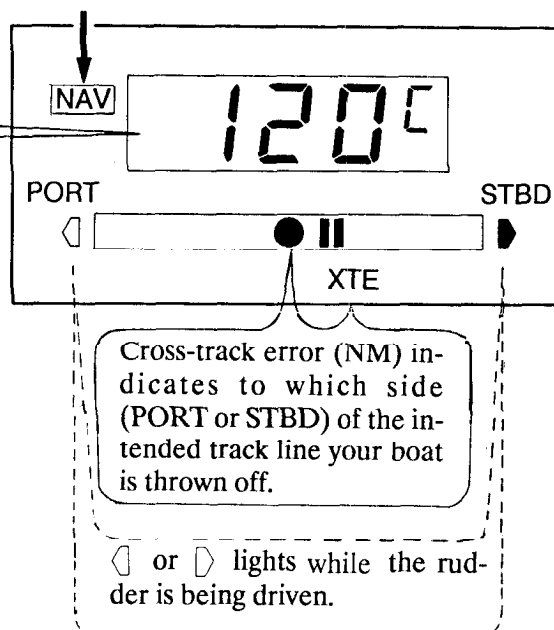
(4) Heading for the destination by the NAV mode

After having directed the ship's heading to the destination, press [NAV]. ----->

FAP-55 goes into the NAV mode;

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

The course reading on the FAP-55 is not always equal to the waypoint direction which is presented on the navaid.



NOTE: 1. Unless nav. information is received properly, a long peep sound is generated, the "NAV" indication blinks, then the previously used mode is recalled automatically.

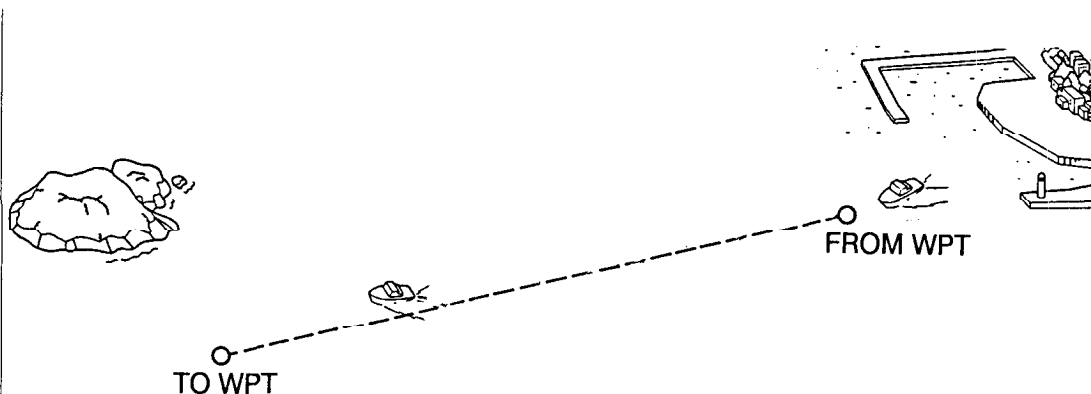
2. If the ship's position is far away from the intended track line, CROSS-TRACK ERROR WARNING will be released. See the next page.

In case that NMEA 0180 format data is transferred from the navaid:

Read out the waypoint direction presented on the navaid.

By adjusting the  course control, set the value on the digital display.

The FAT-55 automatically steers the rudder so that the boat follows the intended track line connecting the FROM and TO WAYPOINTS.



about CROSS-TRACK ERROR WARNING

When the cross-track error exceeds 0.3 nm (for NMEA 0180) or 0.4 nm (for NMEA 0183), the **XTE** indication blinks, and 1-second peep is generated repeatedly. Press [ALARM RESET] to silence the peep.

(5) Dodging other boat/object in the course

Dodging operation may be conducted in the same manner as the AUTO mode described from page 11. When the REM or DODGE mode is selected, "NAV" will blink to indicate that the NAV mode will be recalled when the REM or DODGE mode is terminated.

When an arrival alarm information is transferred from the navaid (NMEA 0183), the course reading blinks and 1-second peep is repeated. Press [ALARM RESET] to silence the peep.

NOTE: The FAP-55 can receive nav. data which is based on the NMEA 0180 or NMEA 0183 standard.

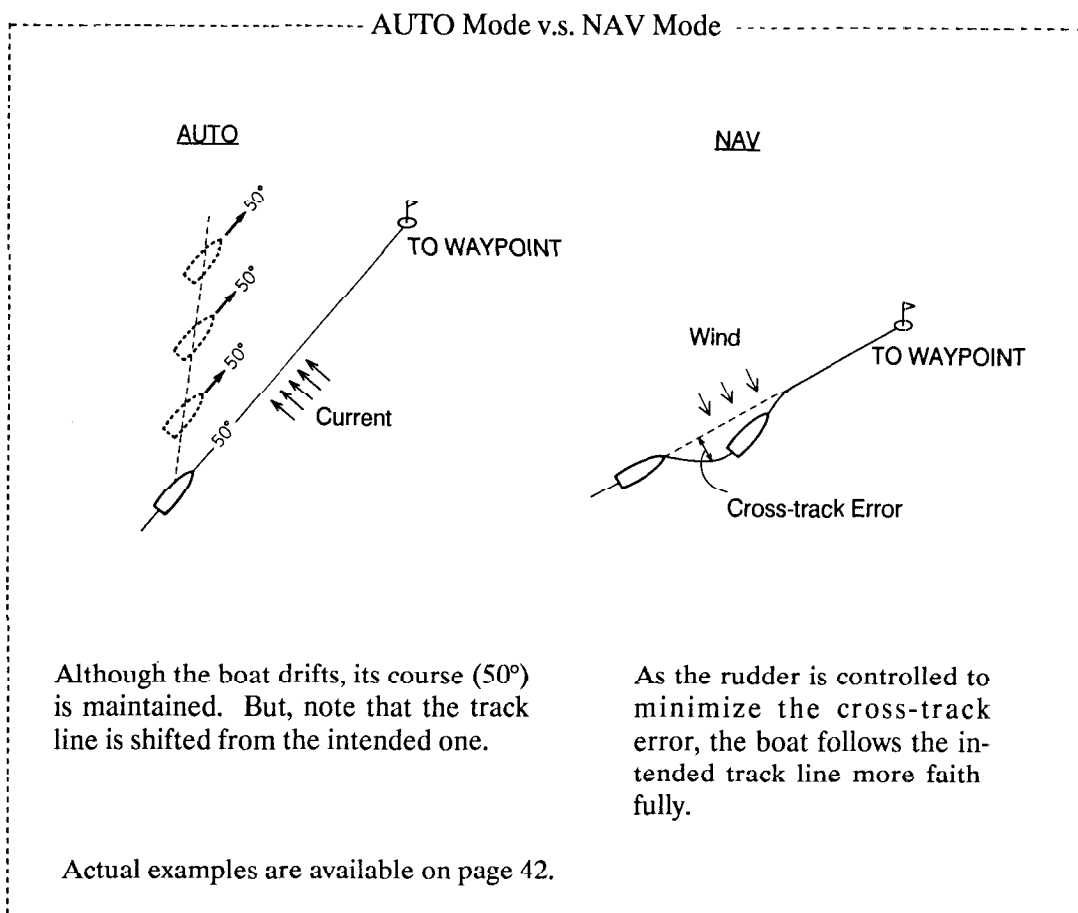
In case of NMEA 0180

Only the cross-track error data is transferred, and the rudder is steered to minimize it, but regardless of the ship's moving direction (approaching the TO WAYPOINT or leaving it). That is, 180° ambiguity exists.

Therefore, it is important to press [NAV] after having directed the boat to the TO WAYPOINT. Then adjust the  course control for proper course reading on the digital display, referring to the waypoint direction which is available on the navaid. The allowance for the course setting is wide ($\pm 30^\circ$), but it is recommended to adjust the course correctly so that the boat can settle onto the intended track line smoothly.

In case of NMEA 0183

Information of the TO WAYPOINT direction is transferred along with the cross-track error information. Therefore, 180° ambiguity does not exist. (The course control does not function.) Nevertheless it is recommended to press [NAV] after directing the boat to the TO WAYPOINT so that the boat can settle onto the intended track line smoothly.



5. INITIAL SETTING OF STEERING CHARACTERISTICS

After the installation, conduct the following adjustments, (1) thru (5), in this order.

NOTE: *General adjustment procedures are explained in the next chapter. It is recommended to read through it beforehand.*

Items of Adjustments

Place	NO.	Item	Adjustment	Display
Harbor	(1)	RUDDER LIMIT ANGLE	Prevents the rudder from being steered beyond a limit angle.	r
		BLIND SECTOR	Prevents the rudder from hunting.	
		CRUISING SPEED	Registers ship's cruising speed.	G
Open Sea	(2)	TRIM	Offsets the influence of current, wind, unbalanced loading condition, etc.	t
	(3)	* WEATHER	Prevents frequent steering between port and starboard in bad weather.	A
	(4)	* RUDDER RATIO	Adjusts the amount of rudder reaction against course deviation.	
	(5)	COURSE CHANGING SPEED	Adjusts speed of course changing which is conducted by FAP-55 itself.	G
		* COUNTER RUDDER	Prevents excessive turning by inertia when changing course.	A

NOTE: *Three sets (1, 2, 3) of values may be set for the items which bear asterisks (*).*

Adjustments (2) thru (5) should be conducted on the calm sea. The characteristics set up in the trial sea are just initial settings. When you want to change the setting later in actual voyage, refer to the next chapter.

in the HARBOR

Press [SBY].----->

The FAP-55 is turned on, the self-check is conducted, and the SBY mode presentation appears;

180^H SBY

(1) RUDDER LIMIT ANGLE and BLIND SECTOR

While holding down [SEA STATE], press [TRIM 1 / ►].----->

5^r

Rudder Limit Angle (for AUTO/NAV)
Degrees = Setting × 5

Adjust the setting by pressing [DIM 2 / +] and [WA 3 /-]:

The rudder limit angle for the AUTO/NAV modes may be considerably narrower when compared with the one inherent in your ships structure.

Press [TRIM 1 / ►].----->

1^r

Dead Band

Adjust the Dead Band when the rudder is hunting [DIM 2 / +] and [WA 3 /-]:

Press [TRIM 1 / ►] twice.----->

8^r

Rudder Limit Angle (for REM/DODGE)
Degrees = Setting × 5

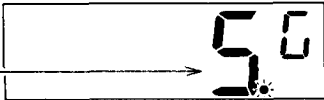
Adjust the setting by pressing [DIM 2 / +] and [WA 3 /-].

The rudder limit angle for the REM/DODGE mode should be wide, but should not exceed the rudder limit angle inherent in your ship's structure.

Press [SEA STATE] and [TRIM①/►] in this order. -----> The SBY mode is recalled.

(1) CRUISING SPEED

Press [SEA STATE] twice. -----> 

Press [TRIM①/►] twice. -----> 
 $\text{KNOTS} = \text{Setting} \times 5$

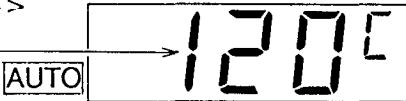
By pressing [DIM②/+] and [WA③/-], register the cruising speed which will be usually used in the NAV/mode.

Press [ALARM RESET]. -----> The SBY mode is recalled.

Go into the OPEN SEA. (calm sea)

The following adjustments should be conducted while navigating. Select an area where the trial sea will not interfere with marine traffic.

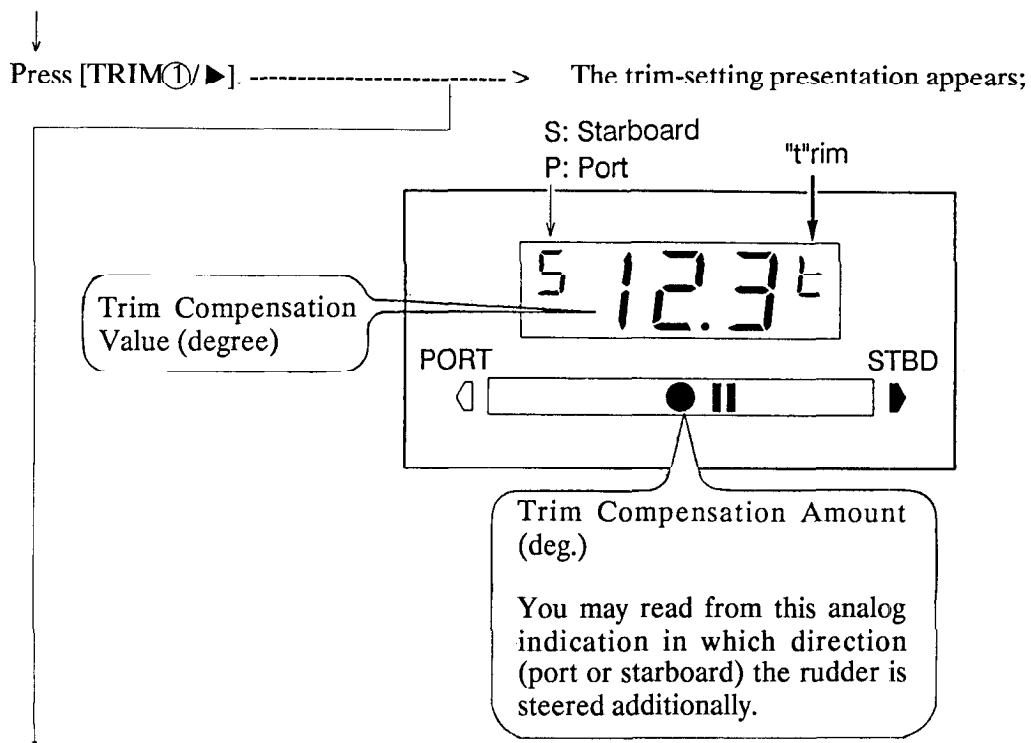
(2) TRIM

Press [AUTO]. -----> 
 Course

Turn on the remote controller with the steering dial set in the neutral position. ----->

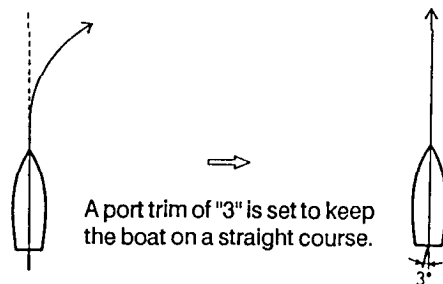
 REM

 RUD



adjust the trim compensation value by the course control so that the boat goes straightly without turning.

The following illustrations show the scenes in which the trim is not compensated and properly compensated for, respectively:



↓
Press [TRIM 1/▶] again. -----> The REM mode is recalled.

↓
Turn off the remote controller switch. ---> The AUTO mode is recalled.

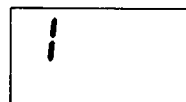
Select SEA STATE①

Press [SEA STATE]. ----->

Presently used SEA STATE number blinks;



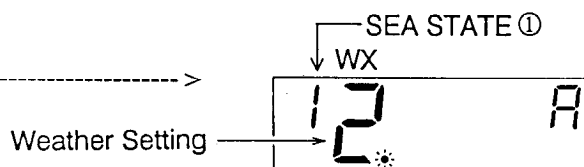
Press [TRIM①/▶]. ----->



(3) WEATHER

Run the boat in the AUTO mode.

Press [SEA STATE] twice. ----->



By pressing [DIM②/+] increase the setting until the rudder stops chattering between port and starboard. (To lower the number, press [WA③/-].)

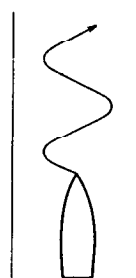
When a higher setting is used, rudder chattering is prevented but the boat tends to zigzag.



(A) WX=3



(A) WX=7



For favorable sea condition, "1" or "2" is commonly used.

(4) RUDDER RATIO

Press [TRIM①/▶].----->

Rudder Ratio Setting → 

By pressing [DIM②/+], increase the setting until the FAP-55 starts oversteering the rudder every time when the heading is deviating from the set course. Then press [WA③/-] to lower the number by one. (The rudder ratio should be set maximum, but oversteering must not occur.)

Press [ALARM RESET].-----> The AUTO mode is recalled.

(5) COURSE CHANGING SPEED and COUNTER RUDDER

DANGER

Do not increase the COURSE CHANGING SPEED much at a time, or the boat will turn sharply.

COURSE CHANGING SPEED

Press [AUTO].

Run the boat in the AUTO mode for a while.
Take note of the course reading.

AUTO →

90°

Call up the DODGE mode by pressing [DODGE].

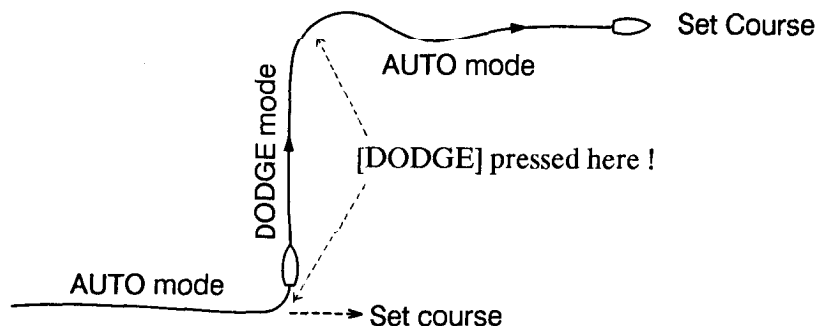
By pressing [PORT], turn the heading by -90 degrees, then run the boat straightly for a while.

Heading = Course - 90°

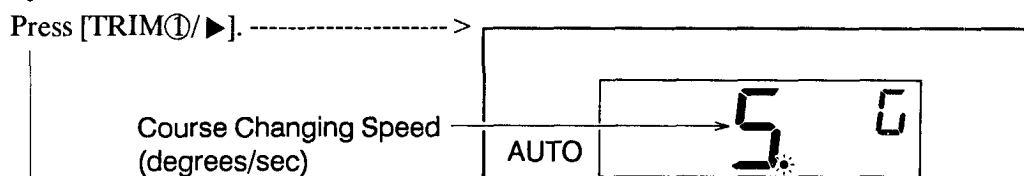
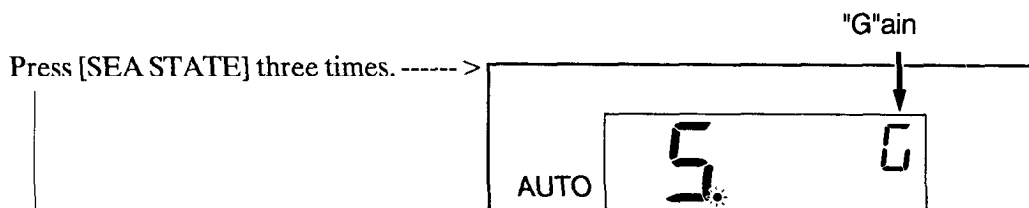
AUTO

0°

By pressing [DODGE], recall the AUTO mode, and watch how the boat returns to the original course:



- If the course changing speed is appropriate,
----> the adjustment has been completed. Proceed to COUNTER RUDDER on the next page.
- If the course changing speed is too fast or too slow,
----> adjust it as follows;



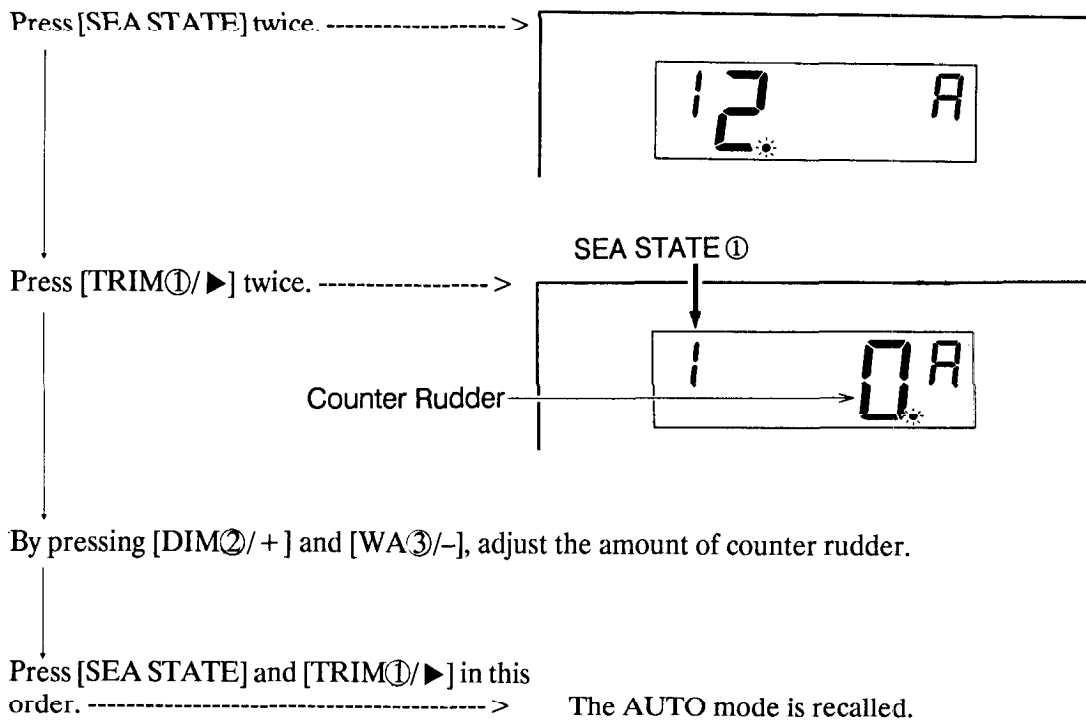
By pressing [WA③/-] (or [DIM②/+]), lower (or raise) the setting (course changing speed) by one.

