FURUNO

OPERATOR'S MANUAL

AUTO PLOTTER

MODEL   ARP-15

FURUNO ELECTRIC CO., LTD.

NISHINOMIYA, JAPAN

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PUB. No. OME-30380
(TATA)   ARP-15

·Your Local Agent/Dealer

FIRST EDITION : MAR 1995
G   : DEC. 2,1997

00080695600

⚠ SAFETY INSTRUCTION

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

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

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

NOTICE	This notice indicates an unsafe practice which, if not avoided, could result in property damage or equipment malfunction.

⚠ WARNING

Hazardous voltage can shock, burn, or cause death.

Only qualified personnel should work in the unit.

This auto plotter is not designed to replace the human eye nor make decisions for the navigator. It is intended for use as an aid to navigation. Always maintain a watch while underway. Data obtained from this auto plotter should always be double checked against other sources to verify the reliability of the data.

This auto plotter automatically tracks a acquired radar target and calculates its course and speed, indicating it by a vector. Since the data generated by this unit are based on what radar targets are selected, the radar must always be optimally tuned for use with it to ensure that required targets will not be lost or unwanted targets such as sea returns and noise will not be acquired and tracked.

A target echo does not always mean a landmass, reef, ships or other surface objects but can imply returns from sea surface or precipitation. As the level of these returns varies with environment, the operator is required to properly adjust the STC (ant-clutter sea), FTC (anti-clutter rain) and GAIN controls to ensure that target echoes within the affected area are not eliminated from the radar screen. The optimum settings of these controls may slightly differ between the normal radar operation and plotting, and it is recommended to readjust them in accordance with the operating mode selected.

NOTICE

The installation must be done by a FURUNO representative or suitably qualified radar technician.

Authorities require this.

Keep magnets and magnetic fields away from the equipment.

Magnetic fields will distort the picture and can cause equipment malfunction. Be sure the unit is well away from equipment which gives off magnetic fields (speaker, power transformer, etc.).

The following items affect calculation accuracy.

- echo intensity
- radar transmission pulsewidth
- radar bearing error
- gyrocompass error
- own vessel or other vessel course change

Data for CPA, TCPA, etc. are approximations only. Always use data obtained prudently.

AUTOMATIC RADAR PLOTTER ARP-15

General

The Auto Plotter ARP-15 is an optional circuit board which is accommodated in the display unit of the FR-1500 Mark 2 and FR-8005 series radars.

The Auto Plotter permits manual acquisition and automatic tracking of up to 10 radar targets. An internal microprocessor calculates target data such as speeds and courses and displays the results in alphanumeric and by vectors. To ensure the reliability of the displayed target data, the radar must be properly adjusted for minimum sea returns and noise.

NOTE: When the ARP-15 is installed(whether or not in use), E-PLOT (manual acquisition, manual tracking with 10 selected symbols) is disabled.

Principal Specifications

Acquisition and Tracking:
• Manual acquisition of up to 10 targets between 0.2 and 32 nm
• Automatic tracking of up to 10 manually acquired targets between 0.1 and 32 nm

Vectors:

Vector length:	30 s, 1, 3, 6, 15, 30 min.
Orientation:	True velocity or relative velocity
Motion trend:	Displayed within 1 min., full accuracy within 3 min. after acquisition
Past positions:	10 past positions at intervals of 15, 30 s, 1, 2, 3, 6, 10, 12 min.
Alarms:	Visual and audible alarms against targets violating CPA/TCPA limits, Visual alarm against lost targets
Trial maneuver:	not provided
Compatible Radar:	FR-1500 Mark 2 series and FR-8051/8111/8251

Target discrimination: A target measuring about 800 m or more in the radial or circumferential direction is regarded as a landmass and not acquired or tracked. Echoes smaller than about 800 m are regarded as true targets.

Note: The Auto Plotter ARP-15 is not intended to cover all the ARPA functions as specified in IMO A.422(XI) and IEC 872. Target acquisition suppression area can not be set, for instance.

Keys Used for Auto Plotter

The Auto Plotter utilizes the following touchpad keys. Given below is a brief description of these keys.

MENU: Displays/Erases the main menu.

CLEAR/DELETE: Terminates tracking of a single target specified by the trackball

ENTER/SELECT: Registers menu options selected; selects the target for data reading.

PLOT: Used to manually acquire a target; displays the plot menu.

AUDIO OFF (on operator control panel): Silences audible alarm.

