Prod.
NAV.
5.1

No. : OM-E3028-0A

FURUNO

OPERATOR'S MANUAL

AUTO PLOTTER

MODEL ARP-4

FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

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 precipitaion. 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.

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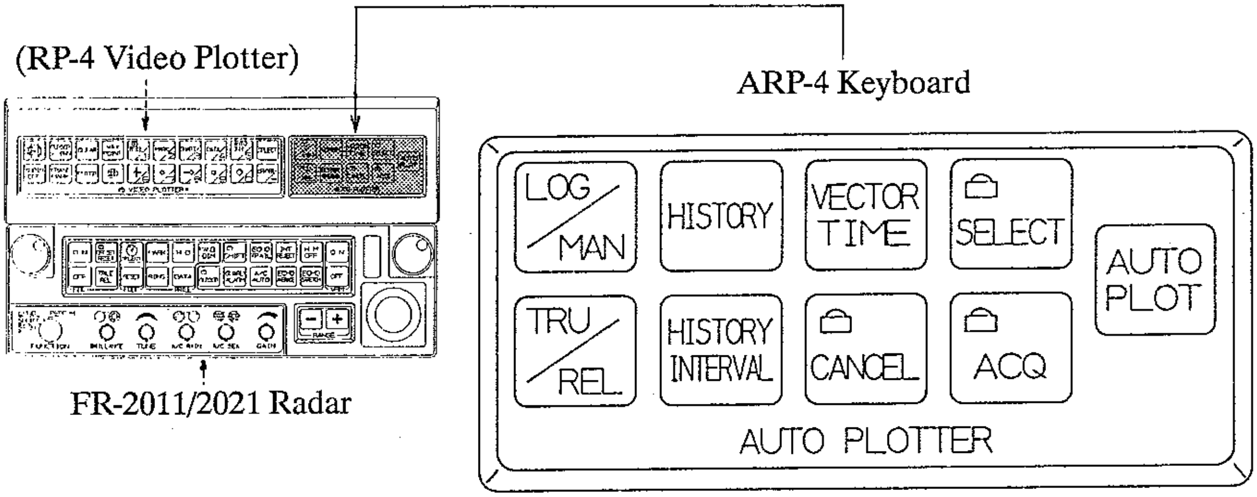
OPERATION

Control Panel Layout


(RP-4 Video Plotter)
ARP-4 Keyboard
FR-2011/2021 Radar
LOG MAN
HISTORY
VECTOR TIME
SELECT
AUTO PLOT
TRU REL
HISTORY INTERVAL
CANCEL
ACQ
AUTO PLOTTER

[AUTO PLOT] key

This key turns the auto-plot presentation on and off.

[ACQ] key

This key is used to acquire a target. The target acquired is automatically tracked, and its status, vector, and history (track line) may be presented. Up to 10 targets may be tracked concurrently.

[CANCEL] key

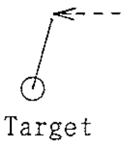
If you want to cease tracking a target, move the " + " cursor onto it, then press this key.

[VECTOR TIME] key

Target velocity is presented as a line segment (called a vector), 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 unit period (e.g. speed) is shown by length. The "unit period" changes in the following sequence at every hit of this key.

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

Example: Vector Time = 10 min.



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

[TRU/REL] key

Every press of this key switches the vector presentation between the true and relative modes.

True Velocity Vector

The true velocity vector indicates target velocity relative to the ground.

Relative Velocity Vector

The relative velocity vector indicates target velocity relative to the own ship, i.e. it tells you how fast and from what direction the target is approaching your ship. The relative velocity vector is influenced by the own ship velocity; if the own ship is moving in parallel with the target at the same speed, the vector length is zero because the relative velocity is zero.

In relative vector mode, all stationary targets are shown with vectors equivalent to own ship's speed on a reciprocal course to actual own ship's course.

