

# FURUNO

## OPERATOR'S MANUAL

AUTO PLOTTER

MODEL ARP-2



**FURUNO ELECTRIC CO., LTD.**  
NISHINOMIYA, JAPAN

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PUB. No. OME-30250  
ARP-2

•Your Local Agent/Dealer

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G : OCT. 7, 1992



# WARNING

This auto plotter is, when used properly, a very effective anti-collision aid for marine vessels. If, however, it is operated incorrectly or used indiscriminately, for example, placing absolute faith in data obtained, the consequences could be life endangering.

## 1. VESSEL SAFETY

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.

## 2. TARGET TRACKING CAPABILITY

This auto plotter automatically tracks a manually 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.

### Operating Range

3 to 24 nm radar range is commonly used for auto plotting although targets may be acquired/tracked in a wider range.

### Returns from Sea Surface and Precipitation

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.

## 3. CALCULATION ACCURACY

The following items affect calculation accuracy.

- 1) echo intensity
- 2) radar transmission pulsewidth
- 3) radar bearing error
- 4) gyrocompass error
- 5) own vessel or other vessel course change

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

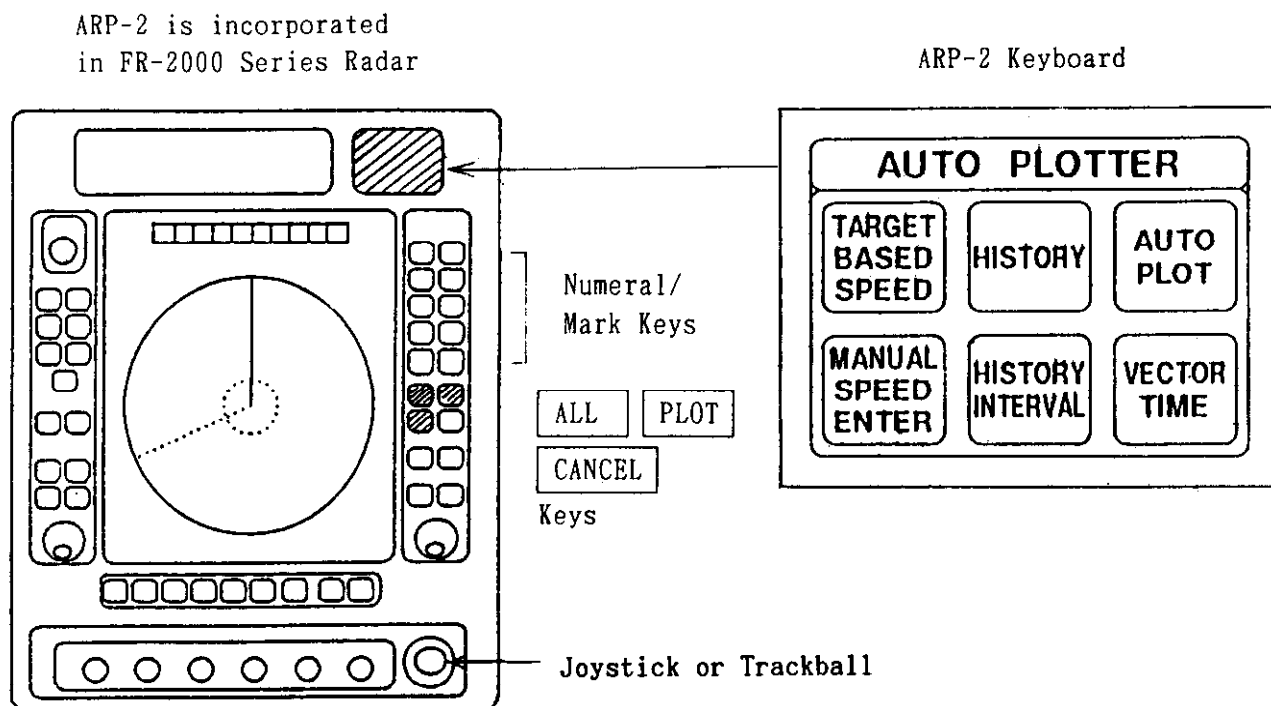
# C O N T E N T S

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	<u>Page</u>
<div style="border: 1px solid black; padding: 2px; display: inline-block;">OPERATION</div> _____	1 to 6
Key Usages _____	1
Operating Procedure _____	3
• How to input own ship speed from speed log automatically -	3
• How to measure own ship speed by using a fixed target - - -	3
• How to enter own ship speed manually - - - - -	4
• How to conduct target acquisition and display vector - - -	5
• How to call up target information - - - - -	7
• How to cease tracking - - - - -	7
• How to present history - - - - -	7
• How to cease the history presentation - - - - -	7
<div style="border: 1px solid black; padding: 2px; display: inline-block;">APPENDIX</div> _____	AP1-1 to AP2-12
1. Specifications _____	AP1-1 to AP1-3
2. Installation _____	AP2-1 to AP2-11
• Incorporating the keyboard - - - - -	AP2-1
• Incorporating the auto-plotter pcb's - - - - -	AP2-2
• Replacing ROM chips - - - - -	AP2-4
• Modifying 03P7030 board - - - - -	AP2-5
• Changing overcurrent protection threshold - - - - -	AP2-6
• Adjustment - - - - -	AP2-8
INTERCONNECTION DIAGRAM _____	S - 1

# OPERATION

## Key Usages



### [AUTO PLOT] key

The auto-plot presentation is turned on and off at every hit of this key.

### [VECTOR TIME] key

Target velocity is presented as a line segment which is marked on the target echo. The target's moving direction is indicated by the direction of the line segment, and the trip distance per a regular period (e.g. speed) is done by the length. The "regular period" changes in the following sequence at every hit of this key.

—30sec. → 1min. → 2min. → 3min. → 6min. → 10min. → 15min. → 30min.—

Example : Vector Time = 10min.

If the target maintains its present course and speed,  
it will reach the tip of the vector 10 minutes later.

○  
Target

[HISTORY] key

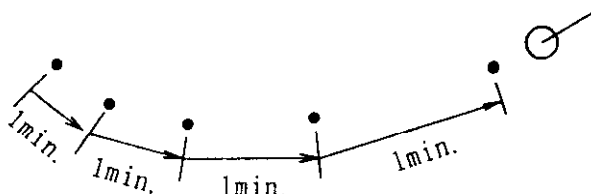
Targets' track lines are presented as a number of dots. Every hit of this key turns on and off the track line presentation alternately.

[HISTORY INTERVAL] key

The track line plotting interval changes in the following sequence at every hit of this key.

15sec. → 30sec. → 1min. → 2min. → 3min. → 6min. → 10min. → 12min.

Example : History Interval = 1min.



You can know from the above picture that the target is moving faster and faster as the dot spacing is becoming longer.

On the contrary, if the spacing is becoming shorter, the target speed is slowing down.

[TARGET BASED SPEED] key

After moving the "+" cursor onto a target by the joystick or the trackball, hit this key, and the own ship speed relative to the target is digitally indicated.

[MANUAL SPEED ENTER] key

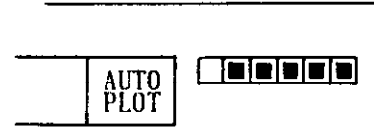
When a speed log is not connected, you may enter the estimated ship's speed by this key.

# Operating Procedure

Select a range from 1.5 to 48nm, and adjust the GAIN, STC, FTC controls etc. for the best target presentation.

NOTE : If you select a range outside the above limit during the following steps, the "AUTO PLOT" indication (shown below) will blink to alert you.

Hit the [AUTO PLOT] key.



## How to input OWN SHIP SPEED from SPEED LOG automatically

This method is used when a speed log is connected. Change the indication to "LOG" then the ship speed will be input automatically from speed log.