NOTE: "5" is commonly used for 10 to 15 knot speed. For higher speed (knots), higher setting is usually used.

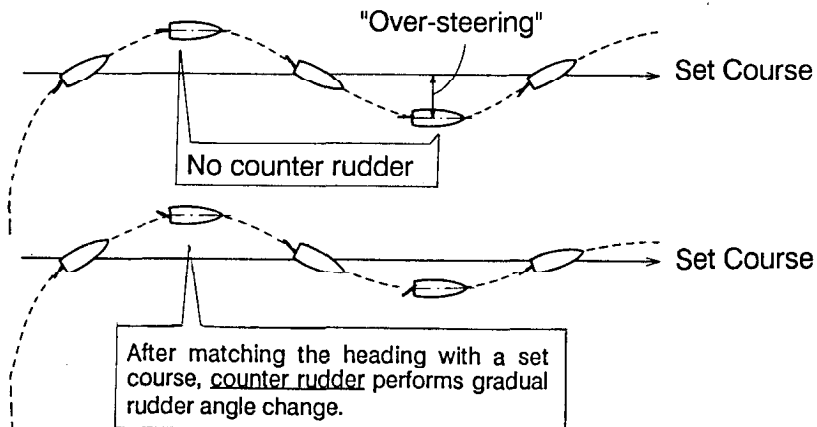
Press [SEA STATE] and [TRIM①/▶] in this order. -----> The AUTO mode is recalled.

COUNTER RUDDER

Counter rudder is usually not required for small boats. If your boat zigzags before settling in the new course, however, increase the setting as follows.



Effect of the counter rudder is illustrated below.



(6) Preliminary Setting for SEA STATES②and③

The WEATHER, RUDDER RATIO and COUNTER RUDDER for SEA STATE①(AUTO + Calm Sea) have been set already. Now, let us set the steering characteristics for SEA STATES②and③.

Assign any conditions to②and③, which are typically experienced, say "AUTO + Heavy Load" and "NAV", etc., and enter characteristic values tentatively, referring to the table below. When such a condition is encountered in future, use the appropriate SEA STATE (②or③), and modify the settings to suit the actual situation. For the modification of the characteristic settings, refer to the next chapter.

NOTE: The default settings shown on page 27 are for the following sea states.

- ① AUTO + Calm Sea
- ② AUTO + Usual Sea
- ③ AUTO + Rough Sea

If you wish, you may assign different conditions to②and③, for example;

- | | |
|--------------------|--------------------|
| ① AUTO + Calm Sea | ① AUTO + Calm Sea |
| ② AUTO + Rough Sea | ② AUTO + Full Load |
| ③ AUTO + Full Load | ③ NAV |

Preliminary Settings for ② and ③

Item	If <u>AUTO + Rough Sea</u> is assigned to ②or③;	If <u>AUTO + Full Load</u> is assigned to ②or③;	If <u>NAV</u> is assigned to ②or③;
WEATHER	Value should be 1 to 2 higher than ①.	Value should be 1 to 2 higher than ①.	Value should be 1 to 2 higher than ①.
RUDDER RATIO	Value should be 1 to 2 higher than ①.	Value should be 1 to 2 higher than ①.	Same value as ①.
COUNTER RUDDER	Same value as ①.	Value should be 1 to 2 higher than ①.	Same value as ①. *

* **NOTE:** In case of route navigation, non-zero setting should be used.

After deciding the preliminary values, enter them as mentioned on page 31.

Whenever the characteristic values are entered/changed, it is recommend to record them in the following table. In the event of destruction or loss of the values stored in the FAP-55, reenter them, referring to this table.

Record of Steering Characteristics

Item	Settings			Note	Display
	①	②	③		
TRIM	☐ / 0				t
WEATHER	☐ / 2	☐ / 3	☐ / 5		A
RUDDER RATIO	☐ / 4	☐ / 5	☐ / 6		
COUNTER RUDDER	☐ / 0	☐ / 0	☐ / 0		
AUTO TRIM SENSITIVITY	☐ / 5				G
COURSE CHANGING SPEED	☐ / 5				
CRUISING SPEED	☐ / 3				
RUDDER LIMIT ANGLE (AUTO/NAV)	☐ / 5				r
BLIND SECTOR	☐ / 3				
RUDDER LIMIT ANGLE (REM/DODGE)	☐ / 4				
NAV MODE DATA SELECT	☐ / 3				S
REMOTE CONTROLLER No. 1	☐ / H				
REMOTE CONTROLLER No. 2	☐ / H				

↑ Factory Setting

6. MODIFYING STEERING CHARACTERISTICS

When using the FAP-55 in actual voyages, you may feel like modifying the steering characteristics. This chapter shows the operating procedures and guidances in adjusting the characteristic values.

Items of Adjustments

Item	Adjustment	Default			Display
		①	②	③	
TRIM	Offsets the influence of sea current, wind, unbalanced loading condition, etc.	0			t
WEATHER	Prevents frequent steering between port and starboard in bad weather.	2	3	5	A
RUDDER RATIO	Adjusts the amount of rudder reaction against course deviation.	4	5	6	
COUNTER RUDDER	Prevents excessive turning by inertia in course changing.	0	0	0	
AUTO TRIM SENSITIVITY	Adjusts the sensitivity in monitoring the ship's trim.	5			G
COURSE CHANGING SPEED	Adjusts speed of course changing which is conducted by the FAP-55 itself.	3			
CRUISING SPEED	Registers the ship's cruising speed which is used in the NAV mode.	3			
RUDDER LIMIT ANGLE	(for safety in the AUTO/NAV modes)	5			r
BLIND SECTOR	Prevent the rudder from hunting.	4			
RUDDER LIMIT ANGLE	(for safety in the REM/DODGE modes)	8			
NAV MODE DATA SELECT	NMEA 0180/0183	3			S
REMOTE CONTROLLER No. 1	CONNECTION OF REMOTE CONTROLLER YES/NO	H			
REMOTE CONTROLLER No. 2	SELECTING THE COURSE AFTER USING REMOTE CONTROLLER	H			

Factory Settings —

Sea State①,②,③

As you will see in the above table, three sets (①,②,③) of WEATHER, RUDDER RATIO, and COUNTER RUDDER may be preset. In a voyage, you may use one of the three sets in accordance with sea condition, etc.

TRIM --- Offsets the influence of current, wind, unbalanced loading condition, etc.

When sea current is very fast or the loading condition is extremely unbalanced, the following symptom may be observed.

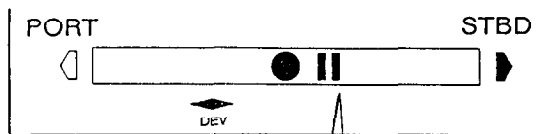
[In case of the REM mode]

The boat tends to circle as shown right even if the rudder is kept neutral.

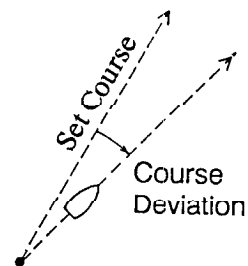


[In case of the AUTO mode]

The boat goes the course deviated from the set course as shown below.



Ship's heading yaws, but not equally to port and starboard. There is a tendency that a course deviation appears more in one direction. Such long-term tendency is called TRIM.



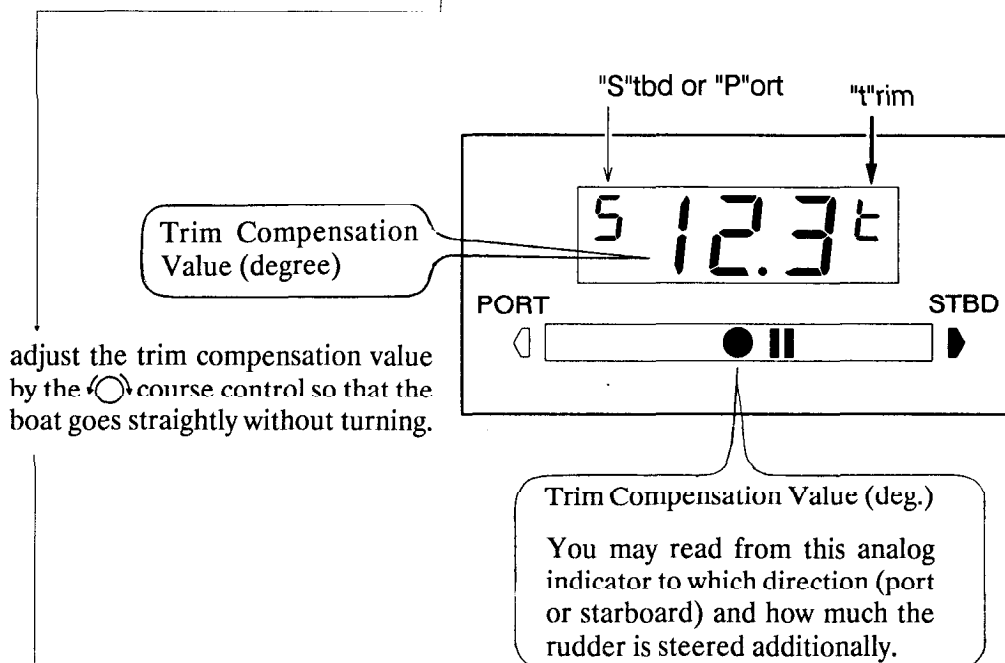
AUTOused from this point.

NOTE: The above-mentioned problem occurs seldom and the trim adjustment is not required usually in the AUTO mode, because trim compensation is performed automatically as explained on page 30.

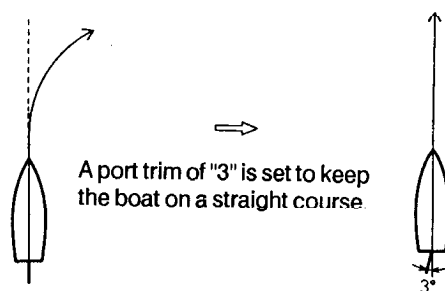
In order to offset the above-mentioned tendency, the rudder should be biased. The adjustment procedure for this "bias" is explained on the next page.

Turn on the remote controller with the steering dial set in the neutral position.

Press [TRIM 1 / ►]. -----> the trim-setting presentation appears:



The following illustrations show the scenes in which the trim is not offset and properly offset, respectively;



Press [TRIM 1 / ►] again. -----> Previous presentation is recalled.

NOTE: The range of the trim compensation is $\pm 30^\circ$. However, it is limited by the **RUDDER LIMIT ANGLE** (for the **AUTO/NAV** modes) mentioned on page 39. The trim compensation amount can not exceed;

(**RUDDER LIMIT ANGLE** in **AUTO/NAV**) – (10 degrees)

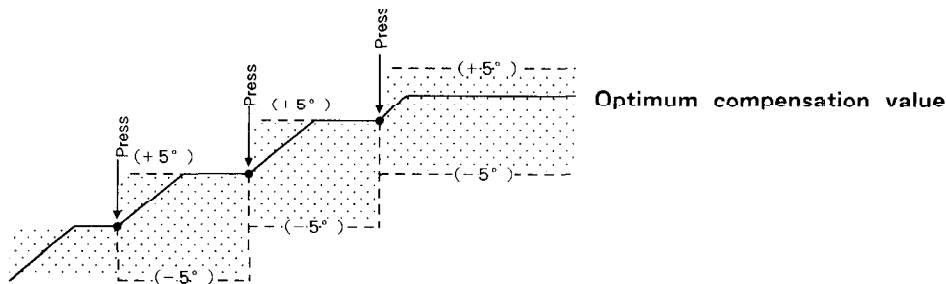
about AUTO TRIM

Influence of wind or sea current changes as time elapses or the boat changes the course/speed. Therefore, the trim compensation value should be readjusted periodically. The FAP-55 is continually sensing the change in ship's trim, and the compensation value is updated automatically. When [TRIM①/►] is held down, the up-to-date trim compensation value is presented, and you may change the setting as explained on the preceding page. When [TRIM①/►] is released, the trim compensation value restarts changing from the above-entered value. Note that the variable range of the compensation value is limited within ± 5 degrees of the manually entered value.

If current, wind or loading condition has changed markedly, exceeding the above-mentioned limitation ($\pm 5^\circ$), you must enter a new value as described on the preceding page, or conduct following operation.

Trim Adjustment without using a Remote Controller

If a course deviation constantly appears, the trim is thought to be out of the above-mentioned range ($\pm 5^\circ$ of the manually entered value), i.e., the compensation value should have reached the $+5^\circ$ or -5° limit. Occasionally press [TRIM①/►]. The variable range of the compensation value will shift up (or down) every time the key is pressed, and finally the course deviation will disappear. See the illustration below.

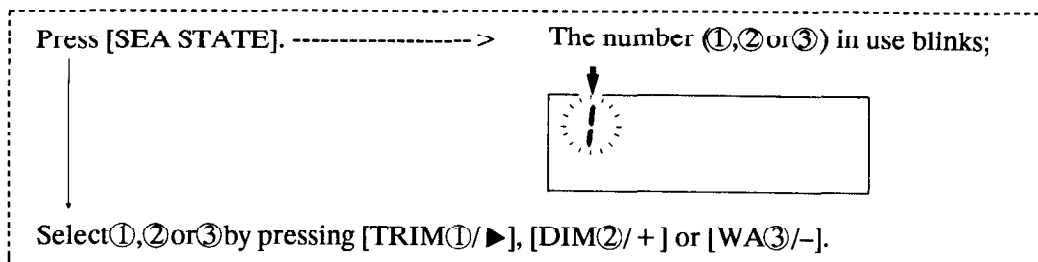


When the boat is stopped or dead slow, the heading can not be changed sensitively, i.e., the rudder must be biased much in order to offset a trim. For this reason the trim compensation value easily reaches the $+5^\circ$ or -5° limit. This may be prevented by selecting the SBY mode or turning the unit off. If ship's speed information is transferred from an external navaid (NMEA 0183), you need not mind this because the FAP-55 automatically stops updating the compensation value when the ship's speed is zero.

WEATHER --- Prevents frequent steering between port and starboard in bad weather.
RUDDER RATIO --- Adjusts the amount of the rudder reaction against course deviation.
COUNTER RUDDER --- Prevents excessive turn by inertia in course changing.

Three sets (①,②,③) of the above-mentioned characteristics may be registered.

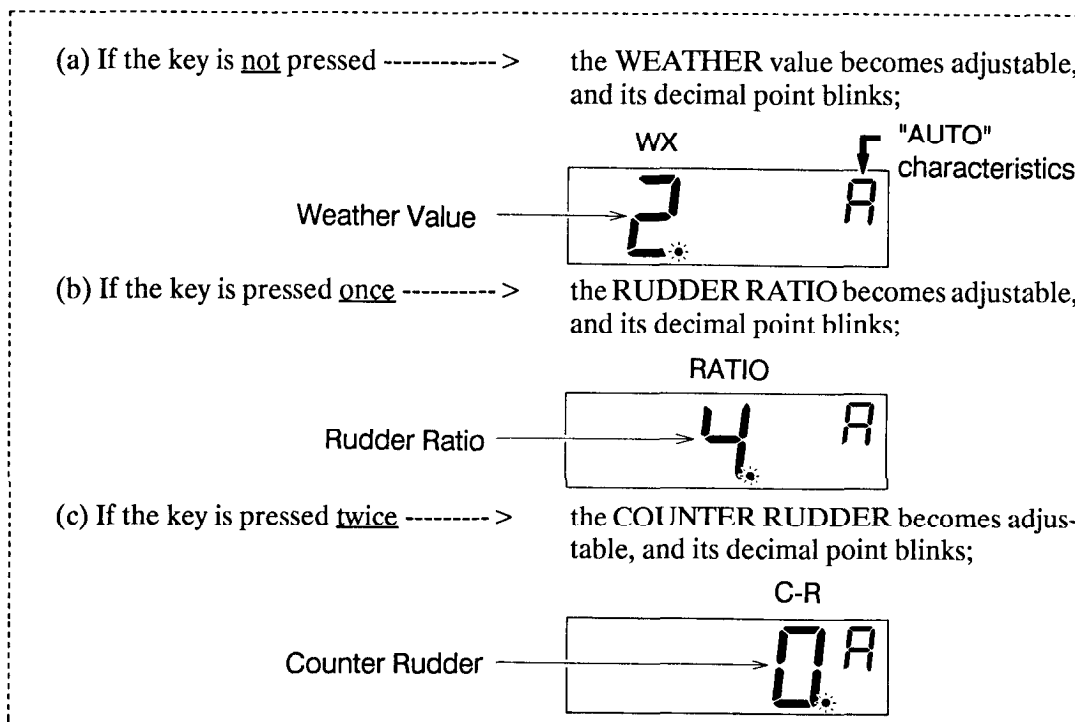
First, select a characteristic set number which you wish to adjust;



Second, register the characteristic set as follows:

Press [SEA STATE] twice.

By pressing [TRIM①/▶], select the item which you wish to adjust;



Adjust the number by pressing [DIM②/ +] and [WA③/-].

Press [SEA STATE]. -----> The previous mode presentation is recalled, and the SEA STATE number blinks.

Select a SEA STATE number by pressing [TRIM①/▶], [DIM②/+] or [WA③/-].

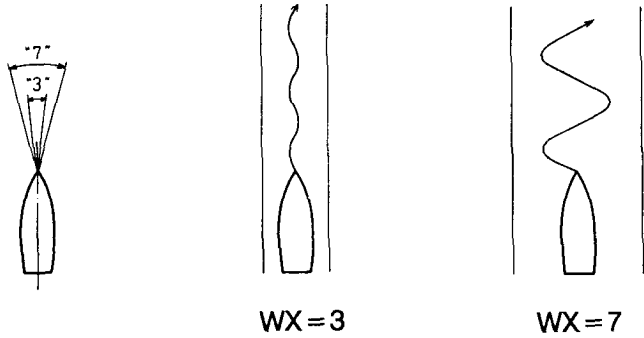
about WEATHER

When the sea is rough, the ship's heading oscillates between port and starboard. If the rudder is driven every time to maintain the set course, the helm mechanism will wear out. In order to prevent this, the WEATHER adjustment makes the FAP-55 insensitive to a minute course deviations.

You may choose a deadband among the following nine. Until the course deviation exceeds the selected deadband, steering to correct the heading is not initiated.

Setting	1	2	3	4	5	6	7	8	9
Deadband	$\pm 1^\circ$	$\pm 2^\circ$	$\pm 3^\circ$	$\pm 4^\circ$	$\pm 5^\circ$	$\pm 6^\circ$	$\pm 7^\circ$	$\pm 8^\circ$	$\pm 10^\circ$

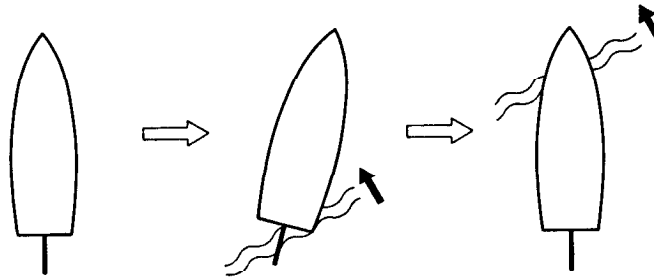
The illustrations below show ship's track lines with weather settings 3 and 7. When 7 is set, the rudder is not driven until the course deviation exceeds 7 degrees. Increasing the setting reduces chattering of the rudder, however the boat tends to zigzag.



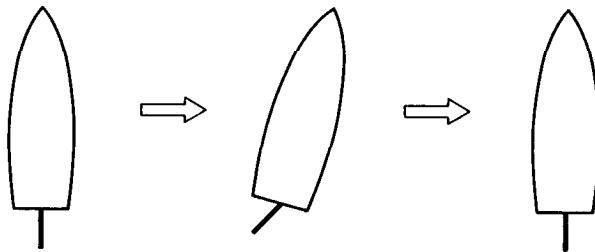
When favorable sea condition exists, setting of "1" or "2" will be appropriate. For rough seas, a higher setting is required.

Rudder Chattering in Following Sea

Let's suppose a wave hits the boat on the starboard quarter. It throws ship's stern to port, and as a result the heading deviates to starboard. As the same wave propagates to the bow, ship's bow is also thrown to port. After all, the heading is not so deviated from the original course.



See the illustrations below. If the autopilot is operating, the rudder will be steered to port when the heading deviates to starboard. When the same wave propagates to the ship's bow, the heading is restored, resulting that rudder will return to the initial angle. This process is repeated each time a wave hits the boat.



Higher setting of WEATHER prevents this kind of rudder chattering.