[HISTORY] key

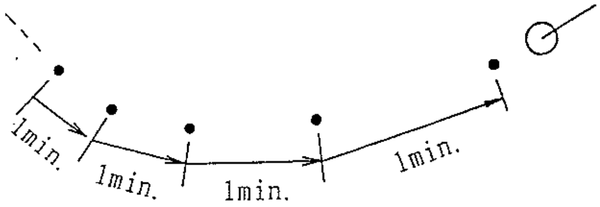
This key turns the target history display on and off. The target history display presents equally time-spaced dots marking the post positions of any targets being tracked.

[HISTORY INTERVAL] key

This key selects a plotting interval. Each time the key is pressed the interval changes in the following sequence:

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

Example: History Interval = 1 min.



You can know from the above picture that the target has increased speed since the distance between dots has increased. On the contrary, if the distance has decreased, the target is slowing down.

[LOG/MAN]

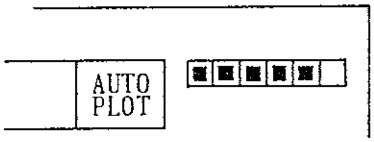
The auto plotter requires ship's speed information to track targets. This key selects the information source between a speed log and a manually entered value.

Start-up & Ship's Speed Entry Procedures

Select a radar range from 1.5 to 48 nm. Adjust the [A/C RAIN], [A/C SEA] controls, etc. for the best target presentation.

NOTE: If you select a range outside the above limit when the auto-plotter is on, the indication "AUTO PLOT" (shown below) is highlighted to alert you.

Hit the [AUTO PLOT] key, and "AUTO PLOT" appears as illustrated right.



The auto plotter requires SHIP'S SPEED information to track targets. Enter it by one of the following methods:

Automatic speed data entry by using a FIXED TARGET

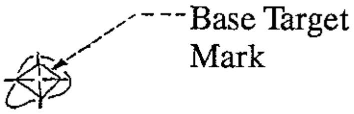
CAUTION: This method is usually less accurate than by a speed log.

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

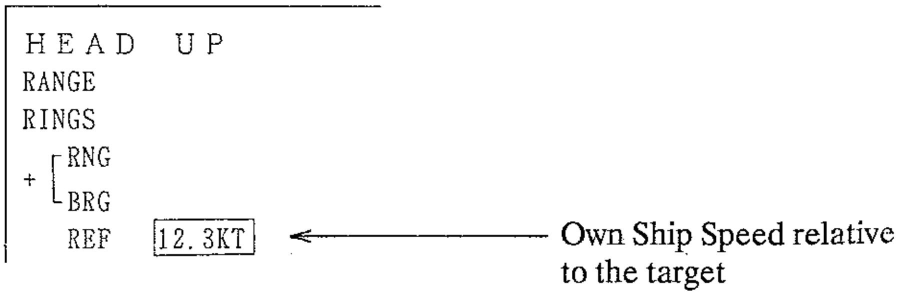
NOTE: The auto plotter calculates the own ship speed from the own ship's movement relative to the center part of the target image. Unless the target presentation is stable, correct speed is not obtainable. Also, a large ground mass or a long coast line is not suitable.

(2) Move the "+" cursor onto the selected target by maneuvering the trackball. ------------------------------>

(3) Hold down the [ACQ] key until a base target mark appears on the cursor crossing as illustrated right. --->



The auto plotter tracks the acquired target and calculates/presents own ship's speed as shown below.

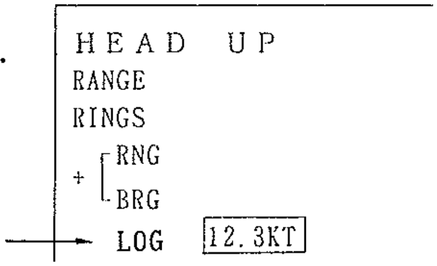


To cease tracking, move the "+" cursor onto base target mark "-◇-", then press the [CANCEL] key. The previously used mode, LOG or MAN, explained later on, is restored.

NOTE: When the target is lost or goes out of the 0.3 to 32 nm range, the base target mark -◇- and speed reading blink. Cease tracking by the above method, then acquire it again.