- (1) Press [MANUAL SPEED ENTER] key while holding down [HM OFF] key.

Decision of the speed displaying mode is done according to the DIP SW setting when turning on the equipment.

HEAD UP  
RANGE  
RINGS  
+ {  
RNG  
BRG  
→ LOG 12.3KT

To quit automatic speed input, press [MANUAL SPEED ENTER] key while holding down [HM OFF] key.

## How to measure OWN SHIP SPEED by using a fixed target

This method is used when there is no speed log or the speed data from speed log is including too many error.

- (1) Find a small(isolated) ground mass on the screen, such as small island, a lighthouse, the tip of a cape, etc. in 0.3 to 32 nm range.

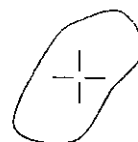
NOTE : The auto plotter calculates the own ship speed from the own ship's movement relative to the center of the target.

Unless the target presentation is stable or if its contour changes easily, correct speed can not be indicated.

Also, do not select a large ground mass or long coast line as a target.

(To be continued to the next page)

- (2) Move the "+" cursor onto the selected target by maneuvering the joystick or the track ball. →



- (3) Hit the [TARGET BASED SPEED] key.

- (4) Hit the [PLOT] key. → • A base target mark appears on the cursor crossing.

NOTE :

When the unit fails to acquire the target, the buzzer sounds. Do the operation from (1) again.



After the acquisition, the target is tracked, and the own ship speed is continually calculated.

• Own ship speed is presented.

Various kinds of data are presented based on this speed measurement.

Own Ship Speed relative  
to the target →

HEAD UP	
RANGE	
RINGS	
+	RNG
	BRG
→	REF 12.3KT

When the target is lost or it goes out of 0.2 to 32 nm range, the base target mark and the speed readout will blink. Do the operation from (1) again.

To cease tracking and speed calculation hit the [TARGET BASED SPEED] and [CANCEL] keys in that order.



How to enter OWN SHIP SPEED manually

(without using a fixed target)

If a speed log is not connected, "MAN" (manual) is indicated as shown right.

If the TARGET BASED SPEED is not measured, estimated own ship speed should be entered manually whenever ship's speed changes:

- (1) Hit the [MANUAL SPEED ENTER] key.

HEAD UP	
RANGE	
RINGS	
+	RNG
	BRG
→	MAN 0.0KT

- (2) By hitting the numeral/mark keys, enter the estimated ship's speed (or the one measured in the preceding step). Hit [10] to enter "0."

Example 1 : To enter 12.3 knots, hit [1], [2] and [3] in that order.

Example 2 : To enter 1.2 knots, hit [1] and [2] in that order.

Example 3 : To enter 10.0 knots, hit [1], [10] and [10] in that order.

(To be continued to the next page)



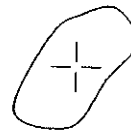
(3) Hit the [MANUAL SPEED ENTER] key.

HEAD UP  
RANGE  
RINGS  
+ { RNG  
BRG  
→ MAN 12.3KT

#### How to conduct TARGET ACQUISITION and display VECTOR

(Up to 10 targets may be acquired and tracked concurrently.)

- (1) Move the "+" cursor onto the center of the intended target by maneuvering the joystick or the track ball.



NOTE : Select a target within the 0.2 to 32nm range. The target must be distinctly presented without being masked by sea or rain clutter.

- (2) Select a track mark by hitting a numeral/mark key.

NOTE : Select an unused mark. If any numeral/mark key is not hit, an appropriate mark will be selected automatically.

- (3) Hit the [PLOT] key.---(a few seconds later)---

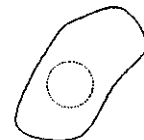
• The track mark appears on the target.

NOTE :

In the following cases, the buzzer sounds.  
Do the operation from (1).

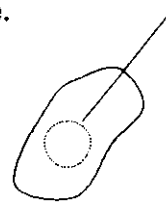
- Acquisition is unsuccessful.
- 10 targets are already acquired.
- The track mark is already used.

(1min.)

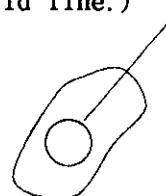


• Vector appears, but is not reliable.

(2min.)

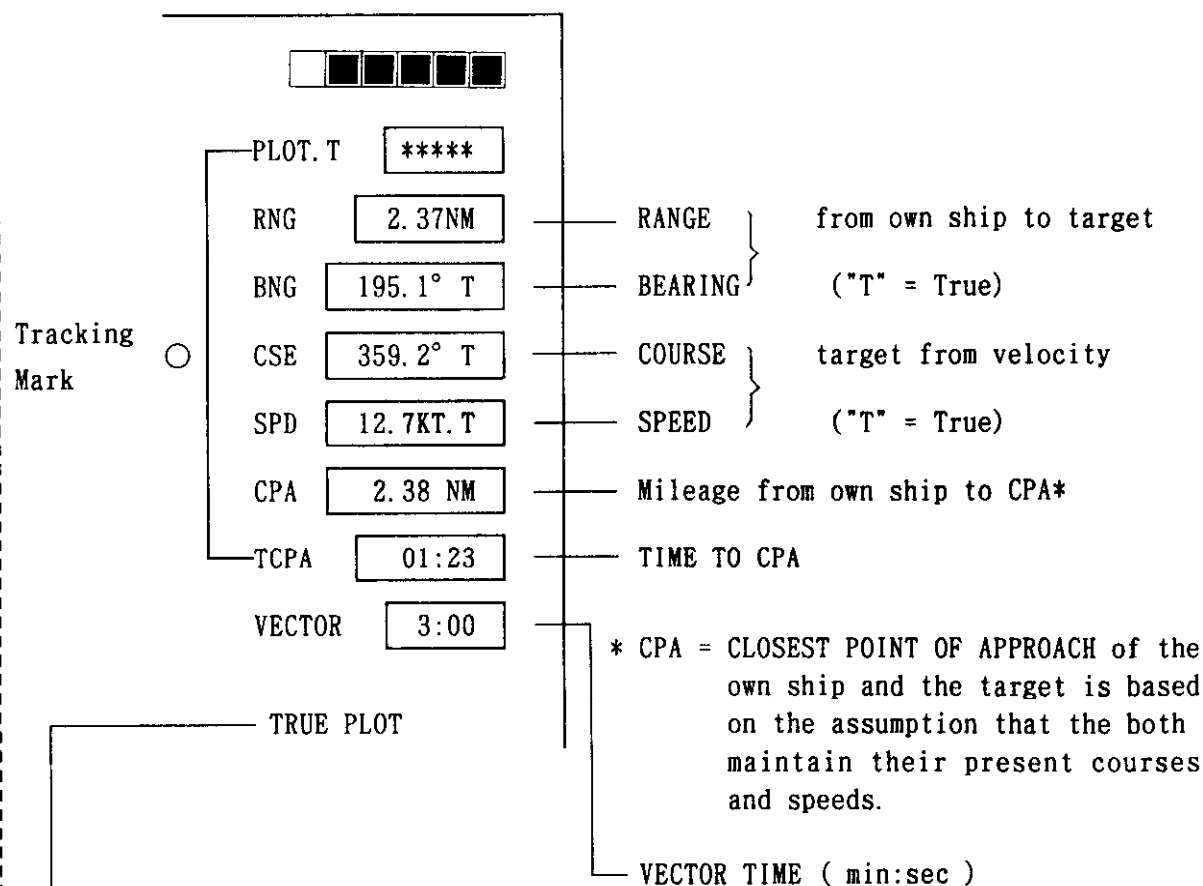


• Vector is reliable.  
(The mark is presented by solid line.)