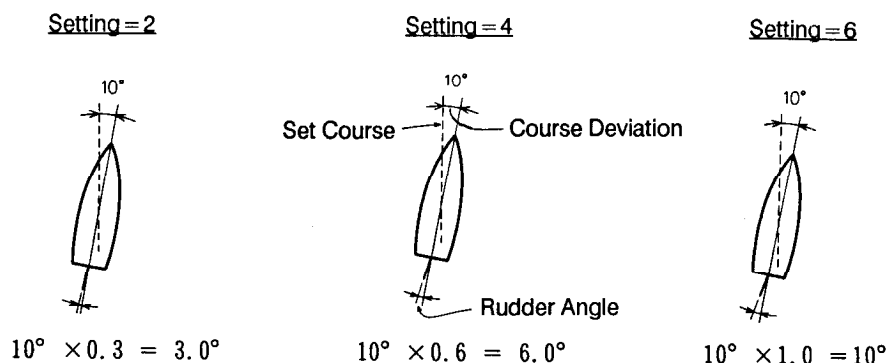
NOTE: A small boat sometimes zigzags seriously in the following sea. Refer to page 40.

about RUDDER RATIO

When the ship's heading deviates from the set course, the FAP-55 drives the rudder to recover 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	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.5	1.9

The following illustrations show how many degrees the FAP-55 steers the rudder in order to nullify 10 degrees of course deviation with various settings of the rudder ratio:



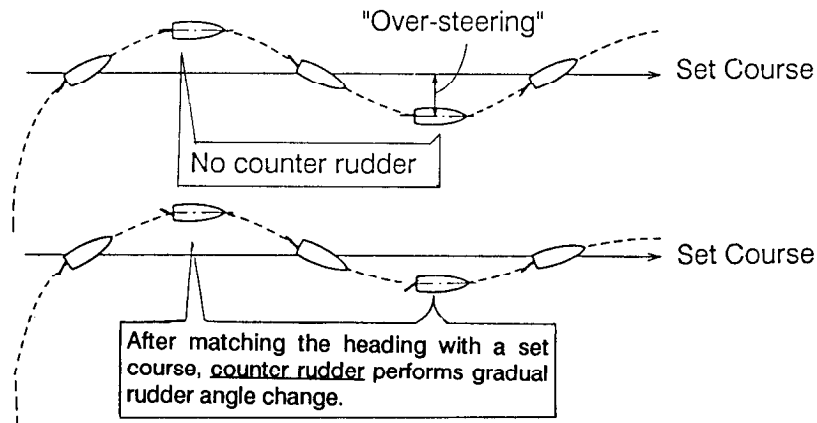
NOTE: When the heading deviates from the set course markedly, a special rudder ratio (higher than the manually entered one) is used automatically.

Increase the setting until over-steering occurs, then reduce it by one. Rudder ratio should be adjusted, considering the following factors.
(Setting of "4" is commonly used.)

fast _____ Ship's Speed _____ slow
light _____ Load Condition _____ heavy
low _____ RUDDER RATIO _____ high

about COUNTER RUDDER

When the course setting is changed, the FAP-55 steers the rudder to the new course. If the boat is heavily loaded, the heading will turn excessively by inertia, passing the new course. Then, the FAP-55 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. A skill known as COUNTER RUDDER is used to prevent this kind of oscillation as illustrated below.



You may set the value of counter rudder from "0" to "9"; the higher the setting, the more counter rudder is steered by the FAP-55.
("0" = No Counter Rudder)

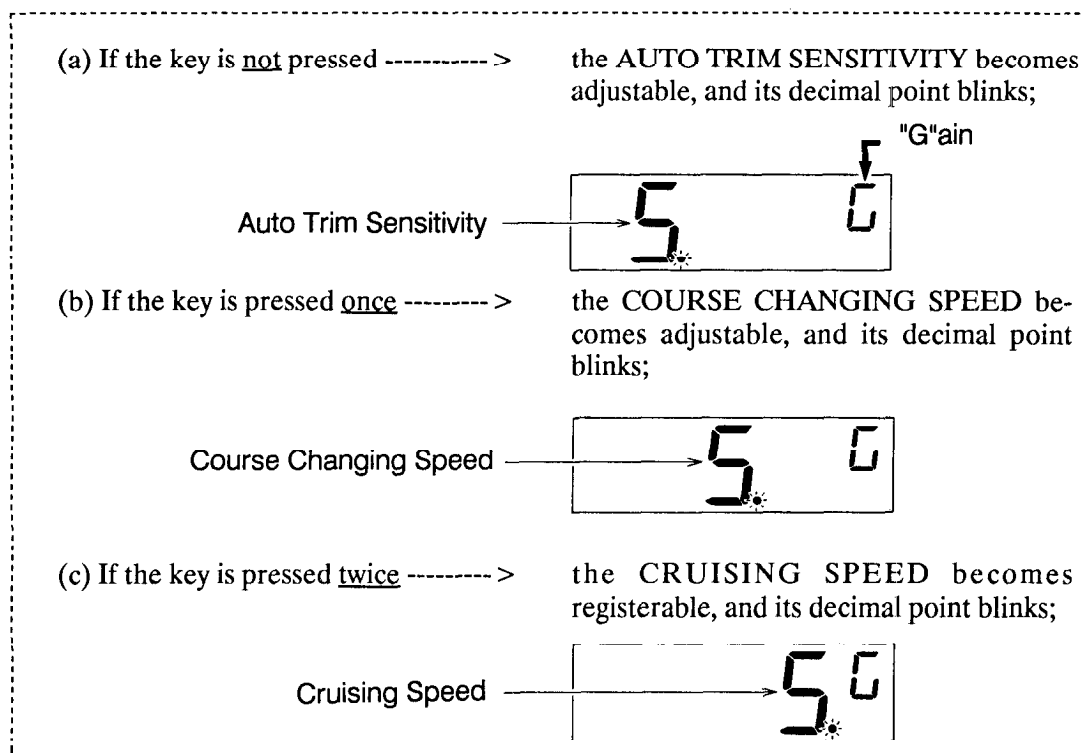
Counter rudder is usually not required for small boats. When your boat zigzags a lot before settling in the new course, increase the setting.

-
- AUTO TRIM SENSITIVITY --- Adjusts the sensitivity in monitoring the ship's trim.
- * COURSE CHANGING SPEED --- Adjusts speed of course changing which is conducted by the FAP-55 itself.
- CRUISING SPEED --- Registers the ship's cruising speed, which is used in the NAV mode.
-

*** NOTE:** When the operational mode is changed or while the NAV mode is used, the course setting is changed/adjusted automatically. In the following operations, you may choose a speed of such course changing. In the AUTO mode the course setting changes depending on the turning speed of the course control knob, irrespective of the course changing speed discussed here.

Press [SEA STATE] three times.

By pressing [TRIM①/▶], select the item which you wish to adjust:



Adjust the value by pressing [DIM②/ +] or [WA③/-].

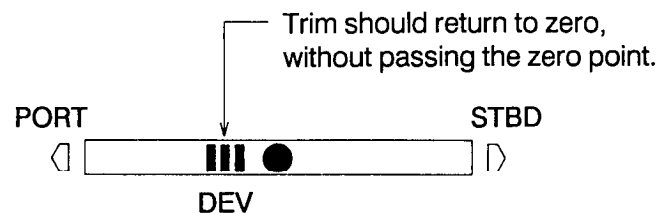
Press [SEA STATE]. ----- > The previous mode presentation is recalled, and the SEA STATE number blinks.

Select a SEA STATE number by pressing [TRIM①/▶], [DIM②/ +] or [WA③/-].

about AUTO TRIM SENSITIVITY

As mentioned on page 30, the FAP-55 continually monitors the ship's trim in order to keep the compensation value optimum. You may enter a number from "1" to "9" ; the larger the number the more frequently detected is the change of ship's trim, resulting that setting of the trim compensation value is updated more quickly. A lower setting is common because ship's trim usually does not change quickly. If high setting is used in order to nullify the trim quickly, the following problems may arise.

1. Trim-compensation is over-effected, resulting that a trim appears in port and starboard directions alternately.



2. A boat usually yaws due to wave, etc. If the setting is too high, the auto trim-compensating mechanism responds even to the yawing, resulting in more serious oscillation of ship's heading.

Choice of Setting Value

Run the boat with setting "0" (AUTO TRIM = off), and measure the period (one cycle) of yawing.

If the period is 2 to 3 seconds, setting "5" or so will be appropriate. For longer periods, lower settings should be used.

If the boat repeats "go" and "stop" frequently, or if the ship's speed is unstable, it might be better to disable the AUTO TRIM function by using setting "0".

NOTE: If a trim is not cleared for a long time, suspect that the trim compensation value has reached its upper or lower limit. See page 30.

about COURSE CHANGING SPEED

When the mode is changed or when the NAV mode is used, the course is controlled by the FAP-55 itself. If the course is changed too quickly, it is dangerous; contrarily if the course is changed too slowly, course change takes a long time. You may enter a number from "1" to "9", which corresponds to the course changing speed of 1 degree/sec to 9 degrees/sec, respectively.

Too high a setting will turn the boat sharply at course change.
Dangerous!

Setting of "5" or so is commonly used for 10 to 15-knot cruising speed. The faster the speed, the higher the setting.

When you feel the course changing speed is too fast, decrease the setting.

CRUISING SPEED

The ship's speed information is used in the NAV mode. You may enter a number from "1" to "9" which corresponds to the following nine speeds.

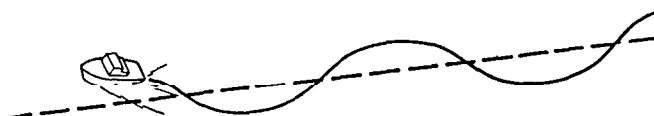
Setting	1	2	3	4	5	6	7	8	9
KNOTS	5	10	15	20	25	30	35	40	45

(KNOTS = Setting x 5)

Select a number in accordance with the speed which is usually used in the NAV mode.

(If the ship's speed information is transferred from the navaid with the NMEA 0183 format, it is used in place of the manually entered value.)

If the boat goes zigzag in the NAV mode, crossing the intended track line, decrease the setting.



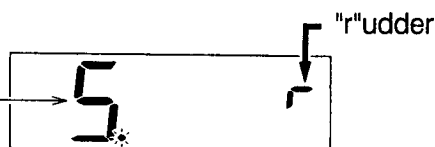
RUDDER LIMIT ANGLE --- for safety in the AUTO/NAV modes
 DEAD BAND ----- to prevent rudder hunting
 RUDDER LIMIT ANGLE --- for safety in the REM/DODGE modes

While holding down [SEA STATE],
press [TRIM 1 /] three times. (Then
release [SEA STATE].)

By pressing [TRIM 1 /], select the item which you want to adjust:

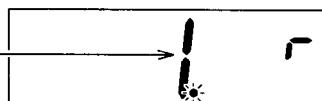
(a) If the key is not pressed ----- > the RUDDER LIMIT ANGLE (for
AUTO/NAV modes) can be adjusted, and
its decimal point blinks;

Rudder Limit Angle
 (for AUTO/NAV)
 = Setting $\times 5^\circ$



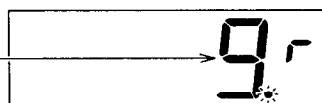
(b) If the key is pressed once ----- > the BLIND SECTOR can be adjusted, and
its decimal point blinks;

Dead Band
 = Setting $\times 0.1^\circ$



(c) If the key is pressed twice ----- > the RUDDER LIMIT ANGLE (for
REM/DODGE) can be adjusted, and its
decimal point blinks;

Rudder Limit Angle
 (for REM/DODGE)
 = Setting $\times 5^\circ$

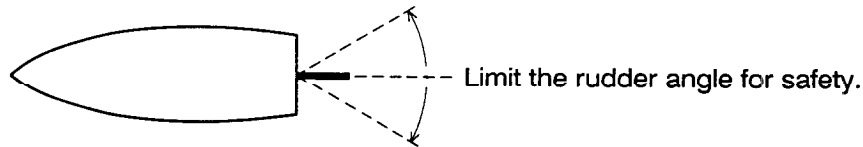


Select a number by pressing [DIM 2 / +] and [WA 3 /-].

Press [ALARM RESET], ----- > The previous mode presentation appears.

about RUDDER LIMIT ANGLE (for the AUTO/NAV modes)

In the AUTO or NAV mode the FAP-55 drives the rudder for course keeping only, where a wide rudder angle is usually not required. It is recommended to limit the rudder angle so that the rudder may not be deeply steered incidentally.



You may enter a number from "2" to "9", and the actual limit angle (degree) is obtained by multiplying the number by five;

$$\text{Limit Angle (degree)} = \text{Setting} \times 5$$

Every boat has its inherent rudder limit angle, and the rudder must not be steered beyond this point. The limit angle for the AUTO/NAV modes may be considerably small compared with the one which is inherent in your ship's structure. 15 degrees or so will be appropriate usually.

Heading Oscillation in Following Sea

The boat which has the following characteristics often zigzags seriously in the following sea.

- Its heading is easily changed when the stern is hit by a wave or when the rudder is steered.
- Its rudder can not move quickly, i.e., hardover to hardover requires a long time, say 10 seconds or more. This causes a lag in recovering the set course.

Adjustment of WEATHER, RUDDER RATIO or COUNTER RUDDER can not be a remedy for this type of problem. Narrow the RUDDER LIMIT ANGLE, $\pm 20^\circ$ for example, and considerable improvement will be observed.

about RUDDER LIMIT ANGLE (for REM/DODGING)

A number from "2" to "9" may be entered, and the actual limit angle (degree) is obtained by multiplying the number by five;

$$\text{Limit Angle (degree)} = \text{Setting} \times 5$$

NAV MODE DATA SELECT -----	NMEA 0180 or 0183
REMOTE CONTROLLER No. 1	CONNECTION OF REMOTE CONTROLLER
REMOTE CONTROLLER No. 2	SELECTION OF COURSE AFTER USING THE
	REMOTE CONTROLLER

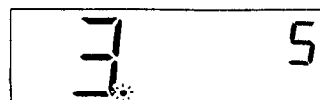
While holding down [SEA STATE],
Press [TRIM①/▶].

Press [SEA STATE]. ----- > Remote Controller function setting
presentation appears.

By pressing [TRIM①/▶], select the item which you wish to adjust:

(a) If the key is not pressed ----- > Navigational data input for NAV mode can
be registered.

- 3: NMEA 0183.
Talker ID will be selected automat-
ically.
C: NMEA 0183
Receives Loran-C only.
O: NMEA 0180.



(b) If the key is pressed once ----- > Remote Controller No. 1 function can be
registered.

- O: No Connection
H: Remote Controller Connected.
The course at the moment
remote controller is turned off
becomes the course.
C: Remote Controller Connected.
The course before using the
remote controller is stored.



(c) If the key is pressed twice ----- > Remote Controller No. 2 function can be
registered.

- O: No Connection
H: Remote Controller Connected.
The course at the moment
remote controller, is turned off
becomes the course.
C: Remote Controller Connected.
The course before using the
remote controller is stored.



↓
Change the setting by pressing [DIM②/+] or [WA③/-].

↓
Press [ALARM RESET] -----> The previous mode presentation is recalled.

* NOTE: If data with various talker IDs come in with Talker ID automatic selection.

Talkers are prioritized in the order of GP-LC-TR-DE-LA-II. The FAP-55 examines all the incoming data for a certain period after power-on, then judges which is the highest priority. The FAP-55 thereafter picks up only the data with that talker ID until power is turned off. Even if such data does not come for an extended period of time, the FAP-55 does not switch to a different talker ID because it is dangerous if data consistency is lost. Safety comes first!

-----about NMEA 0183 Sentences accepted by the FAP-55-----

Immediately after power application, the FAP-55 conducts the following sequence;

(1) Collects nav. data for a certain period.

(2) Examines which of the following nine are contained in the collected data.

1. (RMB)*
2. both (APB)* and (VTG)
3. both (APA)* and (VTG)
4. all of (BOD), (XTE), (VTG) and (AAM)
5. all of (BOD), (XTE) and (VTG)
6. (APB)*
7. (APA)*
8. all of (BOD), (XTE) and (AAM)
9. all of (BOD) and (XTE)

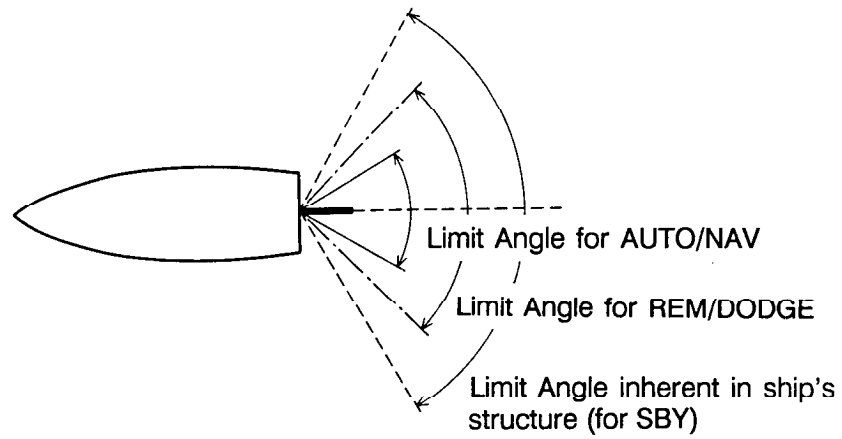
*composite sentence

(3) "1." to "9." are priority numbers. (1 = top 9 = bottom)

The FAP-55 chooses format(s) with the highest priority.

The FAP-55 thereafter fetches the data selected in (3) only until it is turned off.

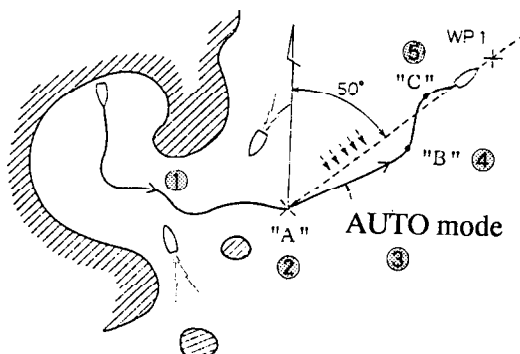
In the REM or DODGING mode steering, we usually use a wide range of rudder angle, and therefore a larger number should be entered. However, it must not exceed the rudder limit angle which is inherent in your boat.



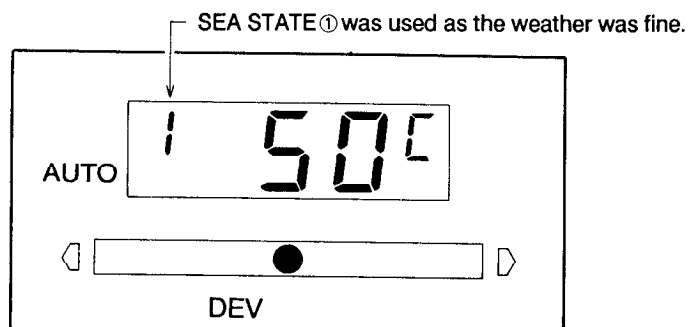
7.EXAMPLES OF AUTOPILOT NAVIGATION

AUTO mode

See the chart below.

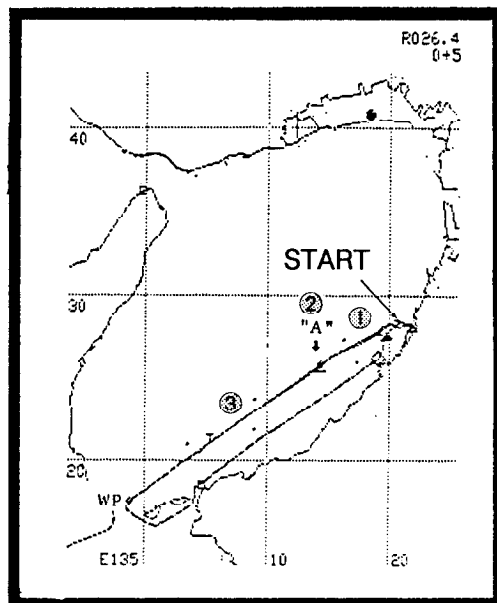


- ① As traffic was heavy in the bay, the boat was steered by using the wheel (SBY mode) until it came to point A.
- ② When the boat entered into the open sea (point A), the heading was directed to WAYPOINT 1 (destination) by steering the wheel manually, then [AUTO] was pressed. The course control was adjusted for the correct course (50 deg.) presentation;



- ③ The boat navigated in the AUTO mode, but it drifted to starboard gradually due to wind.
- ④ As the boat had run a long distance with considerable course deviation, the course setting was readjusted for 40 degrees with the course control. (Point B)
- ⑤ As the course readjustment at Point B was excessive, the course setting was adjusted for 45 degrees again at Point C. Now the boat is heading for WAYPOINT 1.

AUTO mode + **NAV mode** (Loran-C)



- ① After departing the START point, the mode was changed to AUTO, and the course was set for WP (235°). However, the heading deviated to starboard by 10° due to strong sea current. The mean heading throughout this period was 245°.
- ② The mode was changed to NAV at point A.
- ③ The boat navigated optimally on the intended track line, and finally reached WP.

8. ALARM and WARNINGS

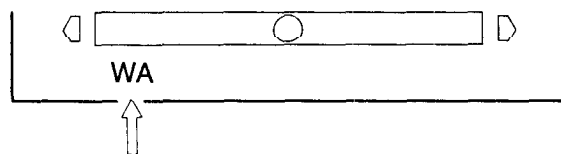
Watch Alarm

If the watch alarm function is enabled, it will periodically warn the helmsman to check the autopilot navigation.

Press [SBY].

The watch alarm function can be turned on or off at SBY mode only.

Press [WA③/-]. ----->



Press [NAV] or [AUTO] to activate watch alarm function.

(a) "WA" lights up, and the watch function is enabled.

(If any key is not pressed for 4 minutes)

(b) Preliminary warning sounds "PipPip PipPip PipPip"

(If any key is not pressed for another 1 minute)

(c) Watch alarm sounds continually "Peep Peep Peep"

NOTE: When any key is pressed, the FAP-55 recognizes that a helmsman is attending, and as a result it returns to starting point (a) in the above sequence. If you are operating the FAP-55 by pressing keys one after another, for example, the alarm does not sound because the FAP-55 returns to the starting point at every key depression.

Press of [ALARM RESET] silences the alarm, but it does not disable the watch alarm function.

When you want to disable the alarm function, press [WA③/-].

Warnings

FAP-55 is continually monitoring its own function and the signals which are exchanged among the units. When any abnormality is detected in the monitoring, visual and audible warning will be issued.

Depending on the seriousness of a trouble, a unique peep is released.