Auto Plot Menu Operation

The auto plot menu operation includes the followings;

DISPLAY : Turns on/off the plot symbols, past positions and target data.

ERASE: Cancels the tracking of all targets.

VECTOR REF: Selects relative vector or true vector. To select your choice, press ENTER/SELECT key, and the legend REL and TRUE appear at the right bottom. Turn the VRM or EBL control left or right. When your selection is circumscribed with a square, press the ENTER/SELECT key.

VECTOR TIME: Selects vector time.

TRACK: Turns on or off past positions.

INTERVAL: Selects past position plot interval.

CPA SET: Selects CPA alarm limit. When a target is predicted to come within this limit, an aural alarm sounds and at the same time the corresponding target symbol changes to a blinking triangle.

Note: If the preset CPA limit is set at **OFF**, a target which is on collision course **will not** produce an alarm.
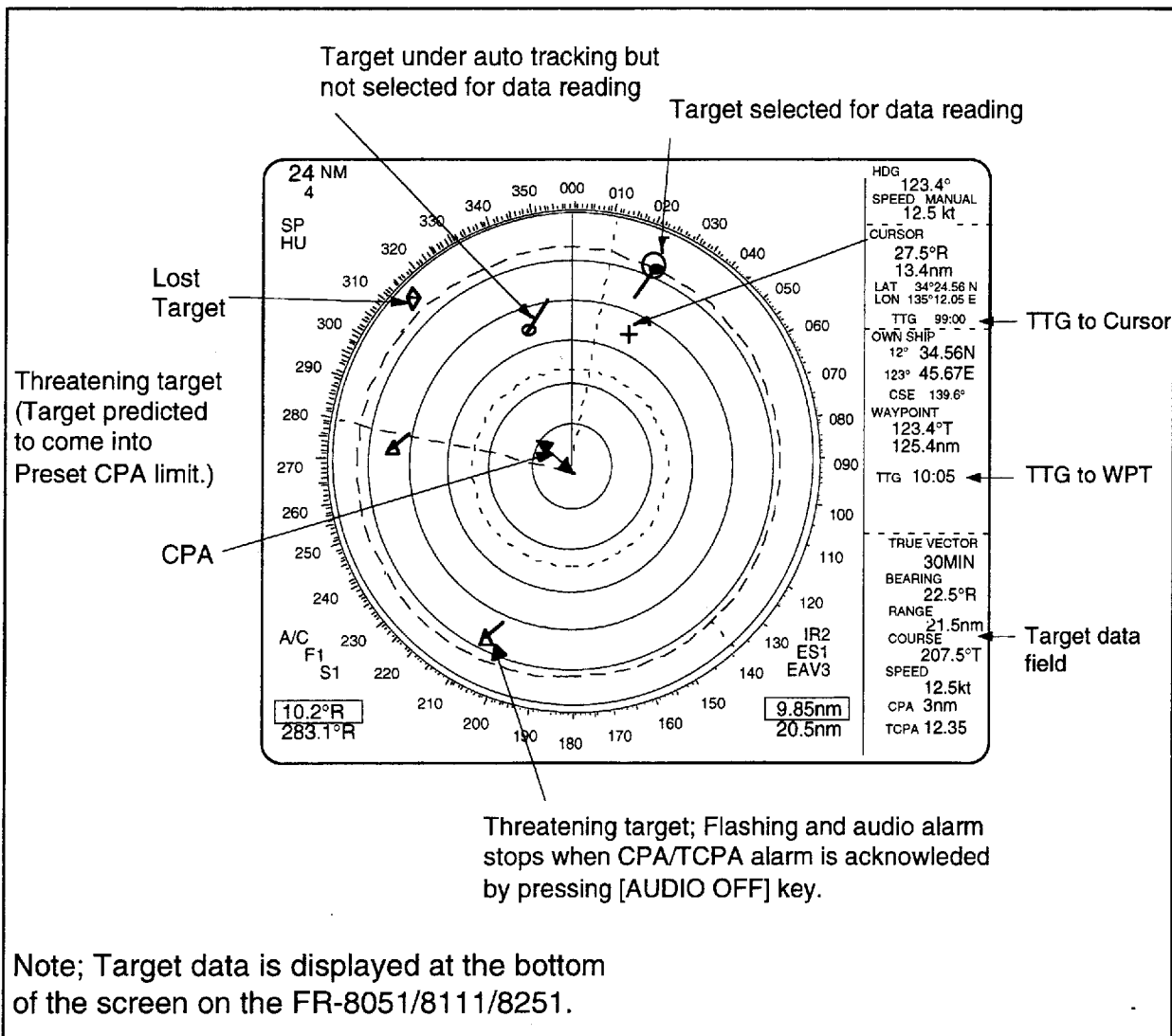
TCPA SET: Selects TCPA alarm limit.