When the target is acquired completely, target information is presented:  
(To be continued to the next page)

# Presented target information



"RELative PLOT" mode is available. See page AP2-8.

Press [VECTOR TIME] key while holding down [HM OFF] key.  
Each pressing of these two keys changes Relative Plotting and True Plotting alternately.  
Decision of the plotting mode is done according to the DIP SW setting when turning on the equipment..

In "Relative Plot" mode the vector indicates the target's velocity relative to the own ship velocity. (If the target is navigating exactly at the same speed and in the same course as the own ship, the relative velocity of the target is zero.)

(4) By hitting the [VECTOR TIME] key adjust the vector length.

The track mark/vector moves, tracking the target movement, and the vector length and direction changes accordingly.

NOTE : When the target is lost or it goes out of the 0.2 to 32nm range, the unit cease tracking after blinking the tracking mark and sounding the buzzer for 30 seconds. When the plotting is ceased, track mark, vector and history are erased.

(To be continued to the next page)

### How to call up TARGET INFORMATION

Hit the numeral/mark key of the intended target, and the target information is presented as shown on page 6.

### How to cease tracking

- (1) To delete a specific target from tracking, hit its numeral/mark key.  
(Hit the [ALL] key if you want to cease tracking all targets.)
- (2) Hit the [CANCEL] key.

↓

### How to present HISTORY

- (1) Hit the [HISTORY] key. - - - - - • Plotting interval is indicated.

#### NOTE :

UP to 5, 10, 20 or 50 dots may be plotted per target under tracking. See page AP2-8.



PLOT. T 0:30 (min:sec)

- Targets' track lines are plotted in dots.



- (2) Adjust the plotting interval by hitting the [HISTORY INTERVAL] key.

### How to cease the history presentation

- (3) Hit the [HISTORY] key.

NOTE : Targets' track lines (dots) are not presented, but plotting is conducted internally. When the [HISTORY] key is hit again, track lines appear instantly.

↓

To return to the normal radar mode operation, hit the [AUTO PLOT] key.

NOTE (1) Target tracking is continued in order to omit reacquiring operation next time.

- (2) You may use the manual plotting function.

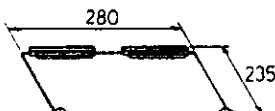
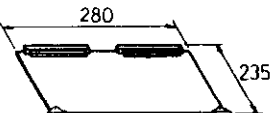

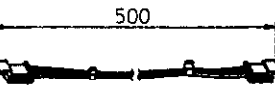
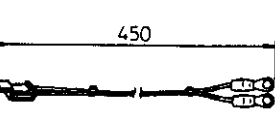
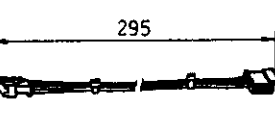
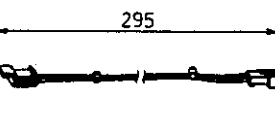


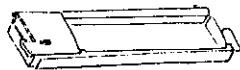
# SPECIFICATIONS OF ARP-2

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1. Functions
  - Calculation/indication of own ship speed relative to a fixed target.
  - Ship's Speed Entry
    - Auto (Speed log required)
    - Manual
  - Manual Target Acquisition/Automatic Tracking and Vector Presentation
  - Presentation of Target Information
    - Distance/bearing from own ship
    - Moving direction/speed
    - Distance/time to CPA (Closest Point of Approach)
  - History Presentation
2. Acquisition & Tracking
  - Manual Acquisition by using joystick/cursor
  - Max. Target Number : 10
  - Acquisition Range : 0.3 to 32 nm
  - Tracking Range : 0.2 to 32 nm
3. Vector
  - Vector Length : 30sec,  
1, 2, 3, 6, 10, 15, 30 min
  - Mode : True Velocity or Relative Velocity  
(selected by internal switch)
4. History
  - Plotting Interval : 15, 30 sec,  
1, 2, 3, 6, 10, 12 min
  - No. of Plotting Points : 5, 10, 20, 50 per target
5. Compatible Radar
  - FR-2000 Series  
(ARP-2 may be used with the range setting of 1.5 to 48 nm.)

# FURUNO

CODE No.		AP1-2
TYPE		

組込材料表 INCORPORATION MATERIALS		ARP-2 オートプロッタ AUTO PLOTTER			
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	プ リ ン ト 基 板 PC BOARD		AFE 03P7610	1	
			CODE No.		
2	プ リ ン ト 基 板 PC BOARD		ACPU 03P7611	1	
			CODE No.		
3	ROM ROM CHIPS			1 セット SET	
			CODE No.		
4	N H コネクター組品 NH CONNECTOR ASSY.		03-1124 (4-4P)	1	4P-4P
			CODE No.		
5	N H コネクター組品 NH CONNECTOR ASSY.		03-1125 (3P)	1	3P-2P
			CODE No.		
6	NH-SM コネクター組品 NH-SM CONNECTOR ASSY.		03-1126 (3-R3P)	1	3P-3P
			CODE No.		
7	NH-SM コネクター組品 NH-SM CONNECTOR ASSY.		03P1127 (6-R6P)	1	6P-6P
			CODE No.		
8	SMコネクターハウジング SM CONNECTOR HOUSING		SMP-03V-BC	1	
			CODE No.		
9	SMコネクターハウジング SM CONNECTOR HOUSING		SMP-06V-BC	1	
			CODE No.		
10	P A B パネル組品 PAB PANEL ASSY.			1	
			CODE No.		
			図 番 DWG. No.		
			検 査 CHECKED		

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# FURUNO

CODE No.		AP1-3
TYPE		


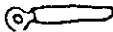




組 込 材 料 表 INCORPORATION MATERIALS		ARP-2 AUTO PLOTTER		オートプロッタ	
番号 No.	名 称 N A M E	略 図 OUTLINE	型 名 / 規 格 DESCRIPTIONS	数 量 Q'TY	用 途 / 備 考 R E M A R K S
11	PAB盲パネル (L) PAB PANEL SEAL (L)		03-026-1289	1	
12	コーティングクリップ CLIP		VJR-3	1	
13	圧 着 端 子 CRIMP-ON LUG		FV2-M3	2	
14	士ナベセムスネジ B PAN HEAD SCREW		M3x10 C2700W MBNI 2	8	
15	カーレントデテクター CURRENT DETECTOR		SCD4A 13-3-5002	1	
16	スライドスイッチ SLIDE SWITCH		ESD-14/52	1	
			CODE No.		

図 番  
DWG. No.

検 図  
CHECKED

FURUNO ELECTRIC CO., LTD.