(a) Continuous tone " ————— "

Fatal trouble ! -----> Immediately press [SBY] or shut down the
(Computer hang-up, etc.) power, and steer the wheel manually.

NOTE: An external buzzer may be connected to the FAP-55. If the external buzzer sounds with the FAP-55's screen totally blank, suspect that power is not fed to the FAP-55.

↓
Press only [ALARM RESET] or both [SBY] and [ALARM RESET] simultaneously, and the buzzer will stop. Turn on the main switch (or circuit breaker), then turn on the FAP-55 again.

(b) Repeated 1-second peep " — — — — "

Trouble detected ! -----> Press [SBY] or shut down the power, and
(Erratic signal input/output, etc.) steer the wheel manually.

5

EXCEPTIONS: In the following cases, you may use the FAP-55, but strictly follow the instructions mentioned below.

"PF" is lit and "SBY" blinks

→ Power supply was interrupted more than 2 seconds in the AUTO, REM, or NAV mode. Press [SBY] and steer the wheel manually. You may use the other modes when the cause of the power failure is rectified.

"PF" blinks

Supply voltage is too low. (more than 10% below the rating.)

Use the FAP-55 after charging up the battery.

The SEA STATE number blinks.



- ↳ The steering characteristic values stored in the FAP-55 are invalid. (Memory contents may have been destroyed by intensive electric noise, etc.) The default characteristic values (shown on page 26) are presently used. If necessary, reenter the characteristic values, referring to the memo on the same page.

NOTE: If none or only one remote controller is connected, "REM" warning (mentioned below) will appear because default REMOTE CONTROLLER CONNECTION STATUS is for two controller connection. Reenter the correct status. See page 41.

"REM" blinks in the REM mode.

- ↳ The remote controller is faulty. Turn off the remote controller switch. Do not use the REM mode.

"REM" blinks in the SBY mode. (No peep)

- ↳ The remote controller is turned on in the SBY mode. If you change the mode to AUTO or NAV, the FAP-55 will go into the REM mode immediately, resulting that the rudder will be driven in accordance with the dial setting on the remote controller. If the setting is extreme port or starboard, the rudder will be driven sharply. Dangerous!



The heading reading blinks.

- ↳ Ship's heading has abruptly changed more than 15 degrees. To silence the warning press [SBY], then return to the previously used mode again. If the warning appears again, the FAP-55 may be faulty. Press [SBY] or turn off the FAP-55 completely, and steer the wheel manually.

"NAV" blinks.

- ↳ Trouble detected in the NAV mode. Use the other modes.

(c) A 1-second peep is released.

When interruption of power supply (shorter than 2 seconds) is detected, the above mentioned warning sounds and "PF" lights up. When you press any key, "PF" goes off. You may use the FAP-55, but the cause of the power suspension must be rectified.

NOTE: 1. "PF lights but no peep"

- (a) This occurs when the unit is turned on. This is not a trouble.
- (b) This also occurs if power is suspended during the SBY-mode operation. Check the power supply.

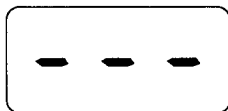
In any case PF disappears when any key is pressed.

2. The following warnings do not mean defect of the FAP-55.

- (a) A long peep at power on page 9
- (b) Course Deviation Warning page 11
- (c) Cross-track Error Warning page 15
- (d) Waypoint Arrival Alarm page 15
- (e) Watch Alarm page 44

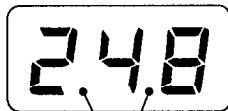
Rudder Angle Indicator

(FAP-6500 Optional supply)



Digital display is displaying "---".

→ No heading data.



Analog display is displaying 0 degree and the decimal point of the digital display is blinking.

→ No rudder angle data.

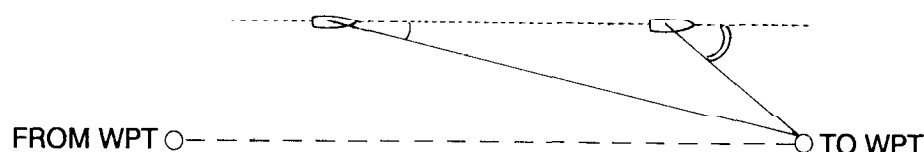
Both of the above.

→ No heading data and no rudder angle data.

9. MISCELLANEOUS

Arrival Alarm Range for NAV Mode Operation (NMEA 0183)

In the NAV mode the set course is modified automatically in order to nullify a cross-track error. As illustrated below, a minute cross-track error can cause a large course deviation (degrees) when a boat is close to the TO WAYPOINT. This means that the rudder may be steered sharply when the cross-track error has changed in the vicinity of the waypoint.

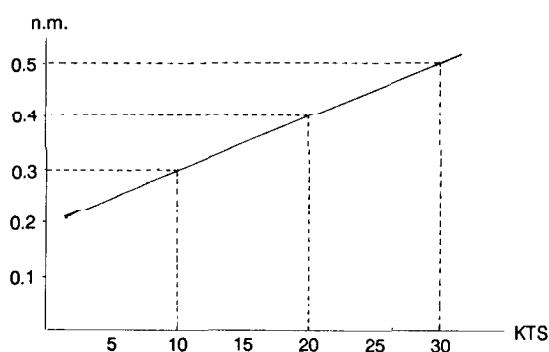


In order to avoid this danger, the following method is taken in the FAP-55. When an arrival alarm information is transferred from the navaid, the set course is frozen to the ship's heading at that moment, and this condition is maintained until a new TO WAYPOINT number is transferred.

Supposing that the arrival alarm range is set short, the rudder may be steered sharply when the boat is near to the alarm zone. Therefore, it is important to set a longer arrival alarm range when the NAV mode is used.

Setting Arrival Alarm Range

If the ship's speed is 20 knots or so, an arrival range of more than 0.4nm will be appropriate. For the ship's speed below (above) 20 knots, decrease (increase) the range by 0.01nm every knot.

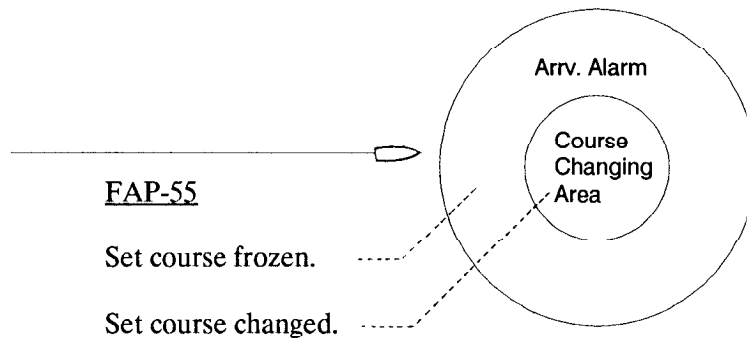


- NOTE:** 1. When FURUNO's Plotter LP-1000 or GD-1000 is connected, the arrival alarm range should be 0.1nm longer than the recommendation on the preceding page.
2. When FURUNO's Plotter GD-180 (Mk-2) is connected, confirm its Program Version Number.

GD-180 Use Ver.21 or after.

GD-180 Mk-2 Use Ver.6 or after.

On the GD-180 (Mk-2), both ARRIVAL ALARM AREA and COURSE CHANGE AREA may be set. When the NAV mode is used on the FAP-55, the former should be set greater than the latter.



MAINTENANCE

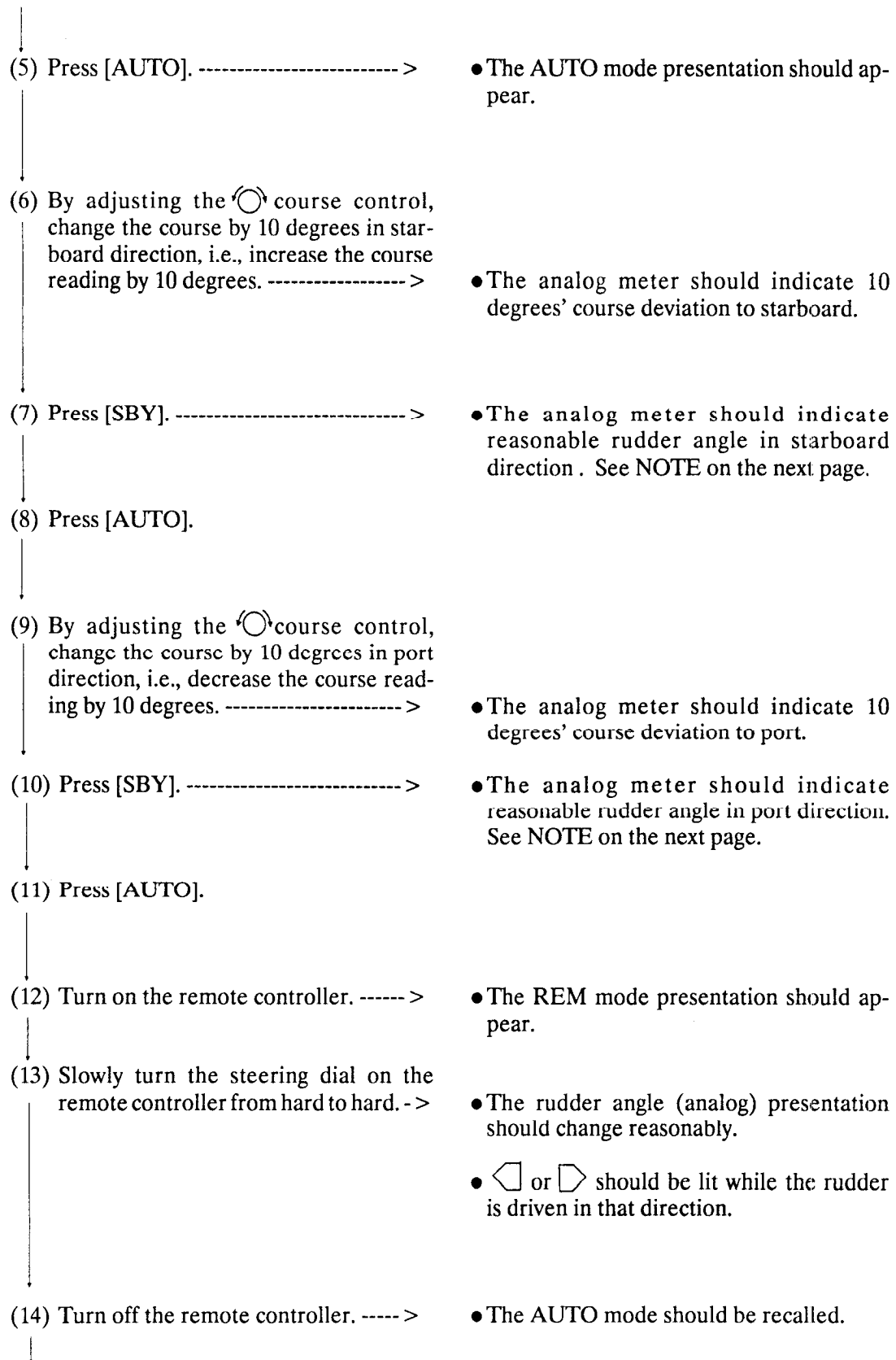
1. CHECK BEFORE SAILING

When the FAP-55 has not been used for an extended period, or before you go on a long voyage, it is recommended to conduct the following function test which is feasible with the boat moored in a harbor.

IMPORTANT

1. The FUNCTION TEST must be conducted by a person who has thorough knowledge of autopilot operation.
2. Make sure that there is no one nor obstruction in the area near the rudder.
3. If the rudder is driven continually, immediately shut down the power or press [SBY]. The FAP-55 may be faulty or not installed properly.

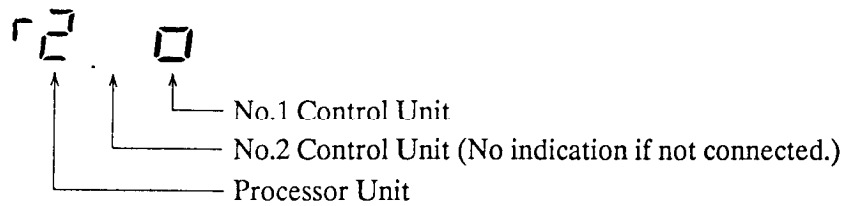
- (1) With the FAP-55 turned off, steer the wheel from hard to hard, then return it to neutral. ----->
 - The rudder should be steered smoothly without undue stiffness.
- (2) Turn on the FAP-55 by pressing [SBY]. >
 - The SBY mode presentation should appear.
 - The rudder angle presentation should be zero. (If not, conduct [Rudder Angle Null Adjustment], page AP-15.)
- (3) Steer the wheel from hard to hard, then return it to neutral. ----->
 - The rudder angle presentation should change reasonably.
- (4) Compare the heading presentation (digital) with the compass reading. ----->
 - The heading presentation should be reasonable.



2. POWER-ON SELF-CHECK

When the FAP-55 is turned on, the following sequence is initiated automatically:

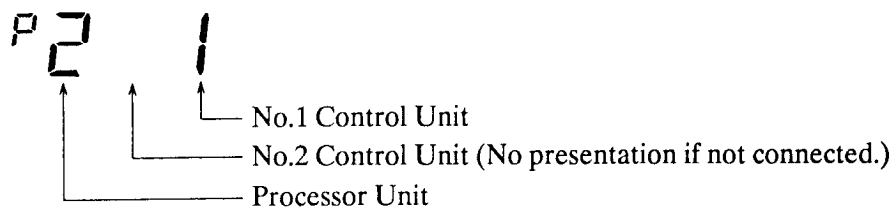
- (1) The memories (ROM/RAM) are checked for proper operation. If any abnormality is detected, the faulty memory (or memories) is identified with a numeric code and the FAP-55 is made inoperative. If normal, the self-check continues.



- 0 = Normal
- 1 = Only ROM is faulty.
- 2 = Only RAM is faulty.
- 3 = Both ROM and RAM are faulty.

- (2) The display (LCD) segments are lit sequentially.

- (3) Program version numbers are presented:



NOTE: The version numbers may differ depending on units.

- (4) The FAP-55 becomes operational, e.g., SBY mode.

Rudder Angle Indicator

(FAP-6500 Optional supply)

(1) Display changes as follows

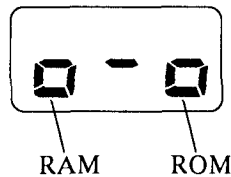
“All the segment on”, “111”, “222”, “333” --- “888”, “999”, “000”

(2) Two decimal points light alternately while the display is displaying the even numbers.

(3) The ROM and the RAM are tested.

The result of the test appears on the digital display for 1 second.

If the test shows faulty ROM or RAM, the sequence freezes.



□ : Normal

— : Faulty

Remedy

Faulty ROM

Replace the P.C. board when the result shows “faulty ROM” after trying the test once again.

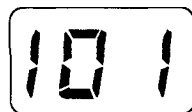
Faulty RAM

Replace the P.C. board

Table 1 The P.C.Board

No.	Name	Type	Code Number	Qty	Remarks
1	PICONT Board	66P1108	009-006-290	1	

(4) Program version numbers are presented:



Program version number

(5) The analog indicator is tested.

Automatically seeks 0 point of the scale and put the needle on it.

(6) The FAP-6500 becomes operational.

3. SELF-CHECK PROGRAM

When a visual/audible warning is issued, it is recommended to conduct the troubleshooting by running the self-check program.

NOTE: 1. During the self-check mode operation, the ship's steering system is electrically isolated from the FAP-55. Even when the AUTO, NAV, or REM mode is selected, the FAP-55 does not drive the steering system.

2. If a trouble is detected during normal operation, the AUTO, NAV, or REM mode can not be called up. In the self-check mode you may call up these modes freely even when a trouble exists. This feature is helpful for troubleshooting.

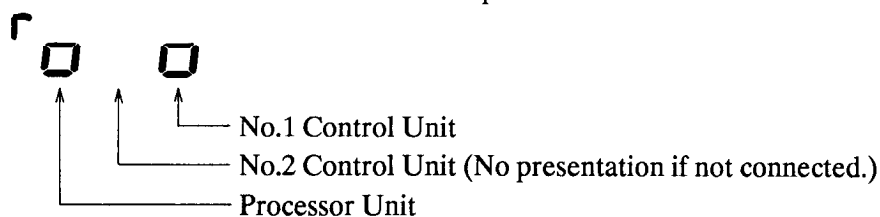
Procedure

Turn off the FAP-55.

While holding down [SEA STATE], press [SBY]. Release [SEA STATE] when presentation appears. ----->

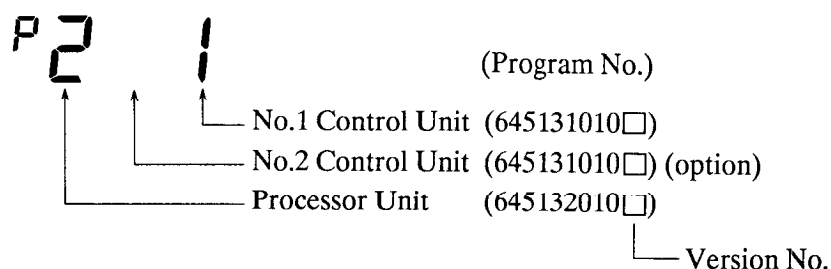
The FAP-55 is turned on, a long peep is generated, the display segments are lit sequentially.

Results of the [ROM/RAM check] are presented as shown left.



-  = Normal
-  = Only ROM is faulty.
-  = Only RAM is faulty.
-  = Both ROM and RAM are faulty.

Press [SEA STATE]. -----> [Program Version Numbers] are presented.



NOTE: The version numbers may differ depending on units.

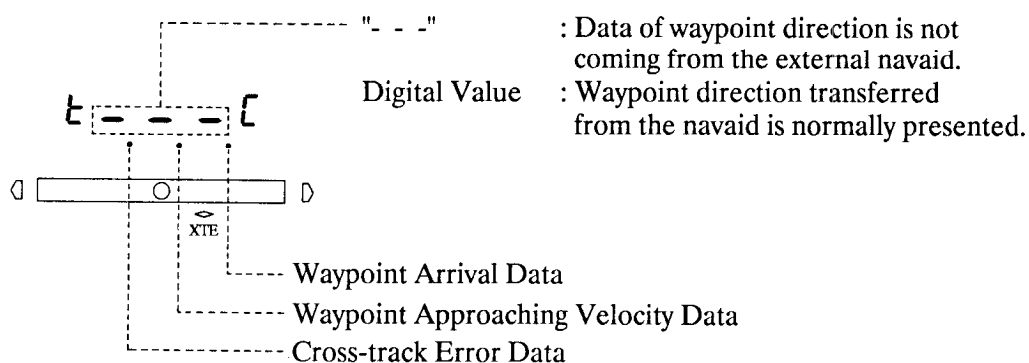
Press [SEA STATE]. -----> "t" (test) is presented as shown left, and [Signal Check] may be conducted as described below.



→ Press [SBY]. -----> The SBY mode is called up. Various signals including rudder angle and heading signals are tested. If any abnormality is detected, audible/visual warning is issued. See page 45.

→ Press [AUTO]. -----> The AUTO mode is called up. Various signals including course setting, course deviation signals are tested. If any abnormality is detected, audible/visual warning is issued. See page 45.

→ Press [NAV]. -----> The nav. signals are tested, and the results are presented:



"•" = Data coming in.

Decimal Point not lit: Data not coming in.

NOTE: For the NAV mode operation the following data are indispensable:

NMEA 0180 Cross-track Error

NMEA 0183 both Cross-track Error and Waypoint Direction

→ Turn on the remote controller. -----> The REM mode is called up, and the remote control signal, etc. are tested.

NOTE: The information presented on the analog meter is not rudder angle, but is the steering dial setting.

→ The following [Key/Display/Dimmer Checks] may be conducted at any time during the [Signal Check].

→ Every hit of [DIM②/ +] should change the illumination.

→ Every hit of [WA③/], should turn "  " (WA) ON/OFF at SBY or REM mode and should change the display H/C at AUTO or NAV mode.

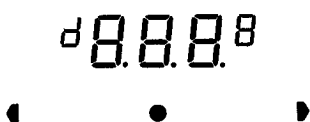
→ After pressing [DODGE];

→  should light while [PORT] is held down.

→  should light while [STBD] is held down.

Press [SEA STATE]. ----->

[Display Check] is conducted. (LCD segments should light as illustrated left.)



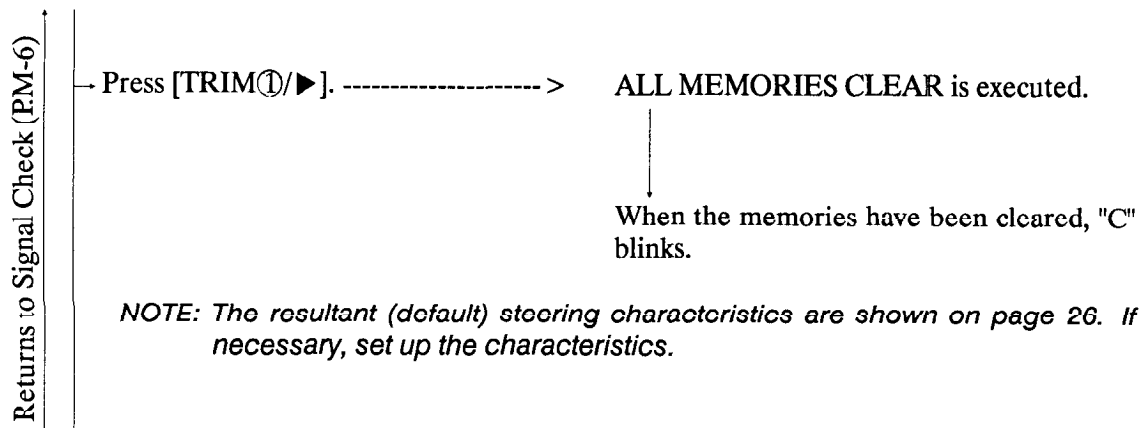
→ Press [TRIM④/ ▶]. ----->

The above-shown segments are lit sequentially.