Activating the Auto Plotter

To activate the Auto Plotter, follow the steps shown below:

1. Adjust the A/C RAIN, A/C SEA and GAIN controls for proper radar picture.

2. Press the MENU and PLOT key in this order to show the PLOT menu.

3. Operate the VRM control to select the menu item "DISPLAY".

4. Press the ENTER key.

5. Operate the VRM control to select ON.

6. Press the ENTER key.

7. Press the MENU key to close the menu.

Target under auto tracking but not selected for data reading

Target selected for data reading

Lost Target

Threatening target (Target predicted to come into Preset CPA limit.)

CPA

TTG to Cursor

TTG to WPT

Target data field

HDG 123.4°
SPEED MANUAL 12.5 kt
CURSOR
27.5°R
13.4nm
LAT 34°24.56 N
LON 135°12.05 E
TTG 99:00
OWN SHIP
12° 34.56N
123° 45.67E
CSE 139.6°
WAYPOINT
123.4°T
125.4nm
TTG 10:05

TRUE VECTOR
30MIN
BEARING
22.5°R
RANGE
21.5nm
COURSE
207.5°T
SPEED
12.5kt
CPA 3nm
TCPA 12.35

Threatening target; Flashing and audio alarm stops when CPA/TCPA alarm is acknowleded by pressing [AUDIO OFF] key.

Note; Target data is displayed at the bottom of the screen on the FR-8051/8111/8251.

Entering Own Ship's Speed

The Auto Plotter requires own ship's speed and heading data. Of these, the speed data can be entered automatically from a speed log, navaid or manually through the menu.

Note: It is customary to use a speed relative to water for collision avoidance and a speed over the ground for navigation purpose.

1. Press and hold down the MENU key to show the INITIAL menu.

2. Operate the VRM control to select SPD MODE.

3. Press the ENTER key.

4. Operate the VRM control to set manual, speed log, or navaid. On the G-type, NAV is not available.

5. Press the ENTER key.

6. Press the MENU key to close the menu.

Notes:
1) IMO Resolution A.422(XI) for ARPA recommends that a speed log to be interfaced with an ARPA should be capable of providing through-the-water speed data rather than over-the-ground speed.

2) Be sure not to select LOG when a speed log is not connected. If the log signal is not provided, the ship speed readout at the screen top will show **.*. If the log speed is less than 0.1 knots, **.* appears.

3) In the event of a log error, you can continue plotting by entering a manual speed.

Manual Speed Input

Select MAN at step 4 above and enter speed by operating the VRM control.

Deactivating the Auto Plotter

To deactivate the Auto Plotter,

1. Press the MENU and PLOT key in this order to show the PLOT menu.

2. Operate the VRM control to select the "DISPLAY".

3. Press the ENTER key.

4. Operate the VRM control to select OFF.

5. Press the ENTER key.

6. Press the MENU key to close the menu.

Acquiring targets

1. Place the cursor (+) on a target of interest by operating the trackball.

2. Press the PLOT key.

The plot symbol changes its shape according to the status as below. A vector appears in about one minute after acquisition indicating the target's motion trend. If the target is consistently detected for three minutes, the plot symbol changes to a solid mark. If acquisition fails, the target symbol blinks and disappears shortly.

SQUARE (dotted)
Immediately after acquisition—Plot symbol shown in broken lines
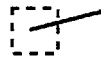
SQUARE (dotted with a vector)
One minute after acquisition—Vector still unreliable.

CIRCLE (Solid with a vector)
3 minutes after acquisition—Plot symbol changes to a solid circle indicating the stable tracking condition.

LARGE CIRCLE
The plot symbol of a target under tracking becomes twice as large as the normal symbol when the target is selected for data reading.

Notes:
1) The target to be acquired should be within 0.2 to 32 nm from own ship and not obscured by sea or rain clutter for successful acquisition.

2) When you want to acquire 11th target, cancel tracking one of less important targets.

> **⚠ WARNING**
>
> Target Swap
> When a tracked target nears another tracked target, the targets may be "swapped." When two targets come close to each other, one of the two can become a "lost target". Should this happen, reacquisition of the "lost target" is required after the two targets have separated.