# INSTALLATION

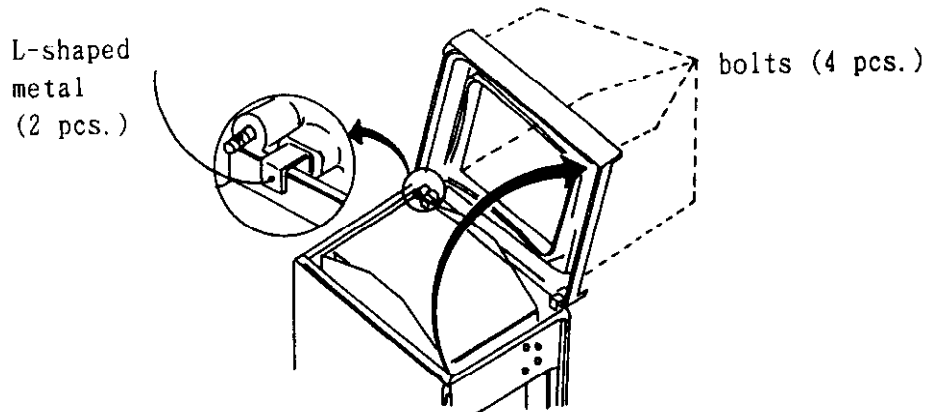
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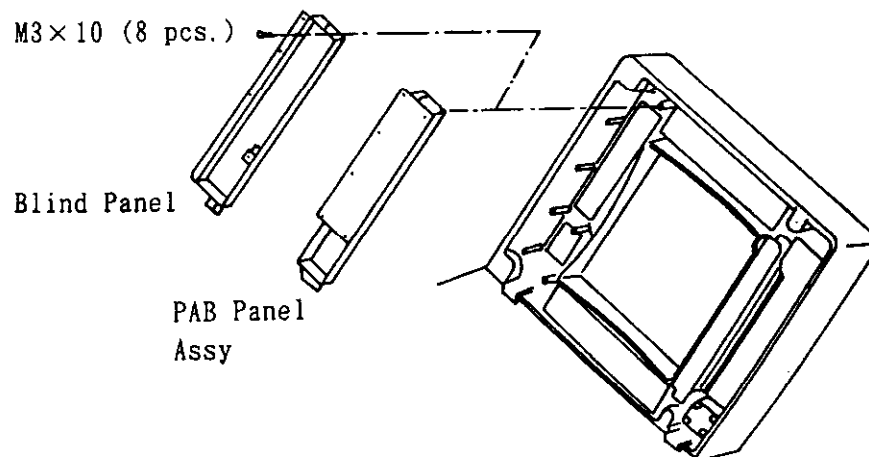
## Incorporating the Keyboard

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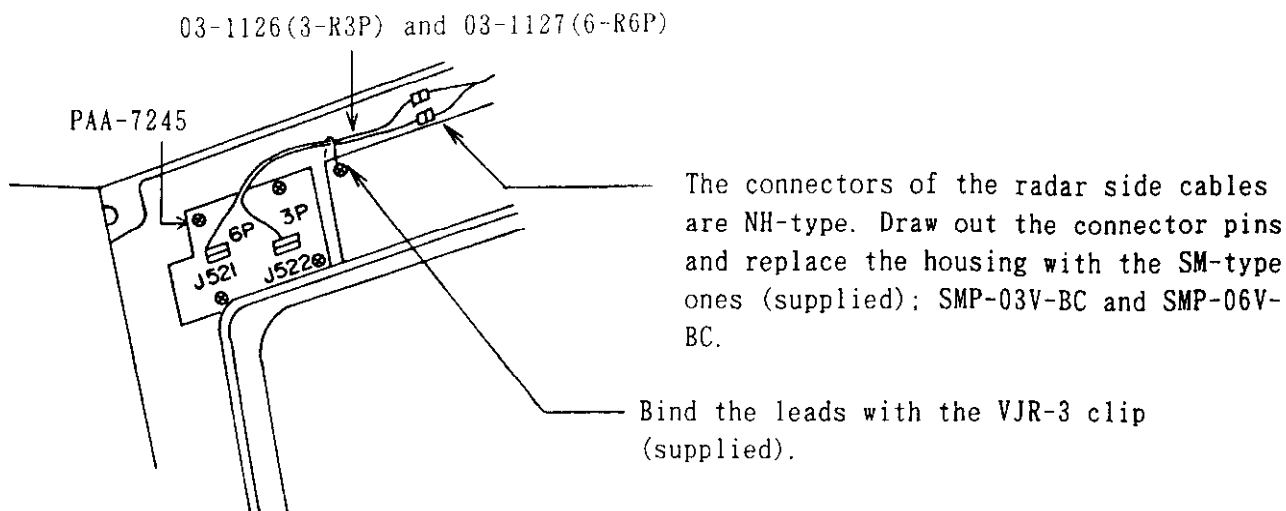
- (1) After loosening the four bolts (shown below), open the control panel. (Hang the L-shaped metals of the panel onto the edge of the display chassis as shown below.)



- (2) After loosening the eight screws (shown below), remove the blind panel, and install the PAB Panel Assembly (supplied) instead.

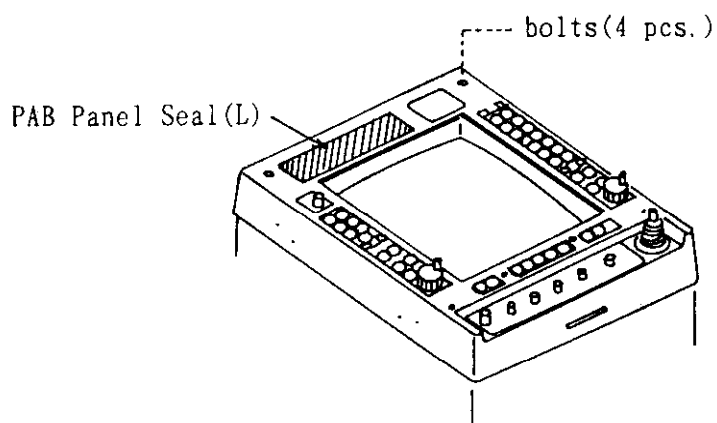


- (3) Connect the ARP-2 panel (PAA-7245) to the cable arranged inside the control panel of the radar as shown at the top of the next page, using the two pcs. of NH-SM connector (cable) assemblies supplied; 03-1126(3-R3P) and 03-1127(6-R6P).



(4) Close the control panel, and fasten the bolts.

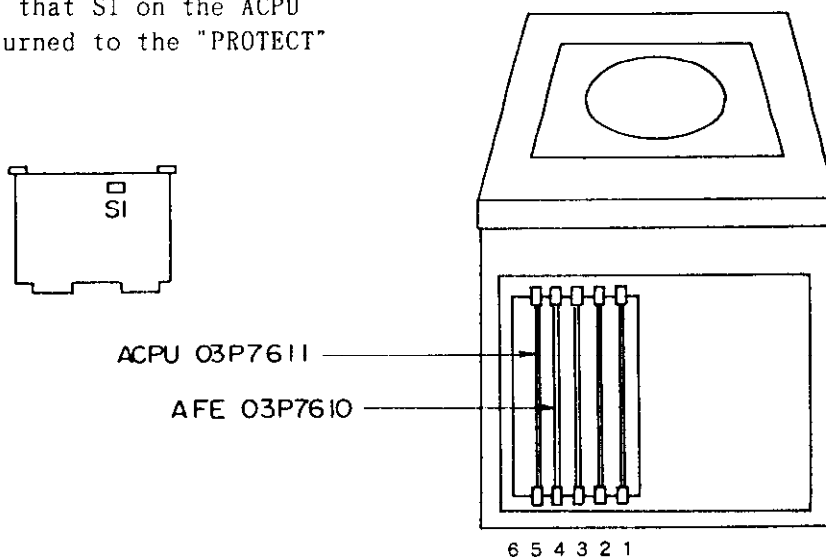
If the radar plotter RP-2 is not incorporated on the hatched part shown below, stick the PAB panel seal (L) 03-026-1289 there.



## Incorporating Auto Plotter PCB's

(1) After loosening the eight screws, open the radar console as shown below. Insert the ACPU 03P7611 and AFE 03P7610 boards into the pc board cage.