Press [SEA STATE]. ----->

"C" is presented as shown left, and the FAP-55 becomes ready for [ALL MEMORIES CLEAR].





How to escape from the SELF-CHECK mode

Hold down [ALARM RESET] longer than three seconds, and the FAP-55 will go into the SBY mode.

NOTE: If [ALARM RESET] is released within three seconds, the FAP-55 will return to Signal Check (page M-6) from any point in the self-check.

FAP-55 SPECIFICATIONS

1. Operating Mode
 - Manual (SBY) • Automatic (AUTO) • Navigational (NAV)
 - Remote (REM) • Dodge (DODGE)
2. Controls
 - Course setting by knob (1° step)
 - Trim compensation . . by knob (1° step)
 - others by touchpad key
3. Setting of Steering Characteristics
 - Trim . . . from -30° to +30° (1° step)
 - * • Weather (Deadband of Course Deviation) . . . from ±1° to ±10° (9 steps)
 - * • Rudder Ratio . . . from 0.3 to 2.4 (9 steps)
 - * • Counter Rudder . . . 9 steps + OFF
 - Auto Trim Sensitivity . . . 9 steps + OFF
 - Course Changing Speed . . . from 1°/sec to 9°/sec (9 steps)
 - Rudder Limit Angle . . . from 10° to 45° (9 steps)
(2 angles may be registered for AUTO/NAV and REM/DODGE, respectively.)
 - *NOTE: 3 sets of the characteristic values may be memorized, and one characteristic set may be used in accordance with weather condition, etc.*
4. LCD Display
 - with backlight dimmer
(common to keyboard dimmer)
5. Presentations
 - 3 digit Digital . . . Heading or Course
 - Bar . . . Rudder Angle, Course Deviation or Cross-track Error
 - Warnings . . . Watch Alarm, Power Failure, Inter-unit Signal Failure, etc.
6. Heading Sensor
 - Fluxgate Heading Sensor (FLUX-50)
 - Gyro Compass (Gyro Converter AD-10S required)
7. Steering Unit
 - Hydraulic or mechanical steering system
8. Navaid connectable
 - NMEA 0180 (I.C-55/70/85 etc.)
 - NMEA 0183 (LC-88, LP-1000, GD-180/185/1000, etc.)
9. Power Supply
 - Control + Processor Units --- 10 to 42 Vdc, 20W
 - Valve Unit (optional) --- 12/24 Vdc, 24W

10. Standard Supply

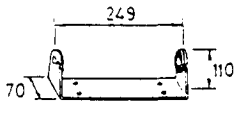
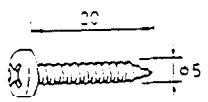
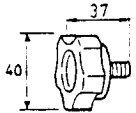
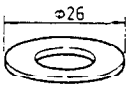
- Control Unit FAP-5510-10CE × 1
- Processor Unit FAP-5520E × 1
- Rudder Reference Unit FT-10-2F-NH/E × 1
- Accessories × 1 set
- Spare Parts × 1 set
- Installation Materials × 1 set

Optional Supply

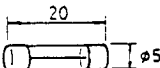
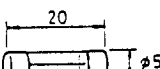
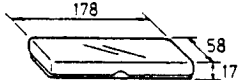
- No.2 Control Unit FAP-5510-10CE
- Remote Controller FAP-5550-NH/E
- Remote Controller FAP-6120
- Remote Controller FAP-6220
(Up to two remote controllers may be connected.)
- Valve Unit (with 8m cable and crimp-on lugs)
SPF-1SVF-12/E (12Vdc) [000-090-130] or
SPF-1SVF-24/E (24Vdc) [000-090-131] or
SPF-1SVF-32/E (32Vdc) [000-090-132]
- Control Unit Flush Mounting Materials
OP64-1 [009-004-020]
- Remote Controller Hanger OP64-2 [009-004-030]
- Rudder Angle Display FAP-6500

FURUNO

CODE No.	000-090-161	64AI-X-9501
TYPE	FP64-00200	

付 属 品 表 ACCESSORIES		FAP-55-J 自 動 操 舵 装 置 FAP-55-E AUTO PILOT			
番号 No.	名 称 N A M E	略 図 OUTLINE	型 名 / 規 格 DESCRIPTIONS	数量 Q'TY	用 途 / 備 考 R E M A R K S
1	ハン ガ ー 組 品 BRACKET ASSY.		FP64-00210	1	
			CODE No. 009-004-910		
2	+ナベタッピンUIネジ TAPPING SCREW 1 種		5 x 20 SUS304	4	
			CODE No. 000-800-488		
3	磨 き 平 座 金 FLAT WASHER		M5 SUS304	4	
			CODE No. 000-864-128		
4	ノ ブ ボ ル ト KNOB BOLT ASSY.		KG-B2 M8 x 20 SUS	2	
			CODE No. 000-800-601		
5	ノ ブ ワ ッ シ ャ KNOB WASHER		05-029-0135	2	
			CODE No. 100-100-390		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		
			図 番 DWG. No. C7227-004-A 検 図 CHECKED   		

FURUNO

		CODE No.	000-090-158		BOX No.		P	
		TYPE	SP64-00300					
SHIP No.	SPARE PARTS LIST FOR			U S E				SETS PER VESSEL
	FAP-55-J 自動操舵装置 FAP-55-E AUTO PILOT							
ITEM No.	NAME OF PART	O U T L I N E	DWG. No. OR TYPE No.	QUANTITY			REMARKS/CODE No.	
				WORKING		SPARE		
				PER SET	PER VES.			
1	ミゼットヒューズ FUSE		FGMB 3A AC125V or GMA-J 3A 125V			6		
							000-104-909	
2	ミゼットヒューズ FUSE		FGMB 5A AC125V	1		3		
							000-112-785	
	予 備 品 箱 SPARE PARTS BOX		F710 用			1		
							000-831-610	
MFR'S NAME FURUNO ELECTRIC CO., LTD.				DWG. No.		C 7 2 2 7 - 0 0 1 - A		

CODE No.	000-090-159	64AI-X-9407
TYPE	CP64-00300	

FURUNO ELECTRIC CO., LTD.

INSTALLATION

Mounting the control/processor units

- Although the units are designed to be splashproof, avoid a place where there is danger of salt or fresh water spray or immersion.
- Do not mount the units in the place exposed to direct sunlight because heat is built up inside, resulting in malfunction.

Even though the LCD display is quite legible in bright sunlight, it is a good idea to keep the control unit out of direct sunlight or at least shaded.

- The control unit is mounted on a bracket assembly (supplied) as shown on page D-1. The bracket itself can be installed either overhead, on a bulkhead, or on a tabletop.

When deciding a mounting place, take the viewing angle into account.

- The processor unit may be fixed to a tabletop or a bulkhead. When installing on a bulkhead, mount the unit with its cable gland side facing toward the deck. If not, water may collect in the cable glands.

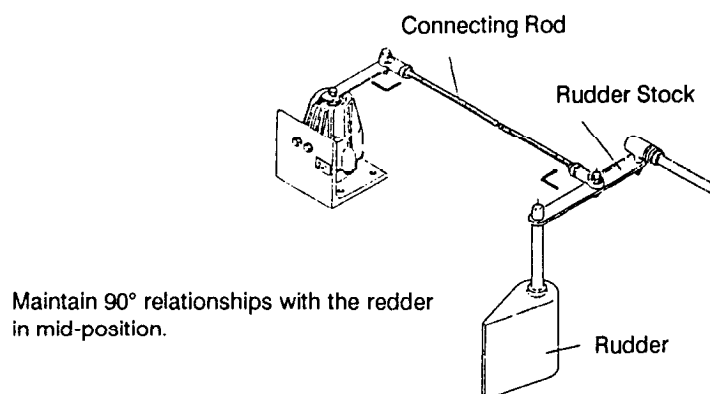
Mounting the rudder reference unit

- Although this unit is waterproof, it is only common sense to give it some protection from splash of water.
- Sufficient clearance must be given around moving parts.
- This unit must be coupled to the rudder as shown on page D-4, where the following conditions must be satisfied:

(1) $Y2 < 600\text{mm}$ $X1 = X2$ $Y1 = Y2$

(2) When the rudder is in neutral position:

- The rudder reference unit should be also neutral.
- The arm of the rudder reference unit should be at right angle (90°) with the connecting rod. Also the rudder stock should be at right angle (90°) with the connecting rod.



After the installation, apply grease to both ends of the rod.

NOTE: This unit may be placed at either side of the rudder.

Cabling

Cabling should be carried out as shown in the cabling diagram on page S-1.

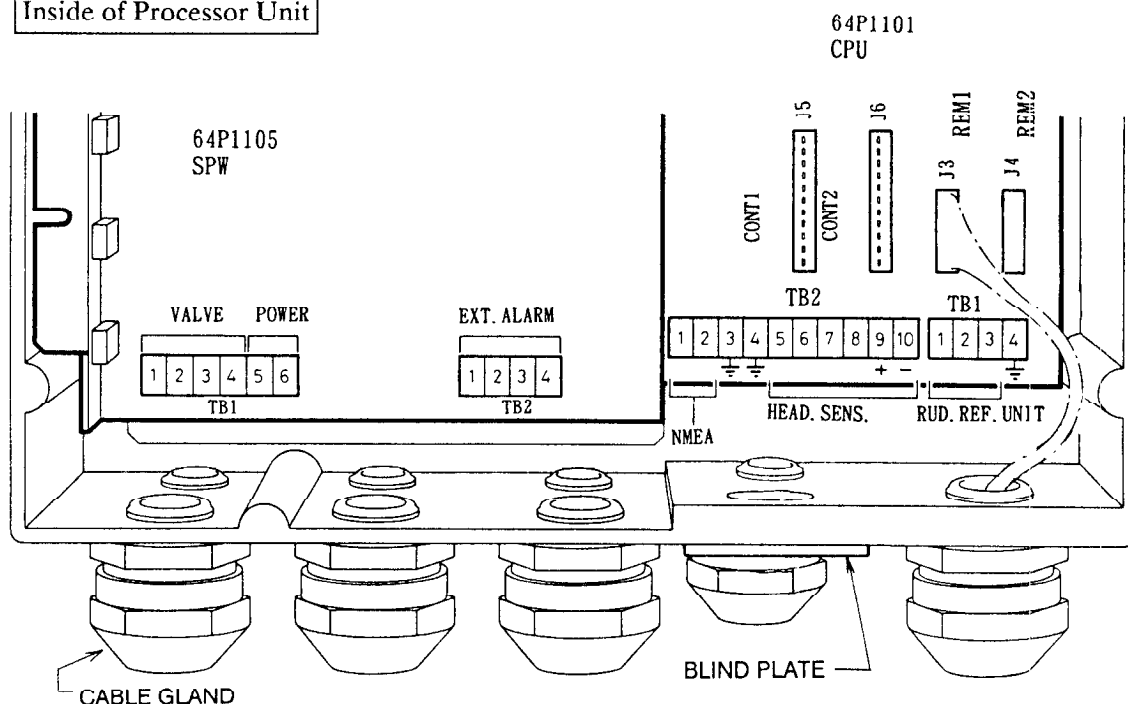
General Notes on Cabling

1. The DC power supply cable should be kept as short as possible, and should be taken directly from the battery for the processor unit, via the circuit breaker (30A fuse incorporated) supplied locally. Longer cable runs require an even larger wire size to minimize voltage drop.

Under no circumstance should a cable be used to supply both the autopilot and other equipment: ship's power lines are notorious for being "dirty" electrically. The voltage can go all over the place as various heavy loads are placed on the line, and the power wiring is a prime source for interfering electrical signals (from such sources as alternators or generators, and other electronics equipment, like radars or echosounders).

2. All signal cables should be separated (not parallel) as far as possible from cables carrying RF or pulsed signals. At least 1m (3ft) separation is recommended.
3. The supplied cables should not be lengthened, otherwise the performance of the unit will be greatly reduced.

Inside of Processor Unit



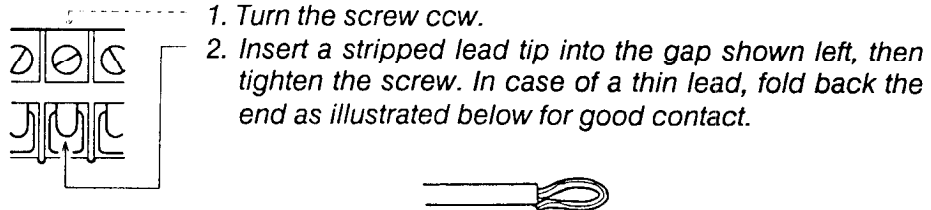
NOTE: 1. Cables should be led into the unit through the cable glands which are nearest to the destination (terminal board or jack). Do not leave unnecessary slackness of cables in the unit.

2. Two lines of cable glands are available. The unit is delivered with the following bushes contained in them:

- Bushes for Large Cable (6.5 to 10mm dia.) ---- upper line
- Bushes for Small Cable (4.0 to 8mm dia.) ---- lower line

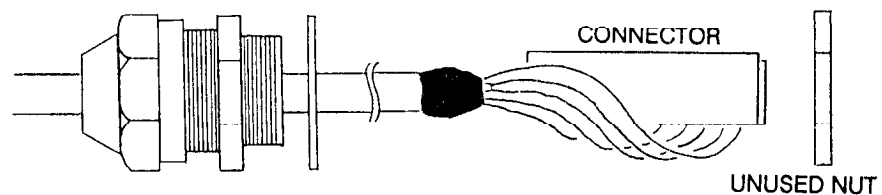
If you wish, you may change the bushes between the upper and lower lines.

3. The cabling diagram on page S-1 shows the full lineup of connections where eleven cable inlets are shown. In reality, however, only ten inlets are available.
4. How to tie a lead to the terminal board.



5. The control unit cable is delivered with the cable gland. Follow the instructions below when connecting it to the processor unit.

- (a) Remove the unused cable gland fixing nut as shown below.

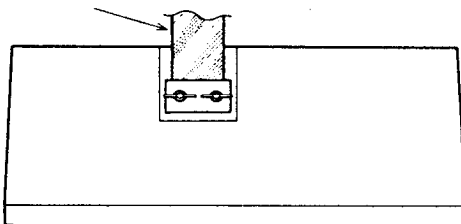


- (b) Remove a cable gland (or blind plate) from the processor unit, and you will see a cutout.
- (c) Lead the cable into the unit through the cutout, then plug the cable-end connector in J5 (or J6 in case of No.2 Control Unit.)
- (d) Fix the cable gland tightly.

about GROUNDING

Do not share the FAP-55's grounding copper strap with other equipment. Unless the processor unit is grounded properly, the FAP-55 may malfunction (the rudder may be steered suddenly) when a radiotelephone transmits, etc.

Use the copper strap supplied.



Terminate the shielding mesh of the interconnection cables as indicated on the cabling diagram (page S-1).

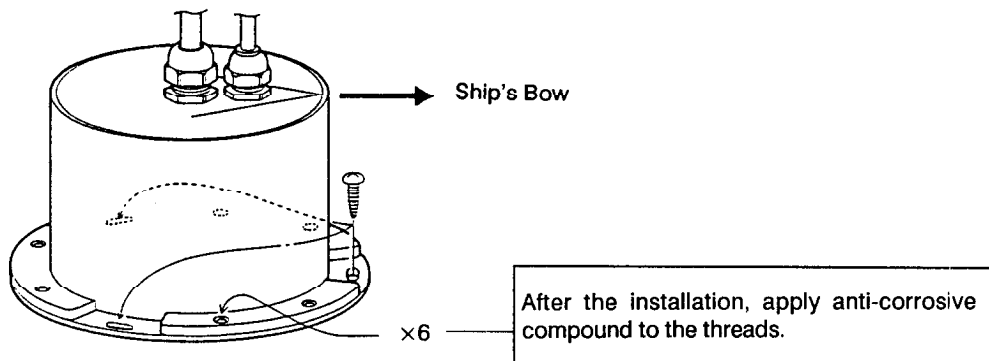
Installing the fluxgate heading sensor (FLUX-50)

Notes on Installation

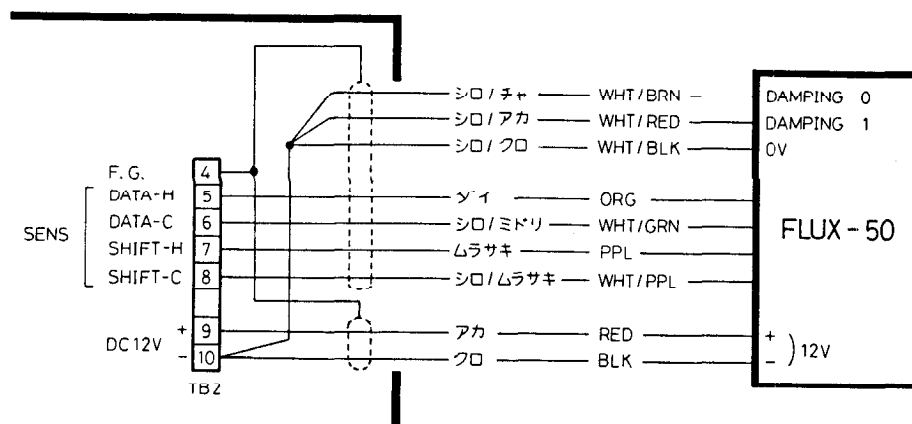
- Ideally the sensor should be mounted near the center of ship's gravity, but this is not critical.
- The FLUX-50 must be installed indoors. Avoid a place exposed to direct sunlight or splash of water.
- This sensor is very sensitive to magnetic fields when compared with a conventional magnetic compass. In selecting a mounting location, choose a spot that is as far from metallic objects as possible. Bear in mind that a transformer and power cable generate magnetic fields. The more carefully you place the sensor, the more satisfactorily the FAP-55 will work.

Mounting

- The arrow mark "➤" on the sensor housing must be parallel with the keel line.
- The sensor should be installed horizontally, however this is not so critical because gimbal structure is employed inside. However, never mount it on the bulkhead.
- The wood screws should be tightened after the compensation has been completed. (Do not overtighten the screws, or the plastic brim may be damaged.)



Connection



NOTE: Insulate the unused leads (not shown in the above diagram) individually. Do not ground them.

Adjustment

Heading Alignment

- (1) Turn the sensor by hand until the heading reading on the FAP-55 gets equal to ship's master compass reading.
- (2) Fix the sensor by tightening the wood screws.

Compensation

The automatic calibration compensates magnetic influence of the boat. Turn the boat through two circles. Make each circle two minutes to complete. Anytime the boat turns through a circle, the compensation is recalibrated. For details, refer to the instructions contained with the Flux-50.

Damping Adjustment

This adjustment determines how sensitively (quickly) the sensor responds to the changes of ship's heading. Four kinds of damping factors are available, and they may be chosen by connection of leads.

Damping (Response)	Connection
1 (fast)	WHT/RED ---> Tie to GND. WHT/BRN ---> Tie to GND.
2 	WHT/RED ---> Tie to GND. WHT/BRN ---> Open
3 	WHT/RED ---> Open WHT/BRN ---> Tie to GND.
4 (slow)	WHT/RED ---> Open WHT/BRN ---> Open

When the FLUX-50 is connected to the FAP-55, select "1" (fast).

FLUX-50 v.s. AD-100

FLUX-50's output signals are equivalent to the ones which are output by AD converter AD-100:

Lead	Signal
Black	Automatic Calibration
Brown	Radar 1 Data-H
Red	Radar 2 Data-H
Orange	Nav 1 Data-H
Yellow	Nav 2 Data-H
Green	Radar 1 Shift-H
Blue	Radar 2 Shift-H
Violet	Nav 1 Shift-H
White	Nav 2 Shift-H
White/Black	Ground
White/Brown	Damping 1
White/Red	Damping 2
White/Orange	Nav 2 Data-C
White/Yellow	Radar 1&2 Data-C
White/Green	Nav 1 Data-C
White/Blue	Nav 2 Shift-C
White/Violet	Nav 1 Shift-C
Black/White	Radar 1&2 Shift-C

NOTE: In case of AD-100, only four lines must be connected.

Installing the rudder angle indicator (FAP-6500)

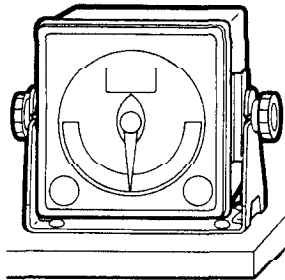
Notes on installation

Avoid the following places

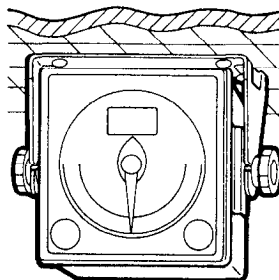
- 1) A place exposed to direct sunlight.
- 2) A place exposed to direct water spray or rain.
- 3) High-temperature, poorly ventilated environment.
- 4) A place with excessive vibration.

Mounting

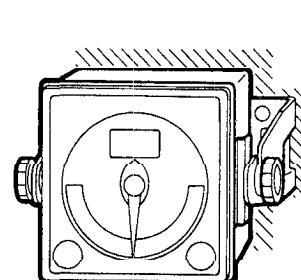
The rudder angle indicator may be mounted on the overhead, on a table top, on the bulkhead or flushmounted using an optional installation materials.