Automatic speed data entry from a SPEED LOG

If a speed log is connected and "LOG" appears on the screen as shown right, speed data is entered automatically. If "LOG" is not presented, do the following:



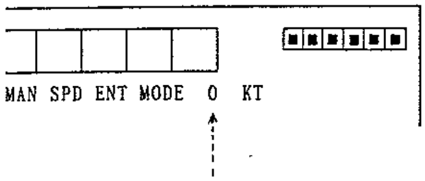
- If "REF" is presented instead of "LOG", cease tracking the base target.

- If "MAN" is presented instead of "LOG", call up the "LOG" mode by pressing the [LOG/MAN] key. (Do not hold down the key longer than two seconds when switching the mode between LOG and MAN.)

Manual speed data entry

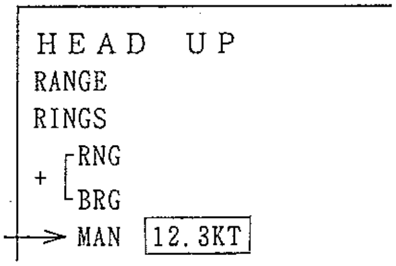
(1) If "REF" is presented, cease tracking the base target. If not proceed to the next step.

(2) Hold down the [LOG/MAN] key until the speed entry prompt appears as illustrated at right.



(3) By turning the VRM knob, adjust the speed reading (KT) on the prompt line.

(4) Press the [LOG/MAN] key to enter ship's speed.



NOTE 1. Reenter ship's speed whenever it is changed.

2. Every press of [LOG/MAN] key switches between the MANual and LOG modes. (Do not hold down the key longer than two seconds when switching the mode between LOG and MAN.)

This concludes the start-up operation for the auto plotter.

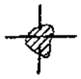
If you want to turn the auto plotter presentation off, press the [AUTO PLOT] key.

NOTE: Although the auto plotter presentation is erased, tracking is continued internally in order to omit target reacquisition the next time the auto plotter is turned on.

Target Acquisition & Tracking

Up to ten targets may be acquired/tracked concurrently. If ten targets are already acquired/tracked when you try to acquire a target, the auto plotter beeps several times to alert you. To acquire the target, cease tracking on an unimportant target. More details later.

(1) Move the " + " cursor onto the center of the intended target by maneuvering the trackball.----------------------->



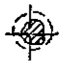
NOTE: Select a target within the 0.3 to 32 nm range. The target must be distinctly presented without being masked by sea or rain clutter.

(2) Press the [ACQ] key.

NOTE: Do not hold down the key longer than two seconds because it acquires the target as a Base Target for ship's speed measurement.

(A moment later)

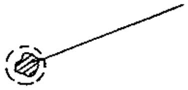
A track mark (broken line) appears on the cursor crossing.



NOTE: Different marks are assigned to each target automatically.

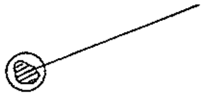
(One minute later)

A vector appears, but is not reliable.