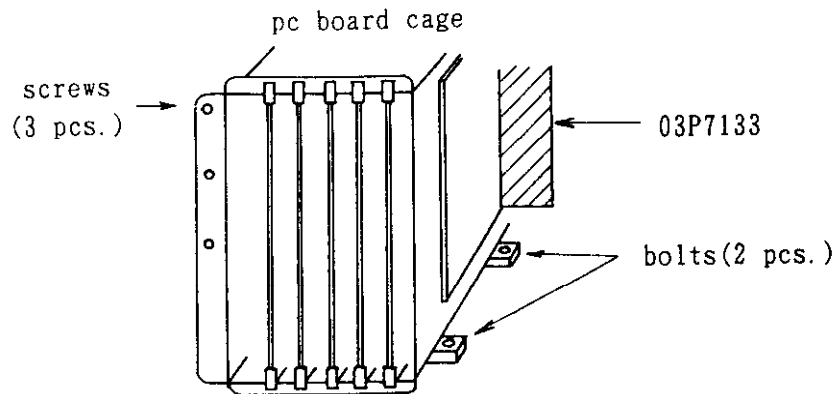
NOTE : Be certain that S1 on the ACPU board is turned to the "PROTECT" side.



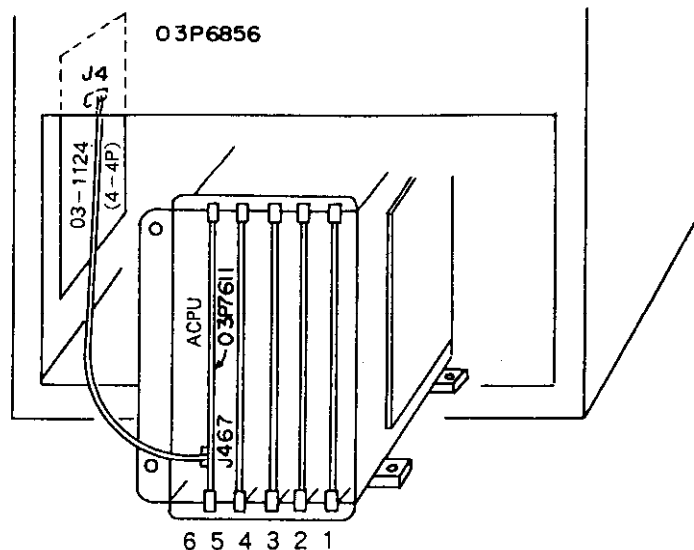


(2) Connection to Gyro Interface 03P6856

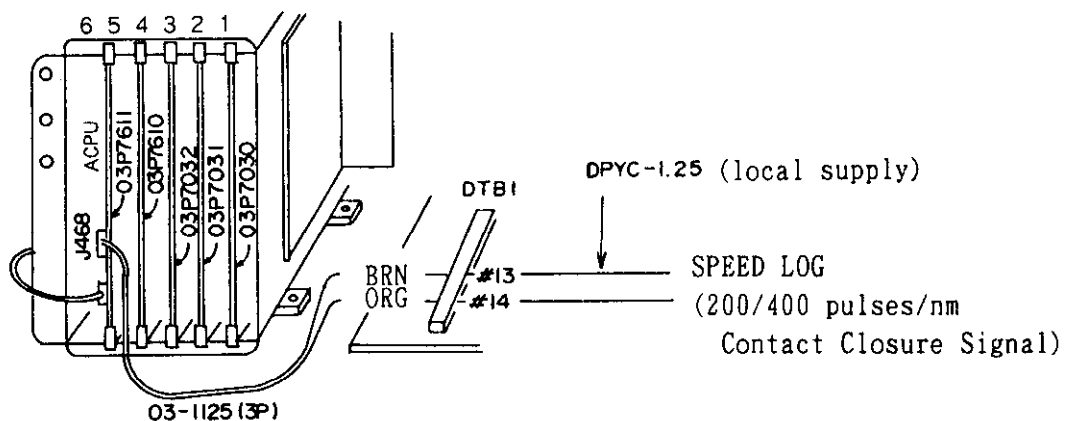
- a. After loosening the two bolts and three screws (shown below) and unplugging all the connectors (11 pcs.) on the 03P7133 board, draw out the pc board cage.



- b. Connect the ACPU board (J467) to the 03P6856 gyro interface (J4) by using the NH-connector (cable) assembly 03-1124(4-4P) supplied.



- c. Reinstall the pc board cage, and reconnect the cables to the 03P7133 board.
- (3) Connect the ACPU 03P7611 board (J468) to the DTB-1 terminal board as shown below by using the NH-connector (cable) assembly 03-1125(3P) supplied. Also, connect a speed log if available.

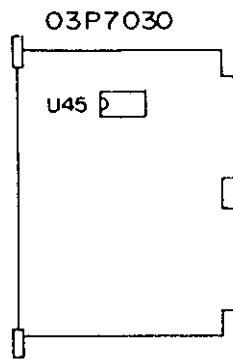


NOTE: If DTBI #13 and #14 are connected to the mother board at the factory, remove the leads from DTBI #13/14. Insulate the lead tips (crimp-on lugs) with vinyl tape.

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## Replacing ROM Chips

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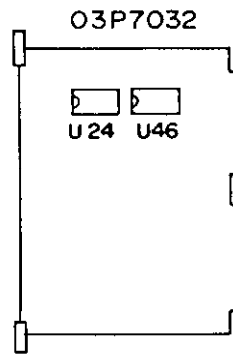


Program No.

U45: 03572041 \* \*  
(Cursor Gyro Presentation  
supported.)

or

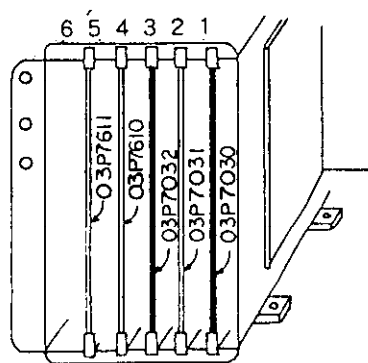
03574001 \* \*  
(Cursor Gyro Presentation  
not supported.)



Program No.

U24: 03572111 \* \*  
U46: 03572112 \* \*

\* \* : Version No.