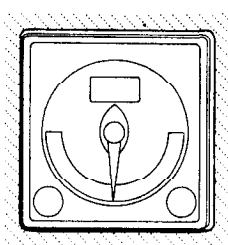
On a table top



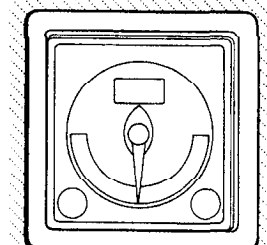
On the overhead



On the bulkhead



A flushmount

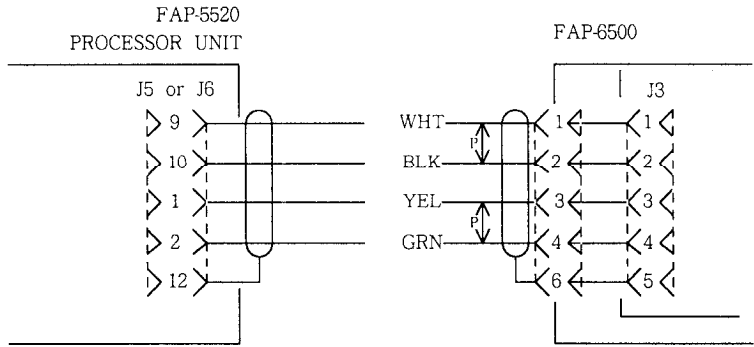


A flushmount

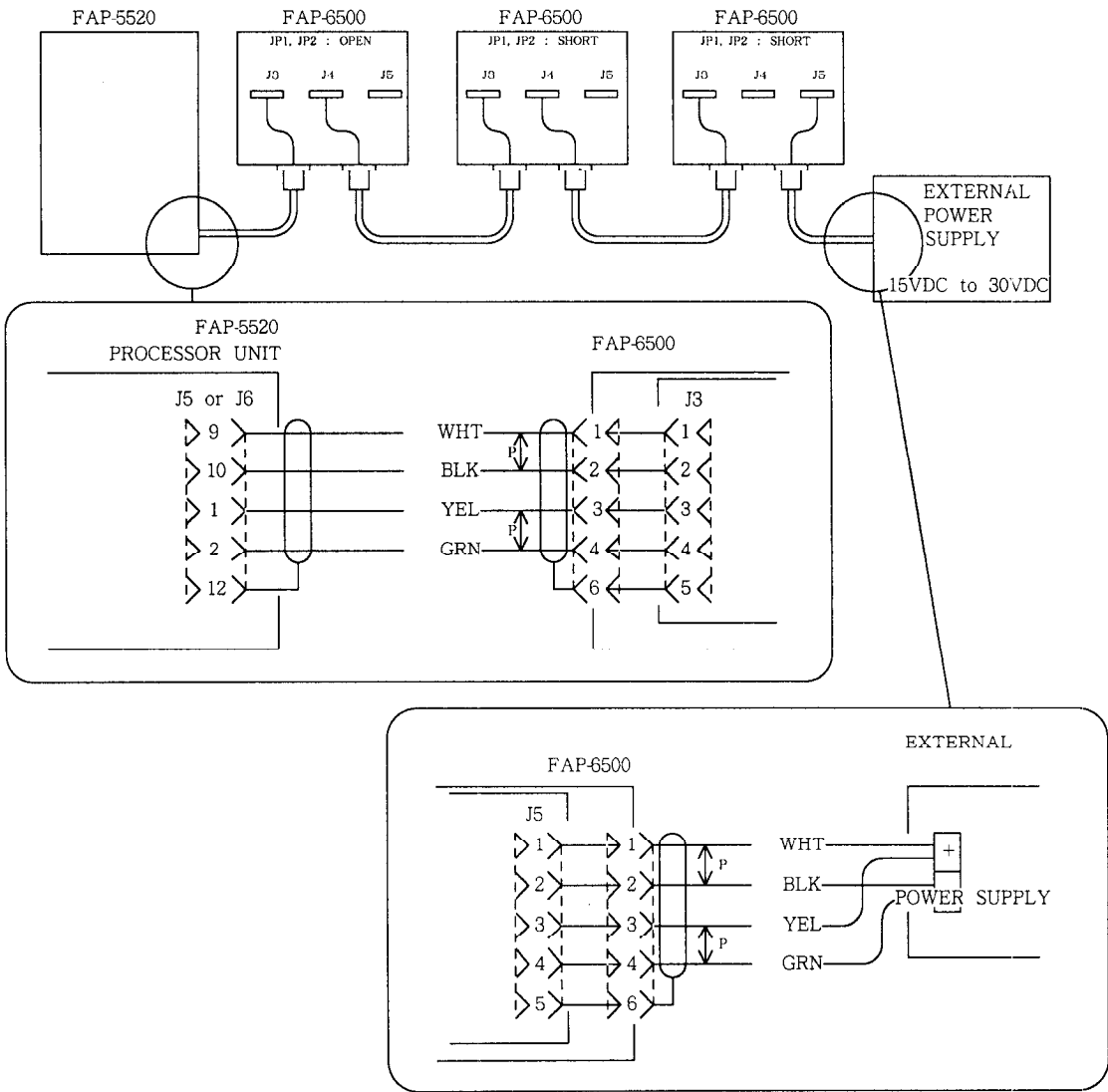
Connection

Connect the rudder angle indicator to a vacant connector either J5 (CONT 1) or J6 (CONT 2). To connect two units to a same connector, pull out the NH conductor from the NH connector housing and solder the wire of a second unit. An external power supply is needed to connect rudder angle indicator in series (Max. three units).

Connection of single FAP6500



Connection of FAP6500 in series



Connection of External Power Supply

1. Cut the jumpers JP1 and JP2 of the FAP6500 to supply the power from the external power supply.
2. Connect pin 1 and pin 3 to the positive terminal and pin 2 and pin 4 to the negative terminal.
See the figure below.
3. Connecting the FAP6500 in series requires an additional "Connection Cable Assembly (OP64-6, Code number 009-005-810)" for each extra unit.

Calibration

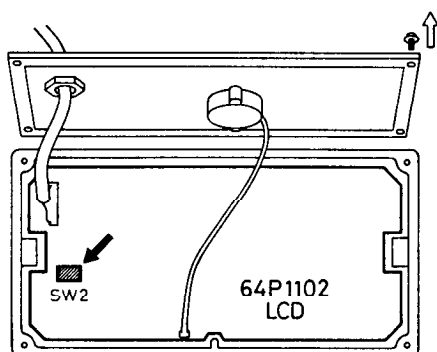
The rotary switch S3 on the P.C.board calibrates the rudder angle indication on the panel. Turn the rotary switch to the direction you want to move the pointer. The range for calibration is ± 3.2 degrees.

Tailoring DIP switches and jumpers

By tailoring the DIP switches and jumpers, you may adjust the FAP-55 to the desired usage.

Control Unit

After loosening the four screws, open the rear panel as illustrated below.



SW2 [Factory Setting: all bits = off]

#1 #2 #3 #4

Language

off English
ON Japanese

off Not used.

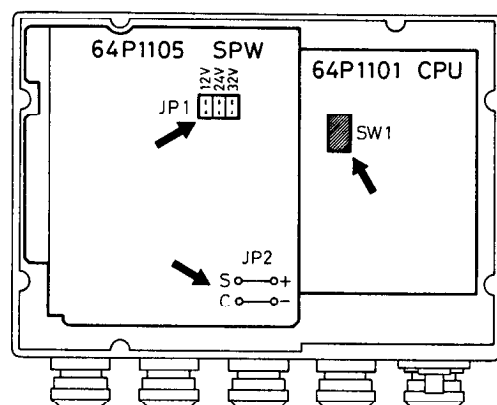
Analog (Bar) Indicator presents:

off Rudder Angle, Course Deviation or Cross-track Error
 depending on the mode.
ON Rudder Angle only irrespective of operational mode.

Operating Mode

off Normal
ON Test (factory use)

Processor Unit



JP1 (Power Failure Alarm Voltage) [Factory Setting: 12V]

In accordance with the supply voltage, set the jumper plug in one of the three positions.

JP2 (Mode of Ext. Buzzer Driving Signal) [Factory Setting: Voltage Signal]

Voltage Signal Connect two jumpers (S — + and C — -).

Contact Closure Signal . Remove the two jumpers, and strap a jumper between "S" and "C".

SW1 (NAV Signal) [Factory Setting : all bits = off]

#1 #2 #3 #4

Type of No. 1 Remote Controller

off FU type

ON NFU type

Type of No. 2 Remote Controller

off FU type

ON NFU type

Output of Heading Sensor

off Magnetic Bearing

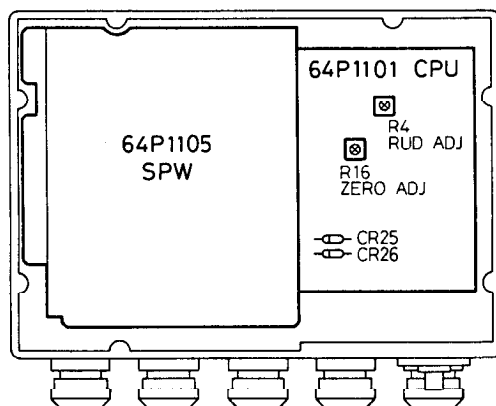
ON True Bearing

Operation Mode

off Normal

ON Test (factory use)

Tuning the processor unit



Turn on the FAP-55 by pressing [SBY].

↓

Rudder Angle Null Adjustment

Set the rudder in its neutral position by steering the wheel manually. (Visually inspect the rudder to confirm this. Do not rely on the rudder angle indicator provided on the FAP-55 because it has not been tuned up yet.)

↓
Adjust R16 [ZERO ADJ] so that CR26 lights.

↓

Rudder Angle Gain Check

While steering the wheel, confirm that the rudder angle indication matches the actual rudder angle. (As the adjustment is done at the factory it is unlikely that a significant discrepancy exists between the two. If it does, the following adjustment is required.)

Adjustment

Set the rudder limit angle (for REM/DODGE) as mentioned on page 39.

↓
Steer the wheel until the rudder reaches the above-set limit angle. (Actually measure the rudder angle. Do not rely on the rudder angle indication on the FAP-55.)

↓
Turn R4 [RUD ADJ] clockwise until the point where CR25 starts illuminating.

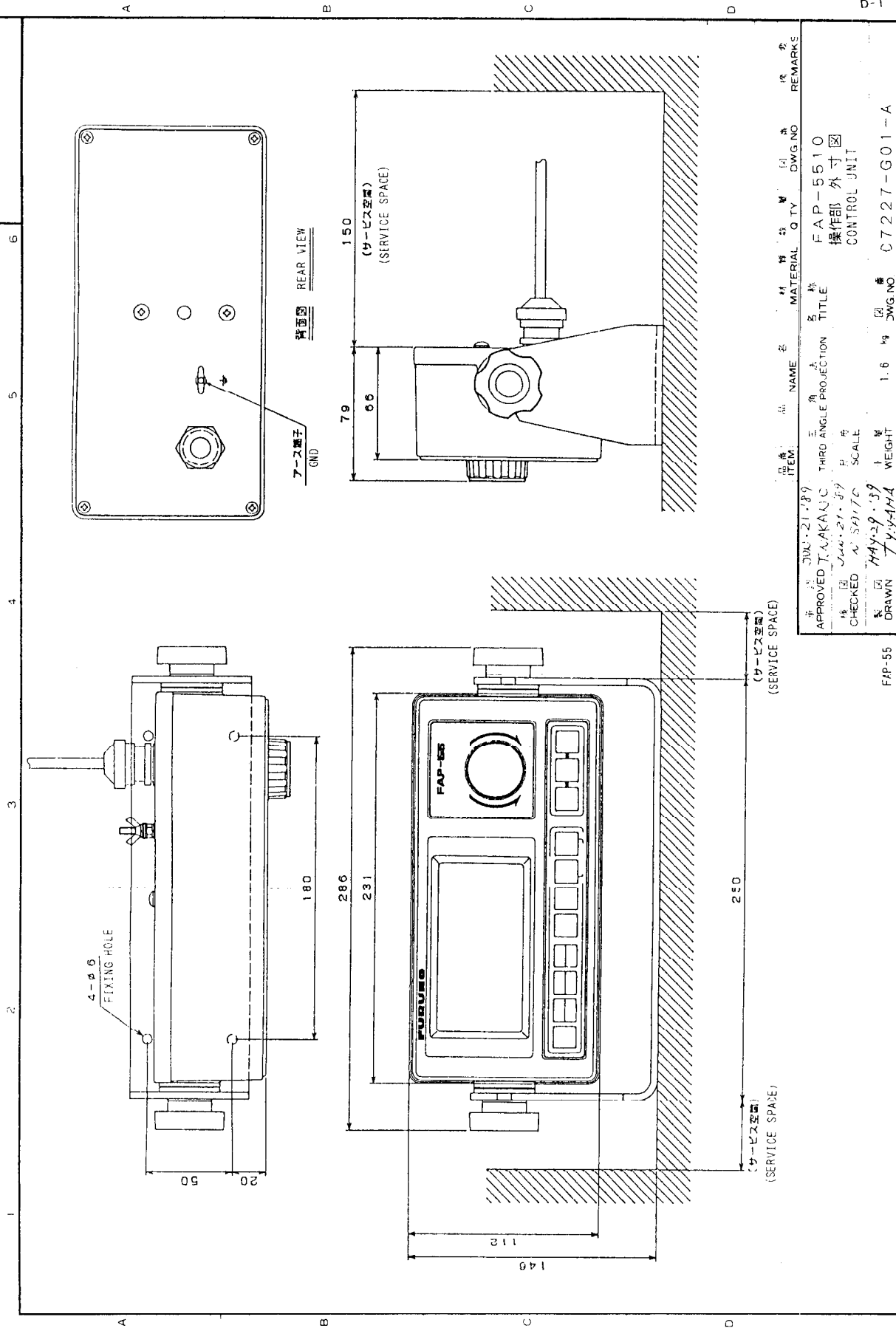
Jobs after the installation

When the installation is completed, conduct the followings;

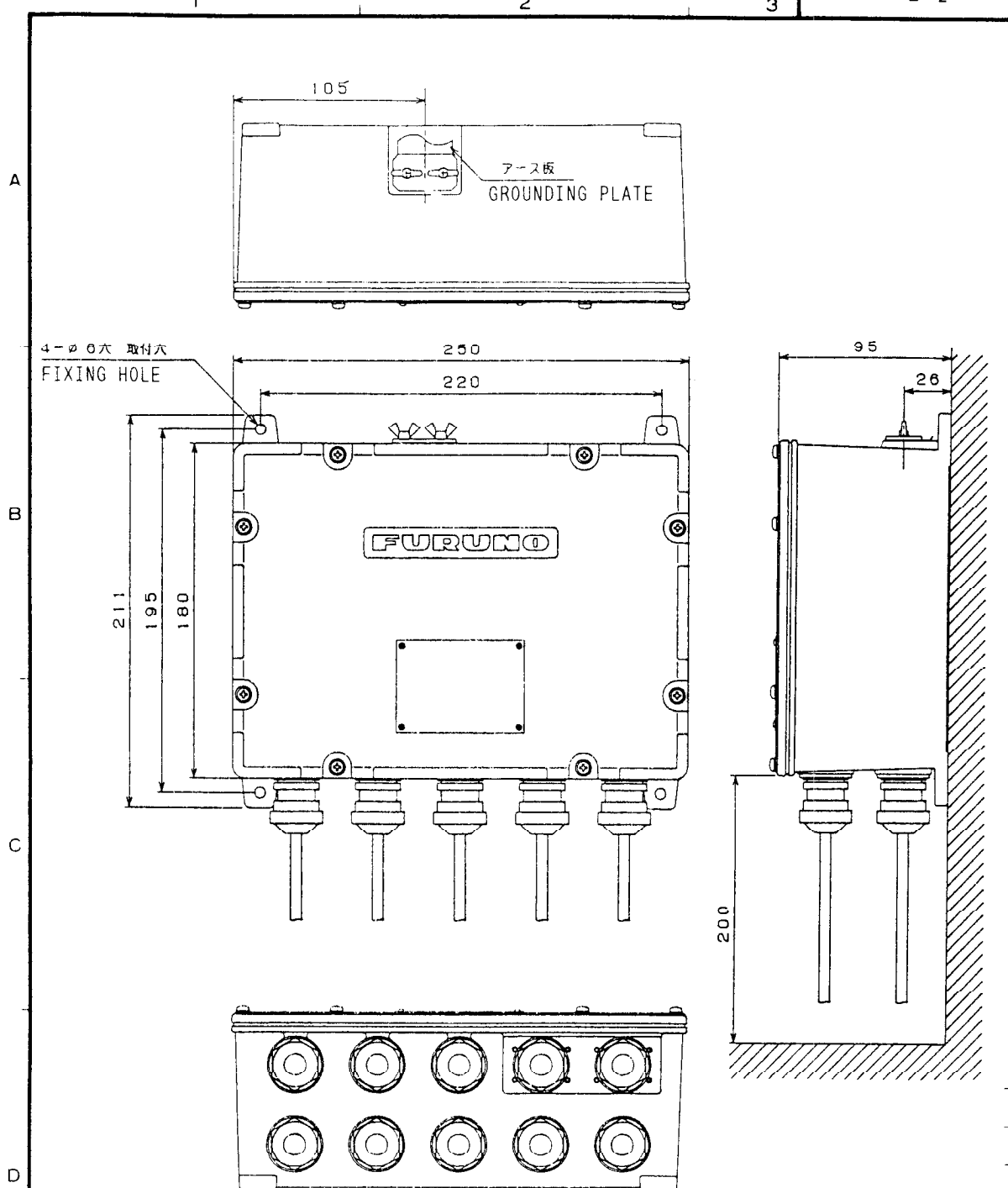
- CHECK BEFORE SAILINGpage M-1
- INITIAL SETTING OF STEERING CHARACTERISTICSpage 17

Notes on the external buzzer

- A horn for a car may be utilized as an external buzzer for the FAP-55.
- As described on page AP-13, the buzzer driving signal may be output in either one of the following modes.
 - Voltage Signal ----- A battery power should be fed to the processor unit (TB2 #1 & #2).
 - Contact Closure Signal ----- Contact capacity is three amperes.
- The external buzzer and the internal one (peep) sound at the same time. If power supply for the FAP-55 is failed, only the external buzzer sounds continually.
- The connection cable should be separated (not parallel) as far as possible from cables carrying RF signals or large power. Test the FAP-55 with a transmitter operated, etc. Use a shielded cable if necessary.