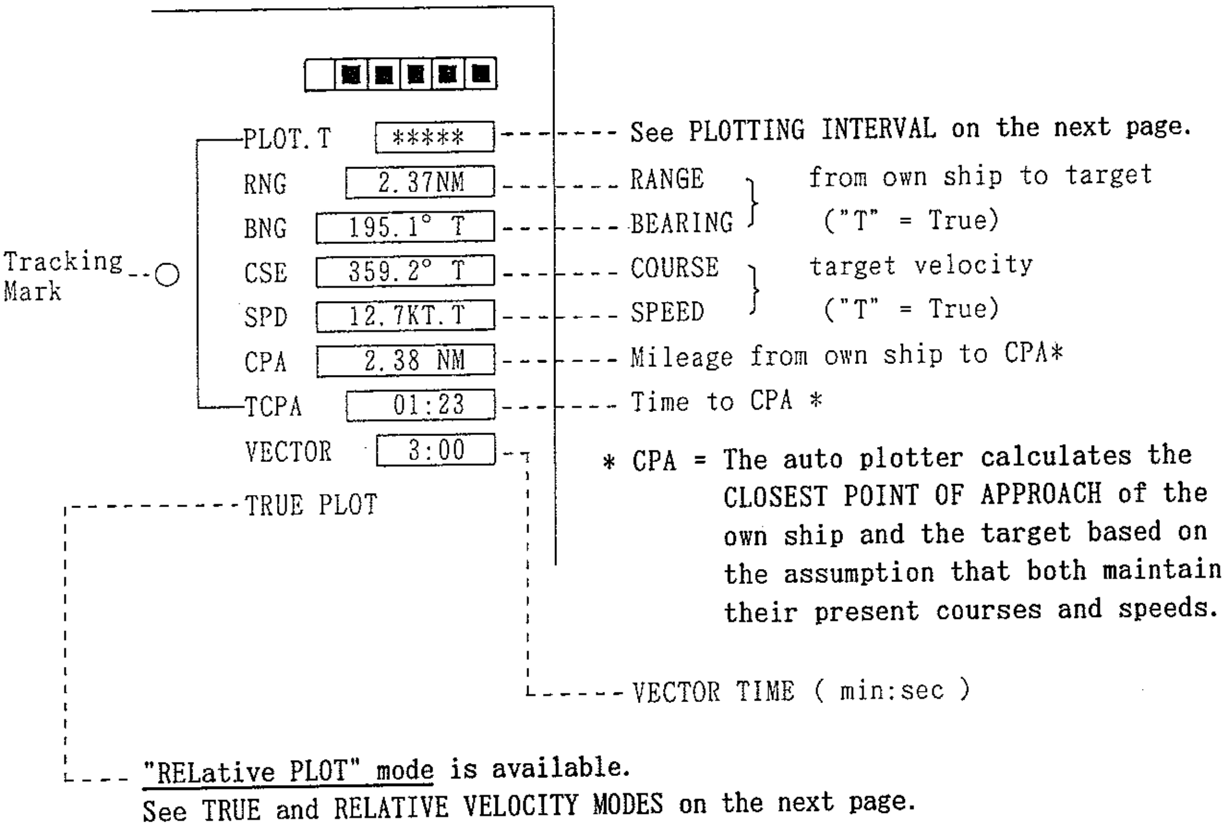


(About 2 minutes later)

The track mark becomes a solid line, indicating that the target was acquired successfully and is being tracked. Full vector accuracy is achieved.



When a target is acquired, its status is presented as illustrated below.



See PLOTTING INTERVAL on the next page.

RANGE, BEARING: from own ship to target ("T" = True)

COURSE, SPEED: target velocity ("T" = True)

Mileage from own ship to CPA*

Time to CPA *

* CPA = The auto plotter calculates the CLOSEST POINT OF APPROACH of the own ship and the target based on the assumption that both maintain their present courses and speeds.

VECTOR TIME (min:sec)

"RELative PLOT" mode is available.
See TRUE and RELATIVE VELOCITY MODES on the next page.

NOTE: When a target is lost or it goes out of the 0.2 to 32 nm range, the unit no longer tracks it; the track mark blinks, then disappears.

How to terminate tracking

(1) Move the cursor crossing onto the center part of the track mark by maneuvering the trackball.

(2) Press the [CANCEL] key. (Do not hold it down longer than two seconds.)

NOTE: To terminate tracking of all targets, hold down the [CANCEL] key until all the track marks/vectors disappear.

Target Status/Vector/History Presentations

Target Status

(1) Move the cursor crossing onto the center part of the track mark by maneuvering the trackball.

(2) Press the [SELECT] key, and the target status is presented as illustrated on the preceding page.

NOTE: When a new target is acquired, its status is presented automatically.

Vector

A speed vector is presented on each tracked target.

- The VECTOR LENGTH may be changed in eight steps by pressing the [VECTOR TIME] key.
- Every press of the [TRU/REL] key selects TRUE and RELATIVE VELOCITY MODES alternately.

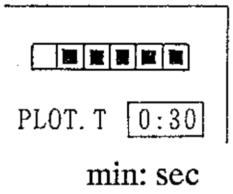
NOTE: For the "N-type" (Dutch Version) radar, the target velocity readings (CSE & SPD) are also switched between the true and relative modes.