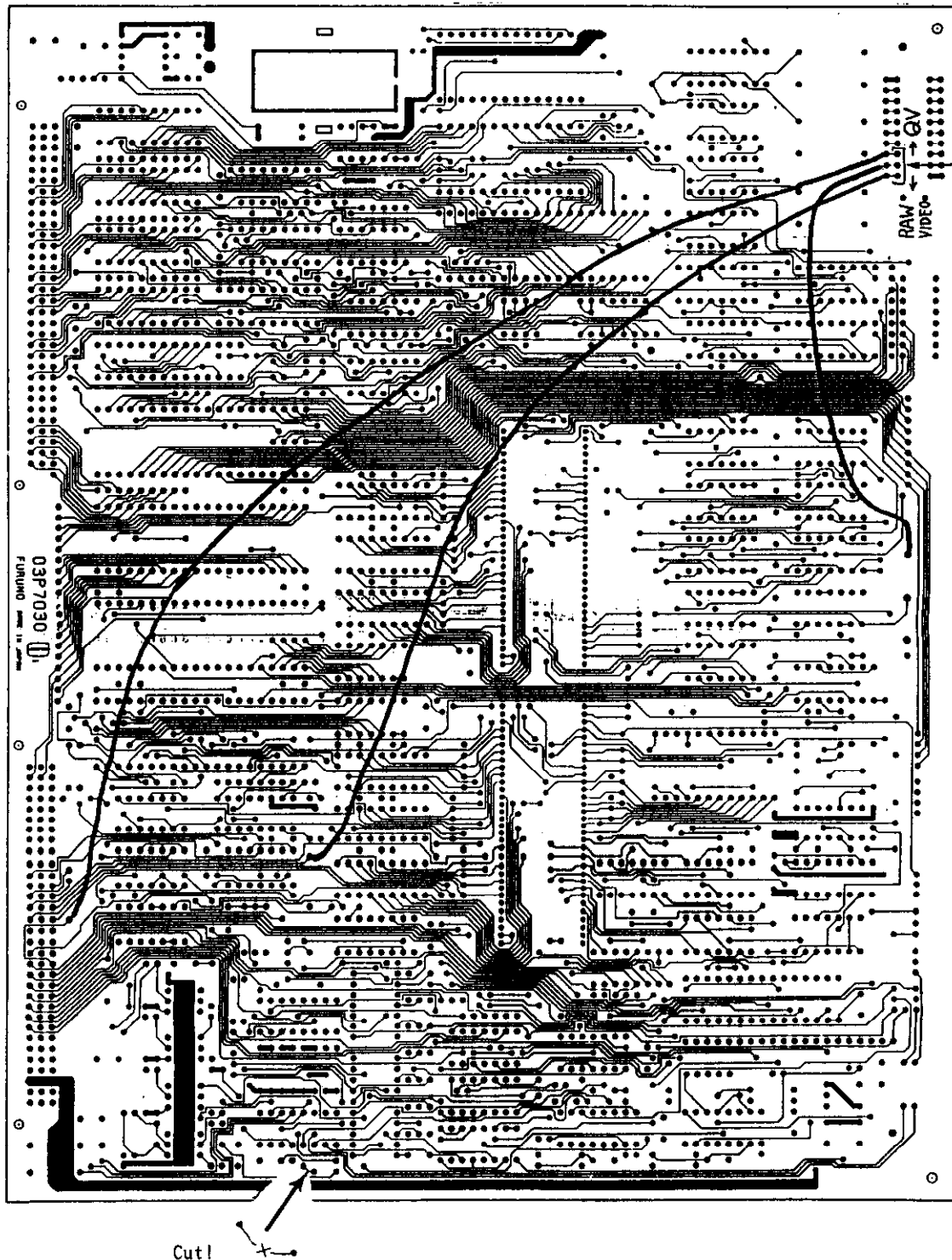
# Modifing 03P7030 Board

If the board level is -33 and above,  
this modification is not necessary.

Add the following modifications.

- (1) Mount the slide switch (supplied).
- (2) Connect three pcs. of jumper leads.
- (3) Cut the copper foil pattern (one point only).

The slide switch selects  
QV(Quantized Video) or  
RAW VIDEO mode. Usually  
use RAW VIDEO mode.



# Changing the Overcurrent Protection Threshold

If the RP-2 Radar Plotter is already incorporated and the serial number of the display unit is one of the followings, this modification is not required.

## FACTORY-MODIFIED SETS

<u>Set</u>	<u>Serial Number</u>
FR-2010 .....	348-0246 and after
FR-2020 .....	349-0072 " "
FR-2050X .....	2306-0014 " "
FR-2030S .....	2304-0013 " "
FR-2060S .....	2305-0012 " "

The following sets have also been factory-modified.

FR-2010 (348-0173 to 0175, 0201 to 0208, 0230 to 0234, 0238, 0239)  
FR-2020 (349-0028, 0052, 0061, 0065 to 0067, 0069, 0070)  
FR-2050X (2306-0011, 0012)

## AC Power Specification

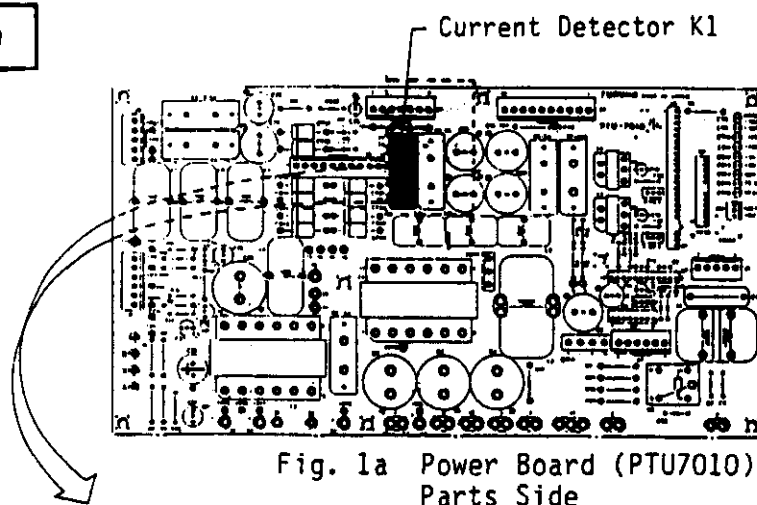


Fig. 1a Power Board (PTU7010),  
Parts Side

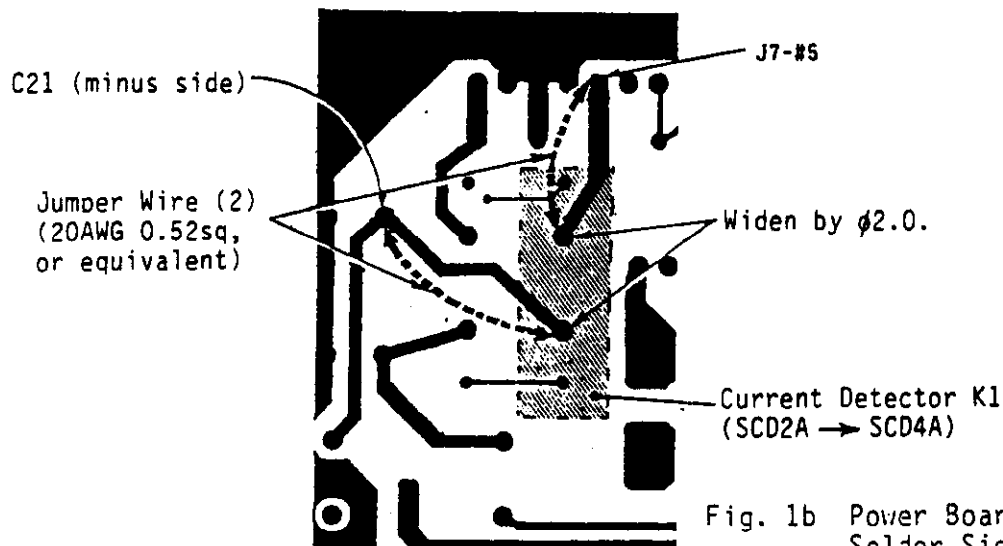


Fig. 1b Power Board (PTU7010),  
Solder Side

1. Remove current detector K1 from the PTU7010 Power Board.
2. Widen by  $\phi 2.0$  the two thru holes where K1 was fixed.
3. Solder the new current detector to the board.
4. Add two jumper wires as shown above.