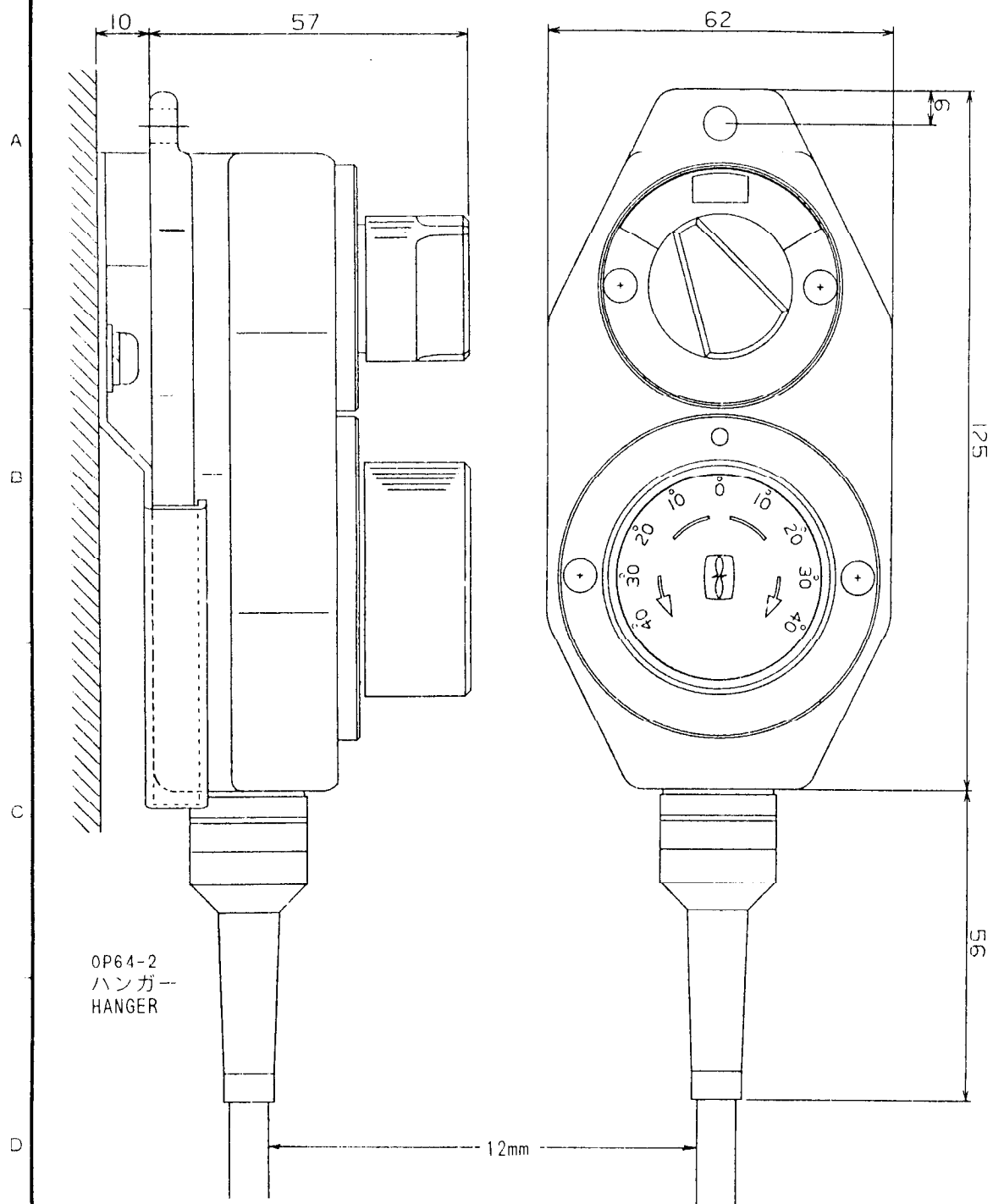
品名 ITEM	品名 NAME	材料 MATERIAL	数量 QTY	図番 DWG. NO.	備考 REMARKS
平 APPROVED	JUL-21-89				
検 CHECKED	Jun-21-89				
製 DRAWN	MAY-29-89				
図 TITLE	THIRD ANGLE PROJECTION				
縮 SCALE	1/50				
重 WEIGHT	1.6 kg				
図 DWG. NO.	C7227-G01-A				
品 FAP-55					



FAP-55		品番 ITEM	品名 NAME	材質 MATERIAL	数量 QTY	図番 DWG.NO.	摘要 REMARKS
承認 APPROVED	500.21.89 TAKAWO		三角法 THIRD ANGLE PROJECTION	名称 TITLE	FAP-5520 制御部 外寸図 PROCESSOR UNIT		
検図 CHECKED	500.21.89 M. S. P. T. O.		尺度 SCALE				
製図 DRAWN	500.29.39 T. Y. Y. A. M. A.		重量 WEIGHT	3 kg	図番 DWG.NO.	C7227-G03-A	

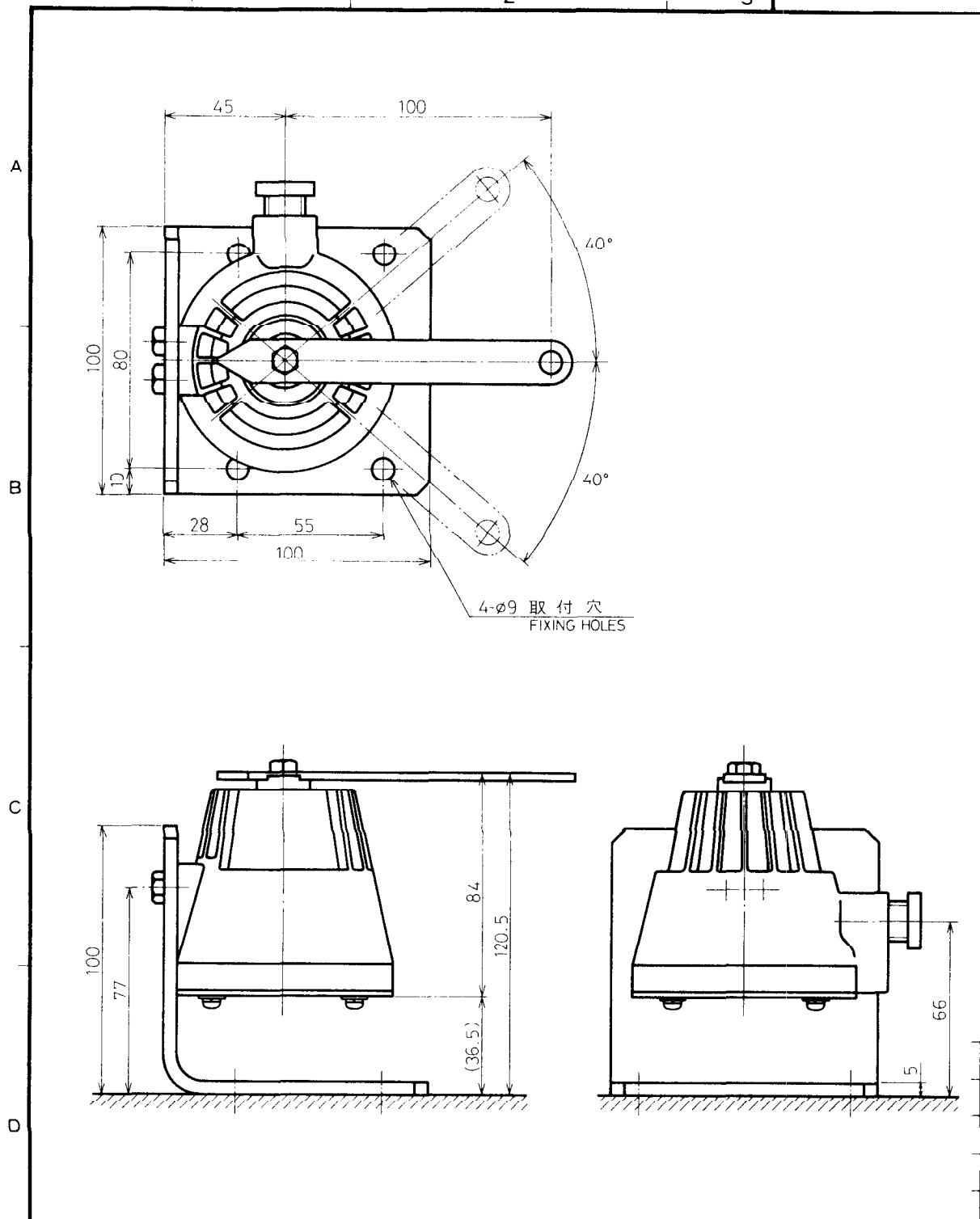
FURUNO

D-3



FAP-55		品番	品名	材質	数量	図番	摘要
		ITEM	NAME	MATERIAL	QTY	DWG.NO.	REMARKS
承認 APPROVED	2002.11.18 TAKAKU		三角法 THIRD ANGLE PROJECTION	名称 TITLE FAP-5550 リモコン (遠隔管制器) REMOTE CONTROLLER			
検 CHECKED	2002.11.18 K. SAITO		尺 SCALE				
製 DRAWN	2002.11.18 TAKAKU		重量 WEIGHT	0.5 kg	図番 DWG.NO.	C7227-G02-A	

FURUNO ELECTRIC CO., LTD.



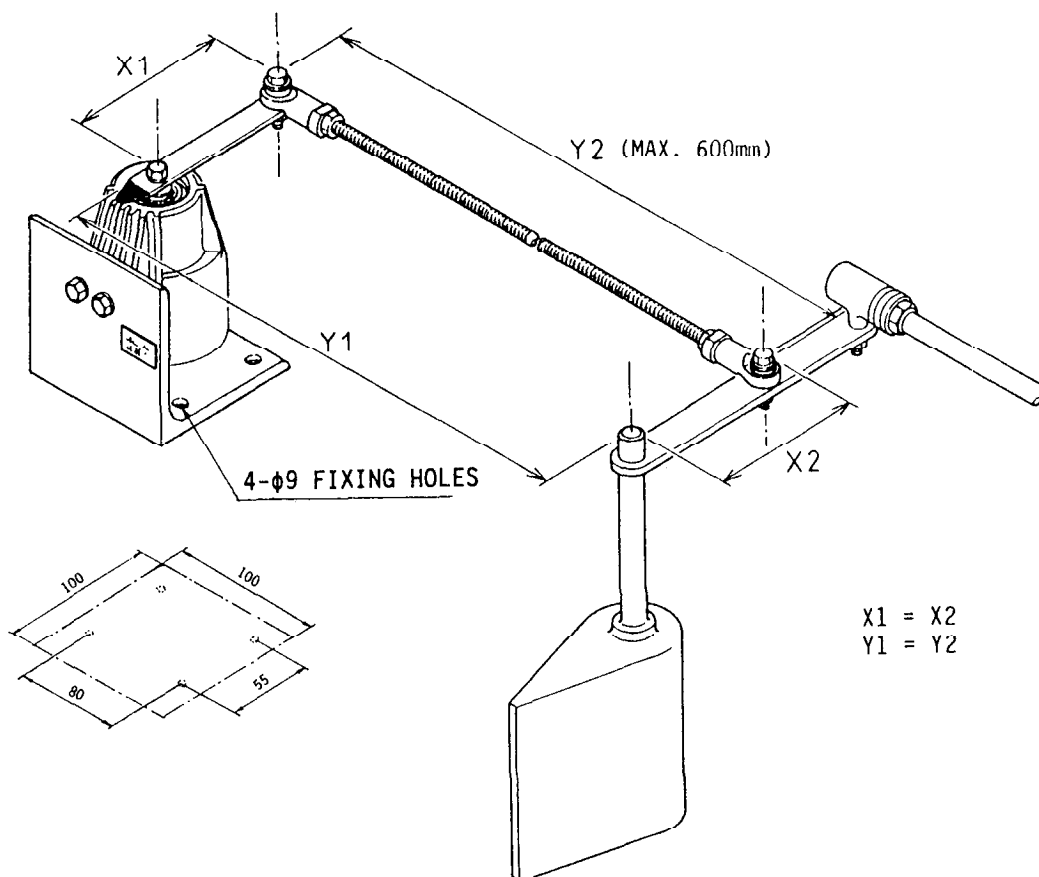
FAP-55		品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS
承認 APPROVED	2009.09.09	三角法 THIRD ANGLE PROJECTION		名称 TITLE 追従発信器 FAP-6100 RUDDER REFERENCE UNIT			
検図 CHECKED	2009.09.09	尺度 SCALE	1/2				
製図 DRAWN	2009.09.09	重量 WEIGHT	1.5 kg	図番 DWG. NO.	C7229-G01-A		

A

B

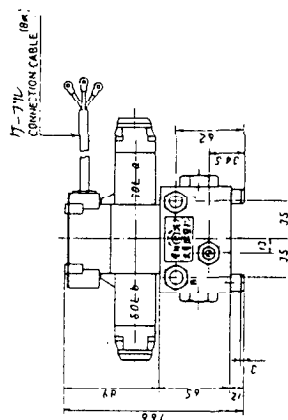
C

D

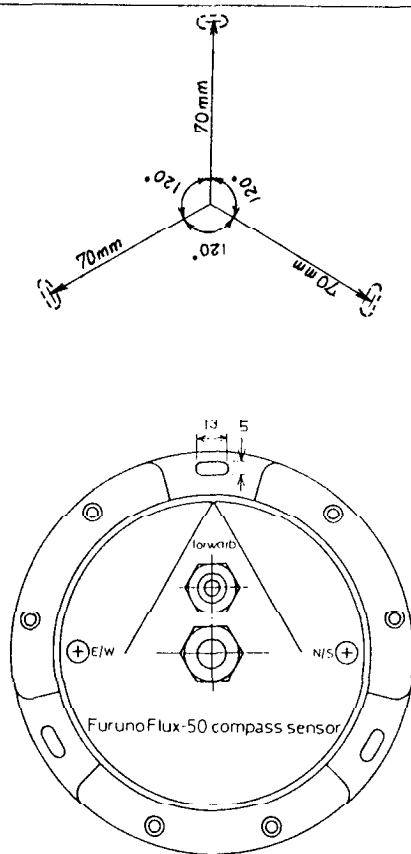
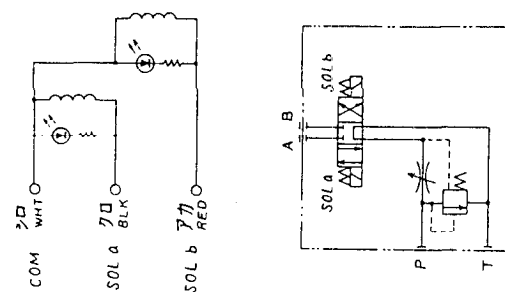


(The unit may be installed at either side of the rudder.)

		品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS
承認 APPROVED	100.13.90	三角法 THIRD ANGLE PROJECTION		名称 TITLE			
検図 CHECKED	100.13.90 N. S. 10/10	尺度 SCALE	RUDDER REFERENCE UNIT INSTALLATION				
製図 DRAWN	100.13.90 S. Nishida	重量 WEIGHT	kg	図番 DWG.NO. E7227-Y01-A			

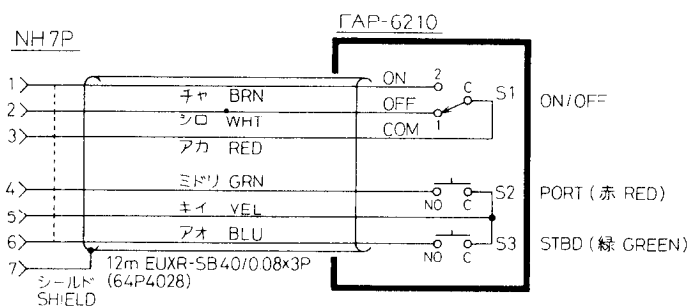
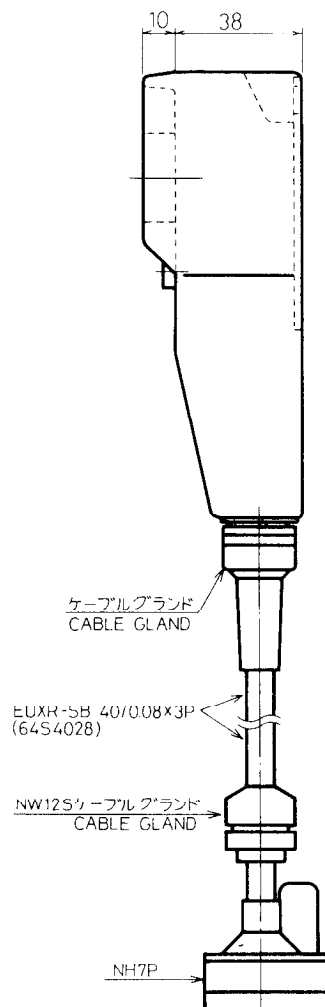
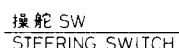


Weight : 5Kg

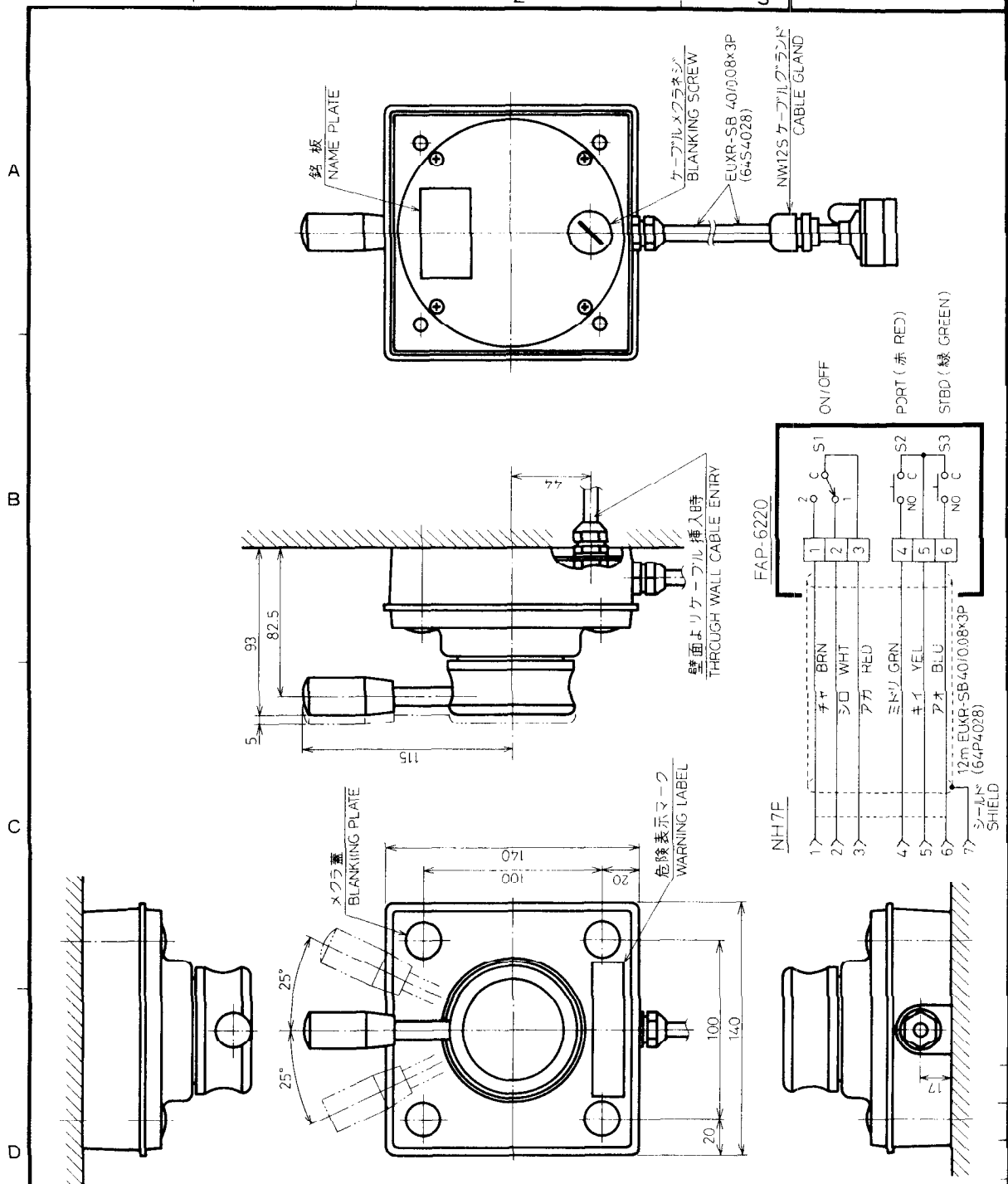


Flux-gate Heading Sensor FLUX-50

weight : 2Kg



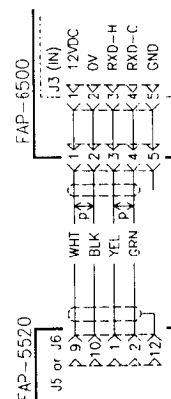
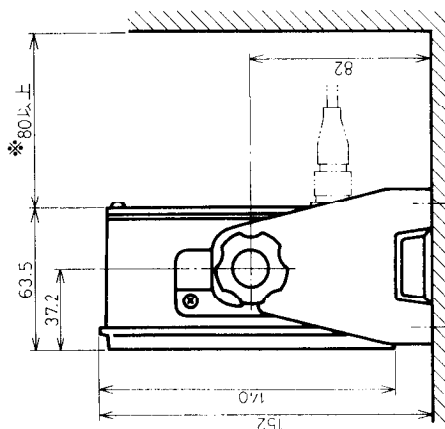
FAP-55		品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS
承認 APPROVED	JAN. 10. 91 T. LAKANO	三角法 THIRD ANGLE PROJECTION		名称 TITLE	遠隔管制器(ボタン式) REMOTE CONTROLLER (BUTTON SWITCH TYPE)		
検査 CHECKED	JAN. 10. 91 N. SAITO	尺度 SCALE	1/2	FAP-6210			
製図 DRAWN	JAN. 10. 91 S. NISHI	重量 WEIGHT	0.5 kg	図番 DWG.NO.	C7229-G02-A		



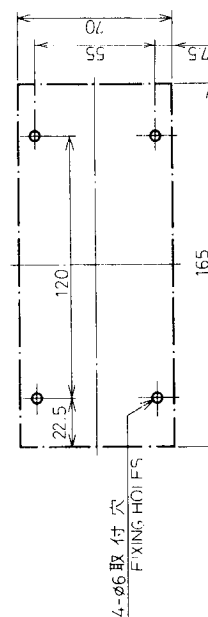
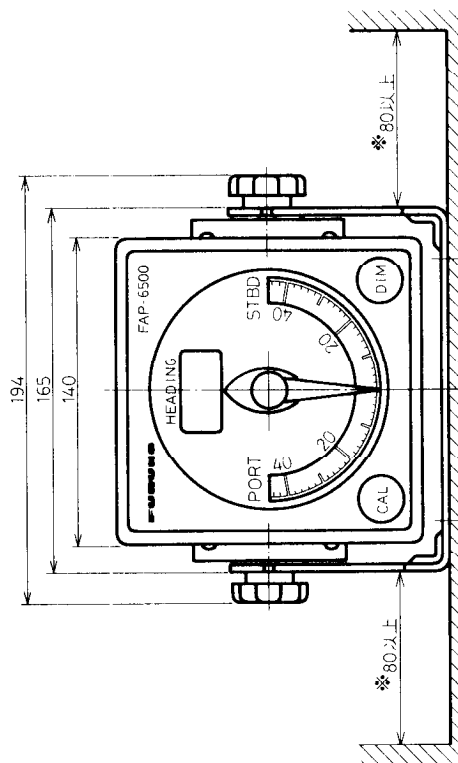
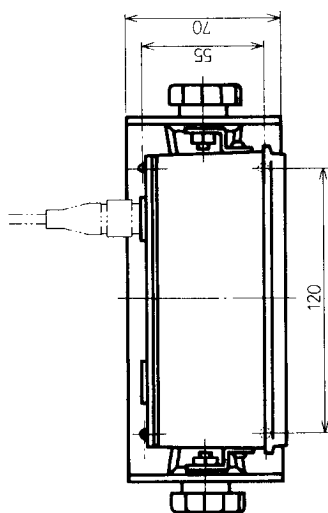
FAP-55		品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS
承認 APPROVED	JAN. 10. '91 TAKAWO		三角法 THIRD ANGLE PROJECTION				名称 TITLE 遠隔管制器(レバー式) REMOTE CONTROLLER (LEVER TYPE)
検図 CHECKED	JAN. 10. '91 N. SAITO		尺度 SCALE 1/3				
製図 DRAWN	JAN. 10. '91 S. NISHI		重量 WEIGHT 2 kg			図番 DWG.NO. C7229-G03-A	