Displaying Target Data

The Auto Plotter calculates motion trends (range, bearing, course, speed, CPA and TCPA) of all targets under tracking.

> **⚠ CAUTION**
>
> Target Date
> At the speed under 5 kts the target data is displayed with a delay becacuse of filtration.

Place the cursor on a wanted target and press the ENTER key. Data on the selected target is displayed on the screen. The symbol of the selected target gets twice as large as the normal circle. The data includes the follows;

RNG/BRG (Range/Bearing): Range and bearing from own ship to the last-plotted or selected target position with suffix "T" (True) or "M" (Magnetic). For true bearings suffix "T" is used in case of gyrocompass input and suffix "M" is used in case of magnetic compass input.

COURSE/SPEED (Course/Speed): Course and speed are displayed for the last-plotted or selected target with suffix "T" (True) or "M" (Magnetic). For true bearings suffix "T" is used in case of gyrocompass input and suffix "M" is used in case of magnetic compass input.

CPA (Closest Point of Approach) is the closest range a target will approach to own ship. Do not mix it with the operator preset CPA alarm limit.

TCPA is the time to CPA measured with present speeds of own ship and the targets. Both CPA and TCPA are automatically calculated. When a target ship has passed clear of own ship, the CPA is displayed and the TCPA appears as "**.***". TCPA is counted up to 99.9 min. and beyond this it is indicated as TCPA>99.9 min.

Note: On the FR-8051/8111/8251, select either PLOT or ALL in the DSP DATA menu. Otherwise, target data is not displayed.

Mode and Length of Vectors

True or Relative Vector
Target vectors are displayed in relative or true mode. Own ship does not have a vector in relative mode.

Vector Time

From the PLOT menu, Vector Time (or the length of vectors) can be set to 30 seconds, 1, 3, 6, 15 or 30 minutes and the selected vector time is indicated on the screen.

The vector tip shows an estimated position of the target after the selected vector time elapses. It can be valuable to extend the vector length to evaluate the risk of collision with any target.

Past Position Display

The Auto Plotter displays equally time-spaced dots (maximum 9 dots) marking the past positions of any targets being tracked.

If a target changes its speed, the spacing will be uneven. If it changes the course, its plotted course will not be a straight line in TM mode.

Displaying and Erasing Past Positions

1. Press the MENU and PLOT key in this order to show the PLOT menu.

2. Operate the VRM control to select the "TRACK".

3. Press the ENTER key.

4. Operate the VRM control to select "ON" or "OFF".

5. Press the ENTER key.

6. Press the MENU key to close the menu.

Selecting the Past Position Plot Intervals
Past position plot interval can be selected to 15, 30 s, 1, 2, 3, 6, 10 or 12 min. from the PLOT menu.

Note: The Auto Plotter ARP-15 can store a maximum of 10 past positions per target being tracked. If the total number of past positions stored in the memory reaches 10, the oldest plots will be erased on the first-in-first-out basis.

Terminating Tracking of Targets

When the Auto Plotter has acquired 10 targets, no more acquisition occurs unless targets are lost. Should this happen, cancel tracking of individual targets or all targets by the procedure described below.

Individual Targets
Place the cursor (+) on a target which you do not want to be tracked any longer by operating the trackball and press the DELETE key.

All Targets
All targets can be canceled from PLOT menu at a time.

1. Press the MENU key, followed by the PLOT key to show the PLOT menu.

2. Select the ERASE line.

3. Press the ENTER key.

Operational Warnings

There are two main situations which cause the Auto Plotter to trigger visual and audible alarms. On the G-type, an alarm message is also displayed. (Display of alarm messages on FR-1500 Mark 2 series only.)

- CPA/TCPA alarm
- Lost target alarm

CPA/TCPA Alarm

Visual and audible alarms are generated when the predicted CPA and TCPA of any target become less than their preset limits. Press the AUDIO OFF key to acknowledge and silence the CPA/TCPA audible alarm.

The Auto Plotter ARP-15 continuously monitors the predicted range at the Closest Point of Approach (CPA) and predicted time to CPA (TCPA) of each tracked target to own ship.

When the predicted CPA of any target becomes smaller than a preset CPA alarm range and its predicted TCPA less than a preset TCPA alarm limit, the ARP-15 releases an audible alarm. In addition, the target plot symbol changes to a triangle and flashes together with its vector.

Provided that this feature is used correctly, it will help prevent the risk of collision by alerting you to threatening targets. It is important that GAIN, A/C SEA, A/C RAIN and other radar controls are properly adjusted and the Auto Plotter is set up so that it can track targets effectively.