# DC Power Specification

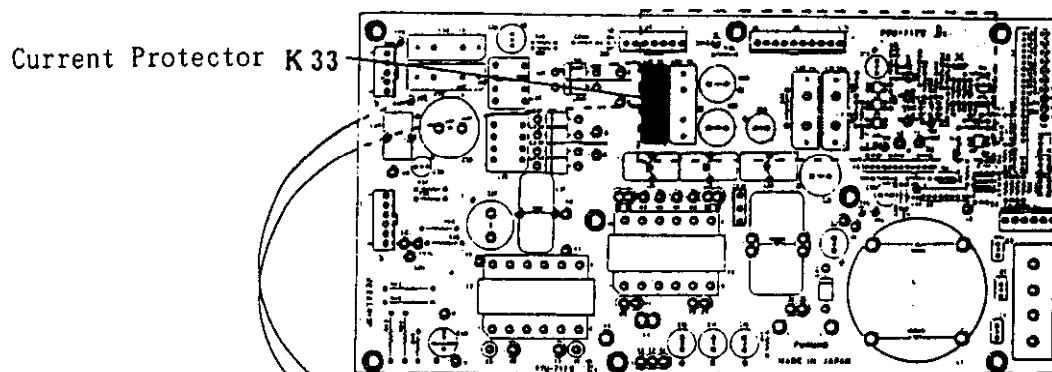


Fig. 2a Power Board (PTU7179),  
Parts Side

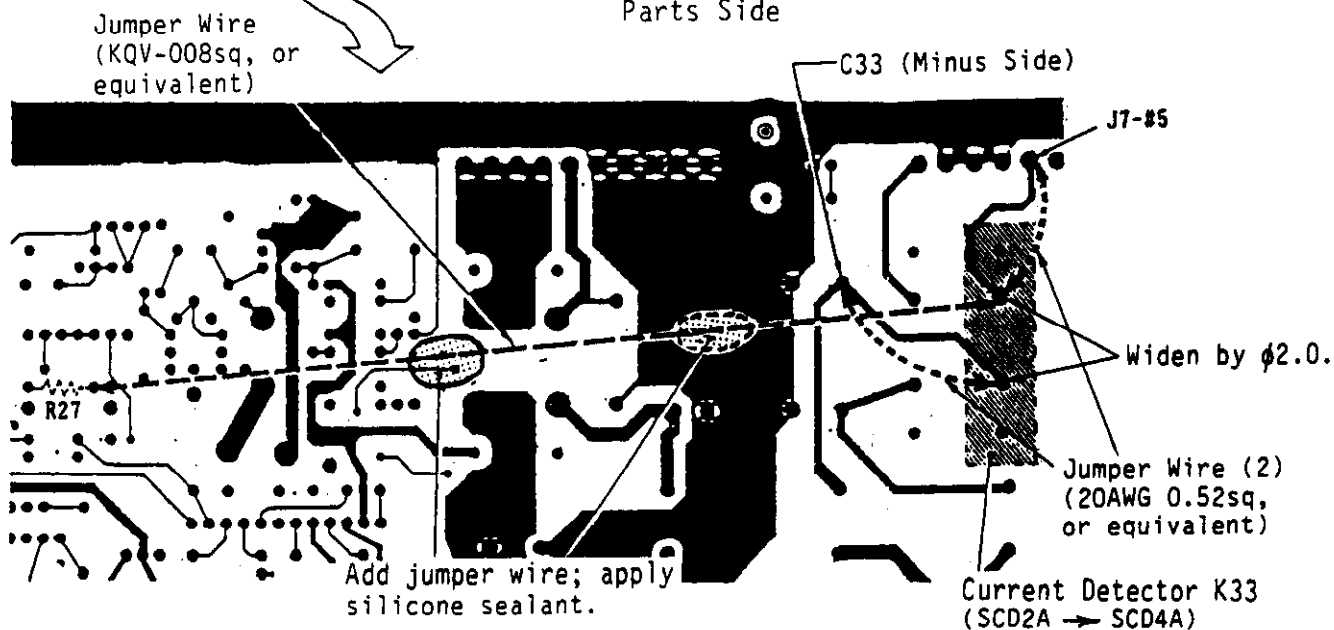
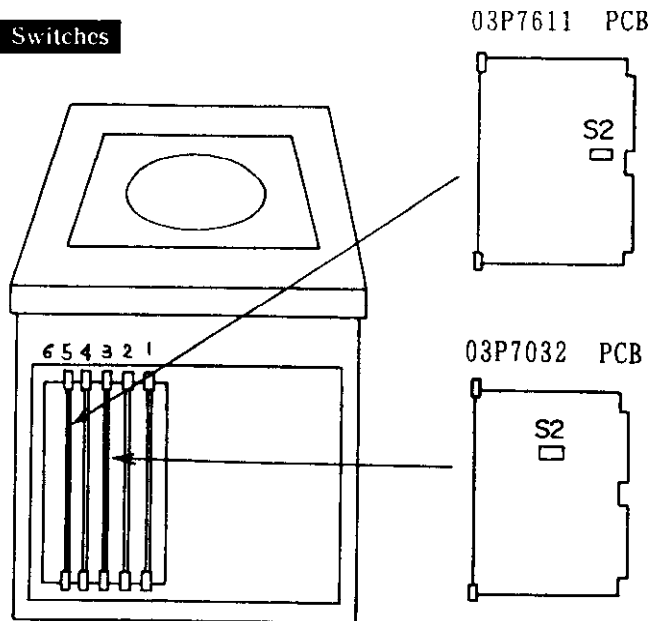


Fig. 2b Power Board (PTU7179),  
Solder Side

1. Remove current detector K33 from the PTU7179 Power Board.
2. Widen by  $\phi 2.0$  the two thru holes where K33 was fixed.
3. Solder the new current detector to the board.
4. Add three jumpers as shown above.
5. Apply silicone sealant as illustrated above.

# Adjustment

## Tailoring DIP Switches



[03P7632 Board] \* : Factory Setting

S2 #1 \* OFF : Automatic Ship's Speed Entry ( from Speed Log )  
ON : Manual Ship's Speed Entry ( from Keyboard )

#2 \* OFF : True Speed Vector

The vector indicates the absolute velocity (relative to ground). It is not influenced by the own ship velocity.

ON : Relative Speed Vector

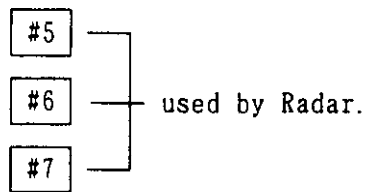
Vector indicates the velocity relative to the own ship velocity. It is influenced by the own ship velocity. If the target is navigating exactly at the same speed and on the same course as the own ship, the vector length is zero. Also, the target's track line (dots) does not extend.

#3 \* OFF    ON    OFF    ON

#4 \* OFF    OFF    ON    ON

|       |       |       |  
5     10    20    50 --- Plotting Points Per Target

(When many points are present on the screen, it takes longer for the unit to repaint the picture.)



[03P7611 Board] \* : Factory Setting

S2 #1 thru #6 : Not used.

#7 ON \* OFF

#8 ON \* ON

400 200 --- Pulses Per Mile ( Speed Log's Pulse Rate )

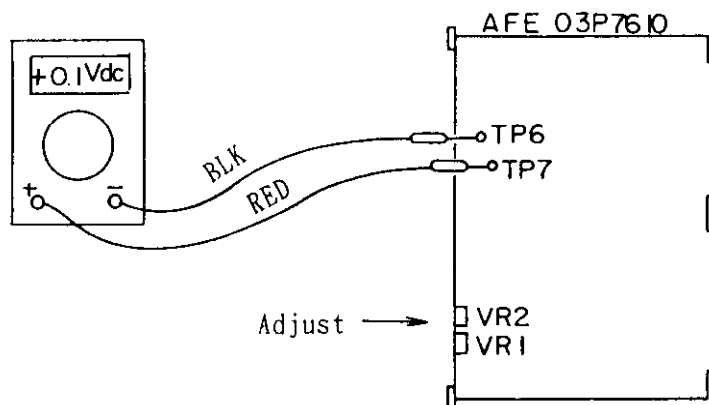
## Adjusting AD Conversion Threshold Level

The following adjustment should be done with the 12-mile range selected.