A

※:推奨サービス空間
RECOMMENDED SERVICE SPACE



B



ハンガー取付寸法 FIXING DIMENSIONS

D

FAP-55

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS
JAN. 10. '91 T. AKAJO	三角法 THIRD ANGLE PROJECTION				
JAN. 10. '91 N. SAITO	尺度 SCALE	1/3			
JAN. 10. '91 S. NISHI	重量 WEIGHT	1.5 kg			

承認
APPROVED

検図
CHECKED

製図
DRAWN

JAN. 10. '91
T. AKAJO

JAN. 10. '91
N. SAITO

JAN. 10. '91
S. NISHI

三角法
THIRD ANGLE PROJECTION

尺度
SCALE

重量
WEIGHT

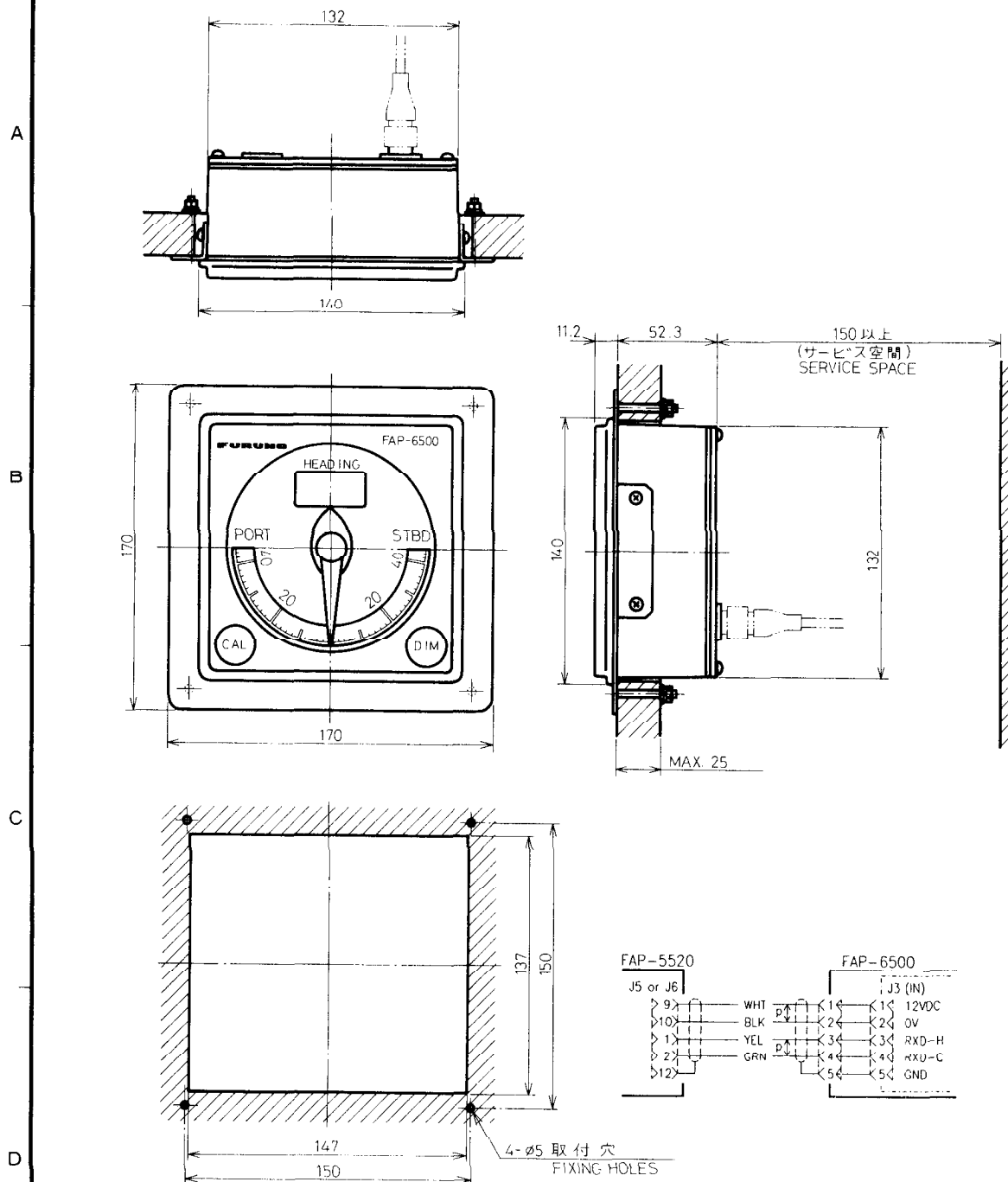
名称
TITLE

FAP-6500

図番
DWG. NO.

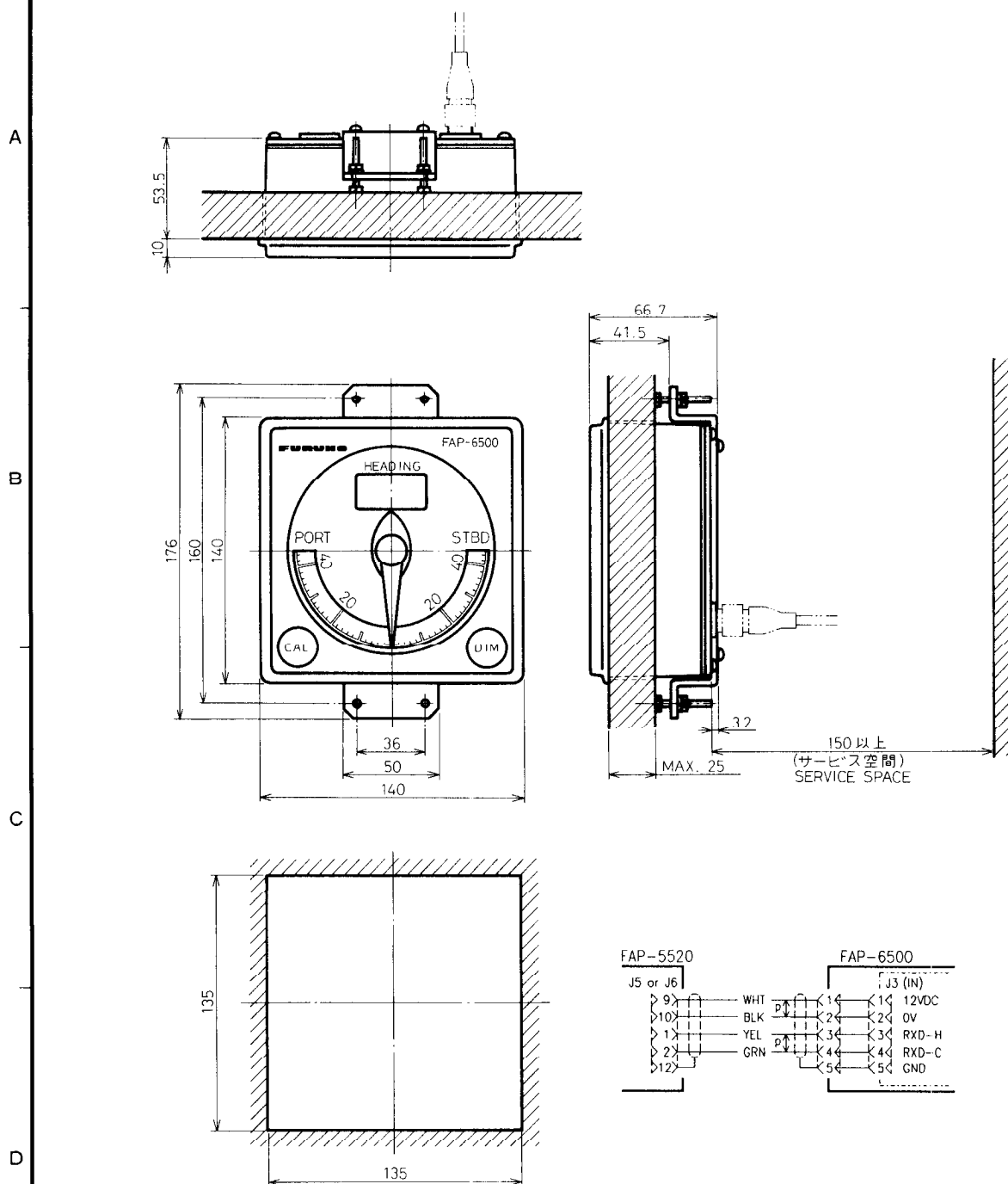
舵角表示器(ハンガー)
RUDDER ANGLE DISPLAY
(HANGER)

C7229-G04-C



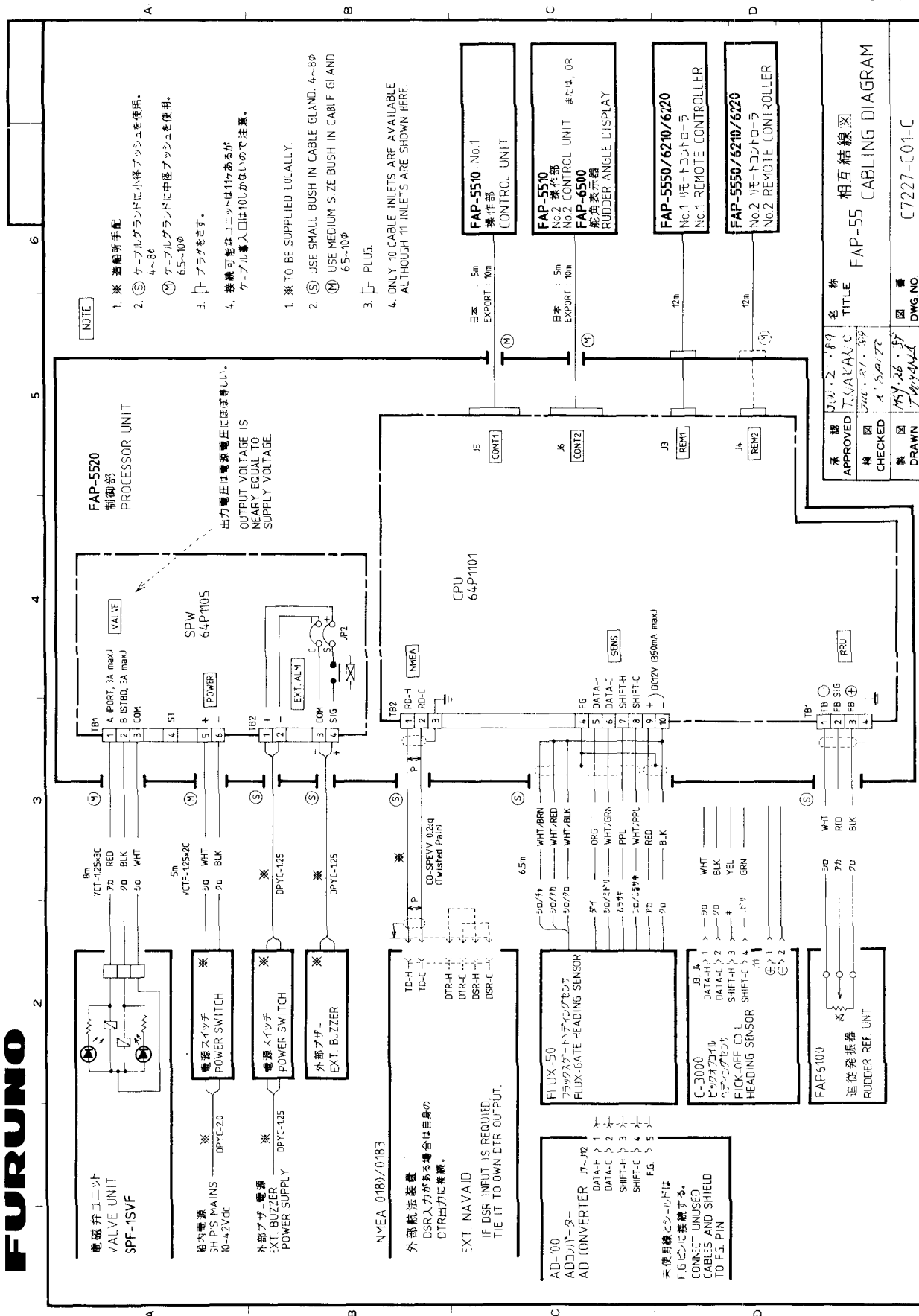
パネル取付寸法
CUTTING DIMENSIONS

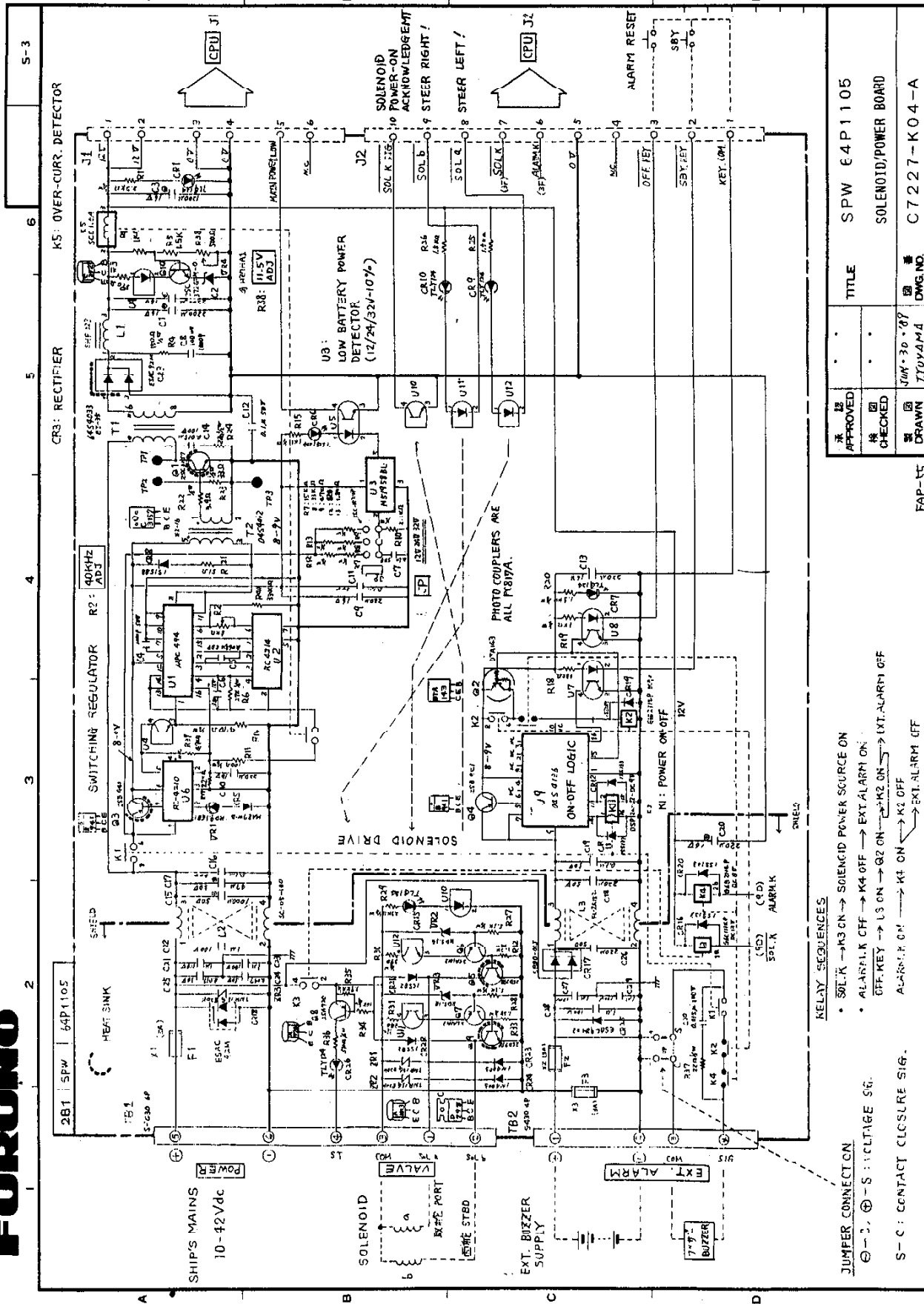
FAP-55		品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS
承認 APPROVED	JAN. 10. '91 T. A. KAWA	三角法 THIRD ANGLE PROJECTION		名称 TITLE	舵角表示器(フラッシュマウント) RUDDER ANGLE DISPLAY (FLUSH MOUNT)		
検図 CHECKED	JAN. 10. '91 N. SAITO	尺度 SCALE	1/3	FAP-6500			
製図 DRAWN	JAN. 10. '91 S. N. S. L.	重量 WEIGHT	1.4 kg	図番 DWG. NO.	C7229-G05-C		



パネル取付寸法
CUTTING DIMENSIONS

FAP-55		品 番 ITEM	品 名 NAME	材 質 MATERIAL	数 量 Q'TY	図 番 DWG.NO.	摘 要 REMARKS
承認 APPROVED	JAN. 10. 91 T. TAKAKUO		三 角 法 THIRD ANGLE PROJECTION				名 称 TITLE 舵角表示器 RUDDER ANGLE DISPLAY
検 査 CHECKED	JAN. 10. 91 N. SAITO		尺 度 SCALE 1 / 3				
製 図 DRAWN	JAN. 10. 91 S. Nishida		重 量 WEIGHT 1.3 kg				図 番 DWG.NO. C7229-G06-C





FURUNO ELECTRIC CO., LTD.

FAP-55

DESIGNED	SPW 64P1105
CHECKED	SOLENOID/POWER BOARD
DRAWN	JUN-30-89
APPROVED	77094M4

DWG. NO. C7227-K04-A

A

外部航法装置
EXT. NAVAID
NMEA 180/183

B

船首方位
センサー
HEADING
SENSOR

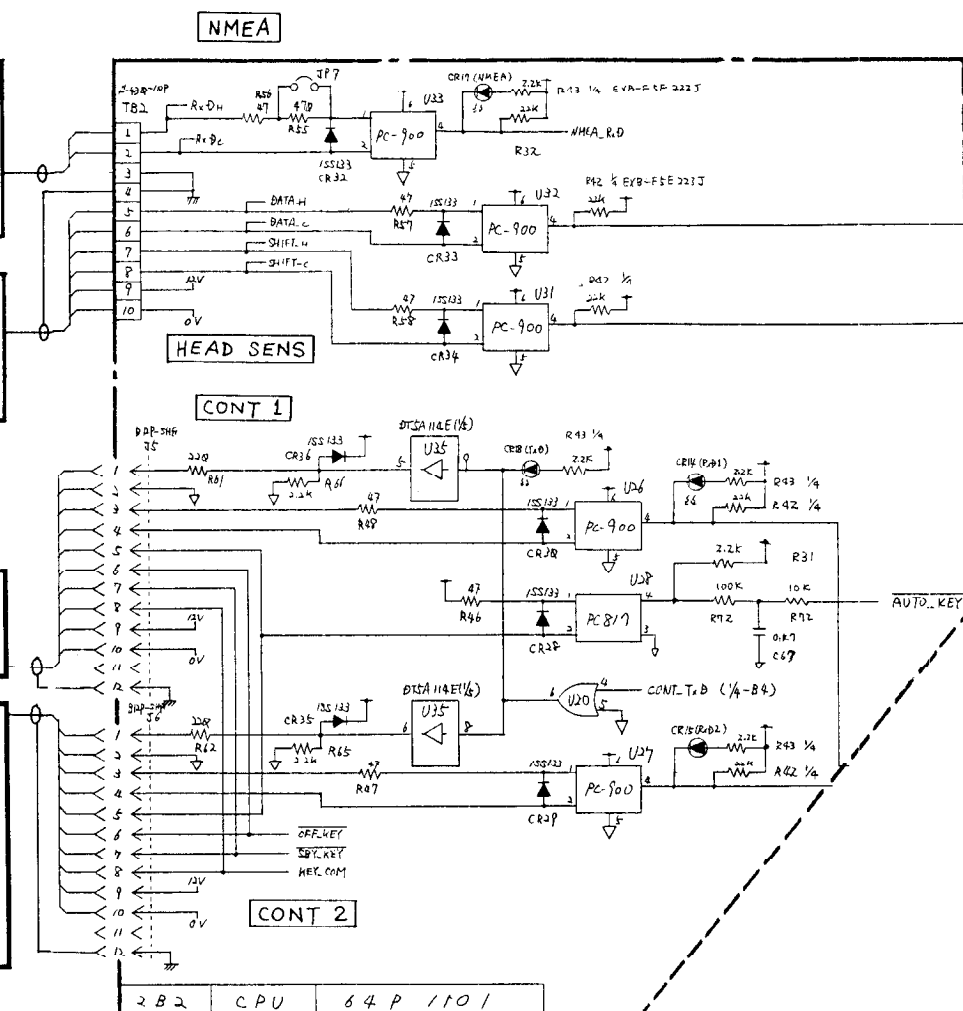
C

FAP-5510
操作部
CONTROL UNIT

FAP-5510
第2操作部
No. 2 CONTROL
UNIT

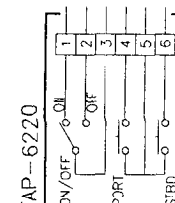
or
FAP-6500
舵角表示器
RUDDER ANGLE
DISPLAY

D



FAP-55

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS
承認 APPROVED	三角法 THIRD ANGLE PROJECTION	名称 TITLE	CPU 64P1101 (1/2)		
検図 CHECKED	尺度 SCALE		CPU 基板 CPU BOARD		
製図 DRAWN	重量 WEIGHT	図番 DWG.NO.	C7227-K02-B		



FURUNO ELECTRIC CO., LTD.