CPA/TCPA alarm ranges must be set up properly taking into consideration the size, tonnage, speed, turning performance and other characteristics of own ship.

> ### ⚠ WARNING
> CPA/ TCPA Alarm
> The CPA/TCPA alarm feature should never be relied upon as a sole means for detecting the risk of collision.
> The navigator is not relieved of the responsibility to keep visual lookout for avoiding collisions, whether or not the rader or other plotting aid is in use.

Follow the steps shown below to set the CPA/TCPA alarm ranges:

1. Press the MENU key, followed by the PLOT key to show the PLOT menu.

2. On the CPA SET line, select a CPA limit desired. (OFF, 0.5, 1, 2, 3, 4, 5, 6 nm)

3. Press the ENTER key.

4. On the TCPA SET line, select a TCPA limit desired. (30 s, 1, 2, 3, 4, 5, 6, 12 min.)

5. Press the ENTER key.

6. Press the MENU key to close the menu.

Silencing CPA/TCPA Audible Alarm

Press the AUDIO OFF key to acknowledge and silence the CPA/TCPA audible alarm.

The flashing of the triangle plot symbol and vector remain on the screen until the dangerous situation is no longer present or you intentionally terminate tracking of the target by using the CANCEL key.

Lost Target Alarm

When the system detects a loss of a tracked target, the target symbol becomes a flashing diamond. On the G-type, the label "LOST" appears at the screen bottom (FR-1500M2).

Installation of ARP-15 Board
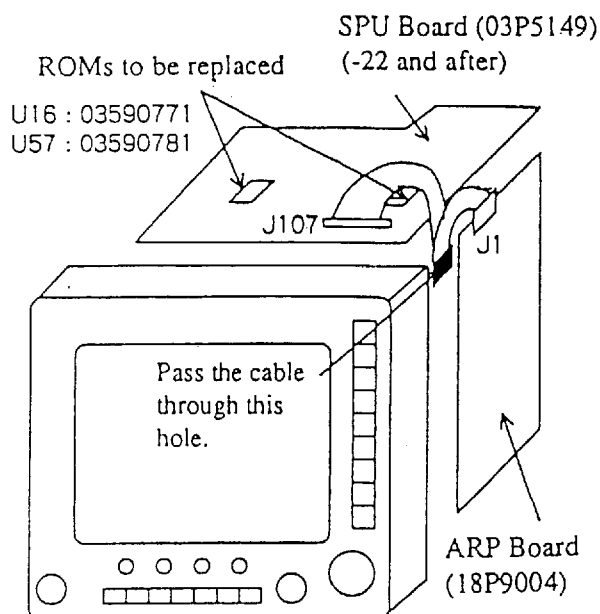
Necessary Parts

FR-1505M2/1510M2/1525M2

ARP-15-2E (008-458-320)

Name / Type	Code No.	Q'ty
ARP Board (18P9004)	008-458-550	1
ROM Set (2pcs.)	008-458-560	1
Accessories (ARP-15-2)	008-458-580	1 set
Flat cable Assy. (HIF6-68D-AA-24-HS)	000-135-142	1
Spacer (SQ-10)	000-801-678	8
Å}Panhead Screw (M3x8, C2700W)	000-881-404	8

Mounting

The ARP Board is attached to the right-hand chassis of the display unit, using the spacer supplied. See figure below. If the SPU board has the suffix of -1, it should be replaced with the one having -2 and after (FR-1500M2 series only).

The flat cable is used to make the connection between the SPU (J107) and ARP (J1) boards. The cable should be passed through the rectangule hole in the right-hand chassis.


ROMs to be replaced
SPU Board (03P5149)
(-22 and after)

U16 : 03590771
U57 : 03590781

J107

J1

Pass the cable through this hole.

ARP Board (18P9004)

ROM Replacement

The two ROMs (U16, U57) on the SPU board should be replaced with the one supplied.