### Threshold Level with Minimum Gain

Conditions : [A/C RAIN] ----- fully ccw  
              [A/C SEA] ----- fully ccw  
              [GAIN] ----- fully ccw

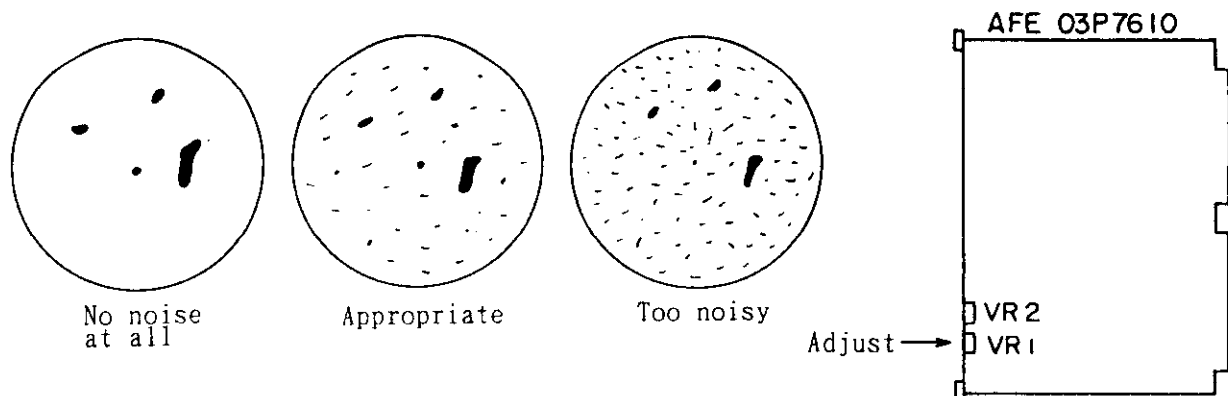
Adjustment : Connect a digital multimeter to TP6 and TP7 as shown below, and adjust VR2 for +0.1Vdc readout.



### Threshold Level with Maximum Gain

Conditions : [A/C RAIN] ----- fully ccw  
              [A/C SEA] ----- fully ccw  
              [GAIN] ----- fully cw  
              [INT REJECT] --- off

- (1) Slide the switch which was mounted on the 03P7030 board on page AP2-5 to the "QV" side.
- (2) Adjust VR1 on the 03P7610 board so that random noises somewhat appear on the screen.



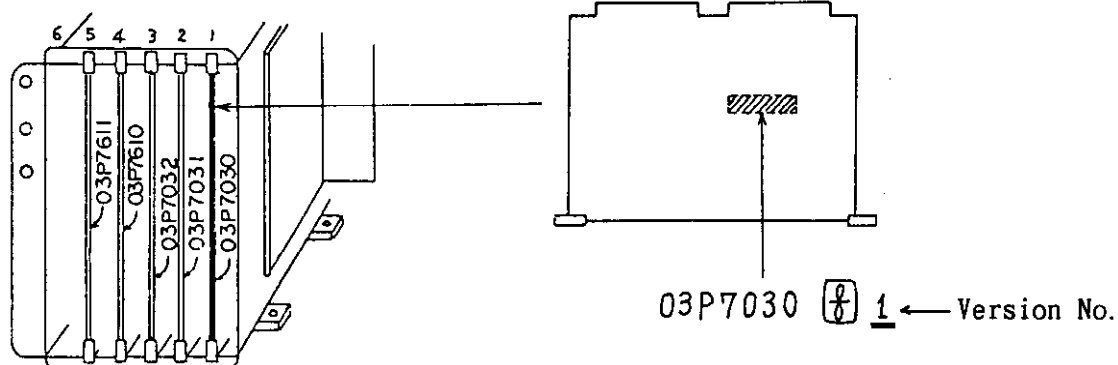
NOTE : Do not reduce noises excessively.  
A little noisy condition is preferable.

- (3) Return the slide switch setting from "QV" to "RAW VIDEO."



## Adjusting Track-mark/Vector Presentation Timing

This adjustment is usually not required. If tracking mark and vector positions are deviated from an echo, align them as follows. Note that the adjustment procedure varies depending on the version number of the AD Board, 03P7030.



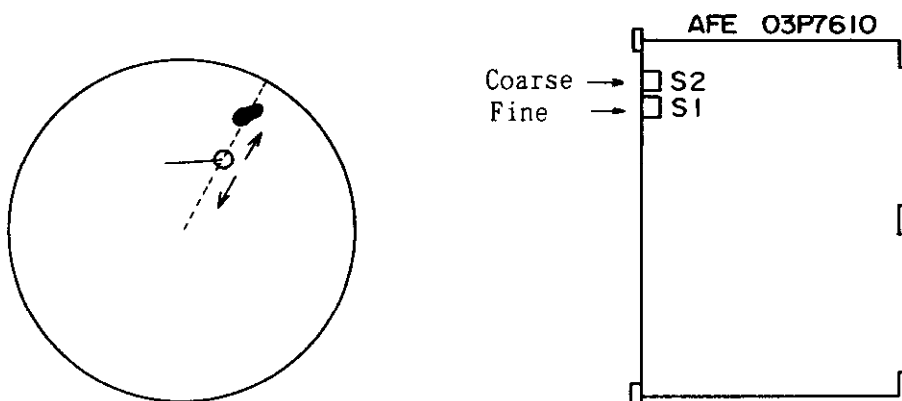
### Adjustment for Ver.1

Position the track mark on the center of the target echo:

- (1) Select the 6-mile range, and find a target of which size is similar or smaller than the track mark in 3 to 5-mile range.
- (2) Adjust the mark/vector position by S1 and S2 on the AFE 03P7610 board.

### NOTE

1. S2 and S1 are for coarse and fine adjustments, respectively.  
When S2 or S1 is turned cw, mark/vector moves toward the own ship position v.v. The mark/vector can not be moved outward of the target echo.



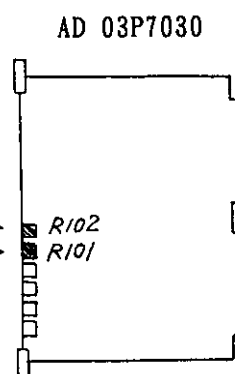
2. Response to S2/S1 adjustment is slow due to smoothing processing by software. The mark/vector will change their positions about 30 seconds later after adjusting the switches.
3. Do not set both S2 and S1 fully ccw.

Adjustment for Ver.3 and after (Ver.2 does not exist.)

- (1) Fix S1 and S2 on the AFE 03P7610 board (illustrated on the preceding page) in the following positions.  
S 1 = "1"      S 2 = "0"
- (2) Select the 6-mile range, and find a target in 3 to 5-mile range of which the size is similar or smaller than the track mark.
- (3) Adjust the mark/vector position by R101(ARP-M) or R102(ARP-S) which are provided on the AD 03P7030 board.

For the Slave Mode display,  
adjust R102.

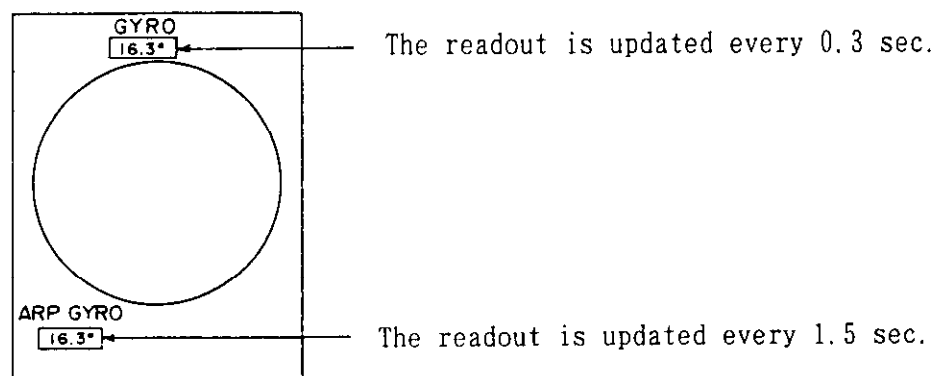
For the Master Mode display,  
adjust R101.



[NOTE] The mark/vector change their positions about 30 seconds later when R101 or R102 is adjusted.

**Checking Gyro Data Entry into ARP-2**

Turn on the radar, hit the [AUTO PLOT] key, and check the "ARP GYRO" readout while the radar is in stand-by condition.





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