Adjustment (for technicians only)

Procedure

1. Set the radar as follows, and transmit.
   Range : 6 nm
   A/C SEA control : fully ccw
   A/C RAIN control : fully ccw
   GAIN control : fully ccw

2. Connect the digital multimeter, set to DCV range, to the following points on the ARP Board.
   + : TP11 (VS+)
   - : TP10 (VS -)

J1

ARP Board (18P9004)

R120
R121
S1
TP10 (VS -)
TP11 (VS +)
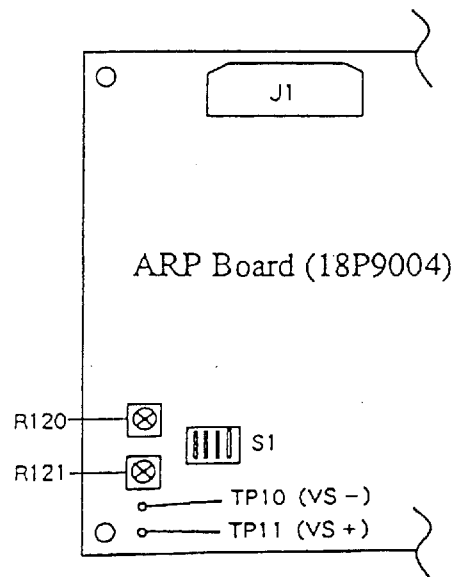
*All digits of S1 are set to OFF.

3. Adjust potentiometer R121 ("OFFSET") on the ARP Board so that the multimerter reads +0.09 to 0.13V.

4. Set the controls and switches as follows.

   GAIN control: fully cw
   A/C SEA control : fully ccw
   A/C RAIN control : fully ccw
   INT REJECT key : OFF
   RANGE : 24 nm
   Echo Stretch (menu) :OFF

5. Select "TEST" of VIDEO SIGNAL from IN-STALLATION SETTING 2 menu.

6. Press the **ENTER** key.

7. Adjust potentiometer R120 ("LEVEL") on the ARP Board so that random noise faintly appears.

When no noise appears, set R120 fully ccw.

No noise   Proper noise   Too much noise
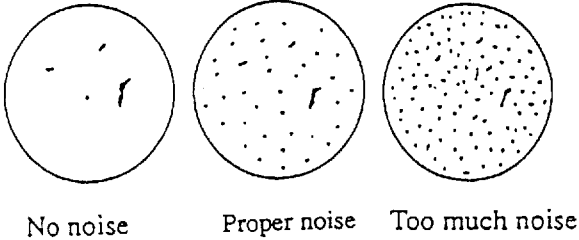
8. Select "**NORMAL**" of VIDEO SIGNAL from INSTALLATION SETTING 2 menu.

9. Press the **ENTER** key.

Input Signal Check

Place the radar in transmit condition after connecting the speed log and gyrocompass. Make sure that all red LEDs, CR1, 2, 3, 7, 10 and 11 are off, provided that the ship's speed is not zero. If a signal is absent, the corresponding LED lights.
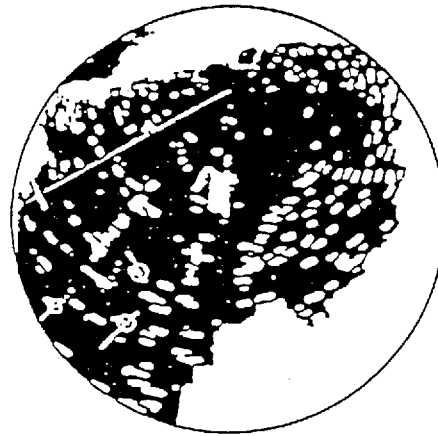

CR1 (Heading)
CR2 (Bearing) — CR3 (Video)
CR7 (Trigger)
CR10 (Gyro)
ARP Board (18P9004)
CR11 (Log)
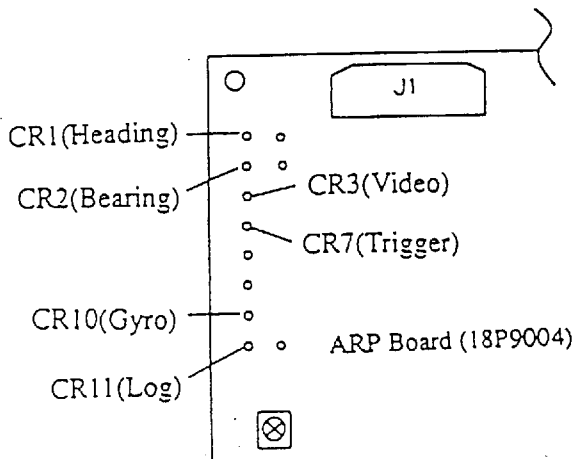
The CR11 may lights when the speed is less than 2 knots.

Video Signal Check

Selecting "NORMAL" and "TEST" signals from the menu, make sure that the picture differs as follows. If not, adjust R120 and R121 again.

NORMAL Video

TEST Video