The vector time and mode in use are displayed on the bottom part of the target status presentation.

History

Every press of the [HISTORY] key turns on and off the history presentation alternately.

The PLOTTING INTERVAL for the track line (history) may be changed in eight steps by pressing the [HISTORY INTERVAL] key. The plotting interval in use is presented as illustrated right.



SPECIFICATIONS OF ARP-4

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 trackball/cursor
- Max. Target Number : 10
- Acquisition Range : 0.3 to 32 nm
- Tracking Range : 0.2 to 32 nm

3. Vector

- Vector Length : 30 sec,
  1, 2, 3, 6, 10, 15, 30 min
- Mode: True Velocity or Relative Velocity

4. History

- Plotting Interval : 15, 30 sec,
  1, 2, 3, 6, 10, 12 min
- No. of Plotting Points: 5, 10, 20, 50 per target
  (Selected by internal switch)

5. Compatible Radar

- FR-2011/2021
  (ARP-4 may be used with the radar range setting of 1.5 to 48 nm.)

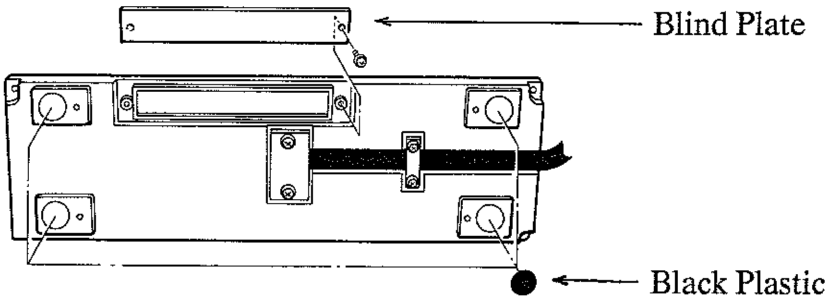
INSTALLATION

* * * * * * * * * * *

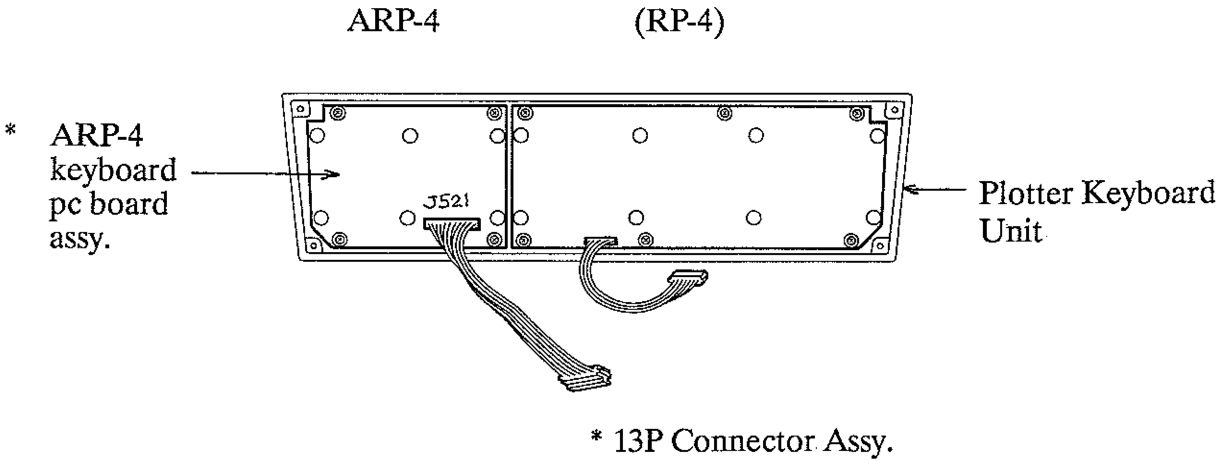
This chapter provides information necessary for installation of the ARP-4. The items marked with an asterisk are included in the ARP-4 installation kit.

Installing the plotter keyboard

(1) Remove the 4 pcs of black plastic from the bottom of the radar keyboard unit. Remove the blind plate, too.

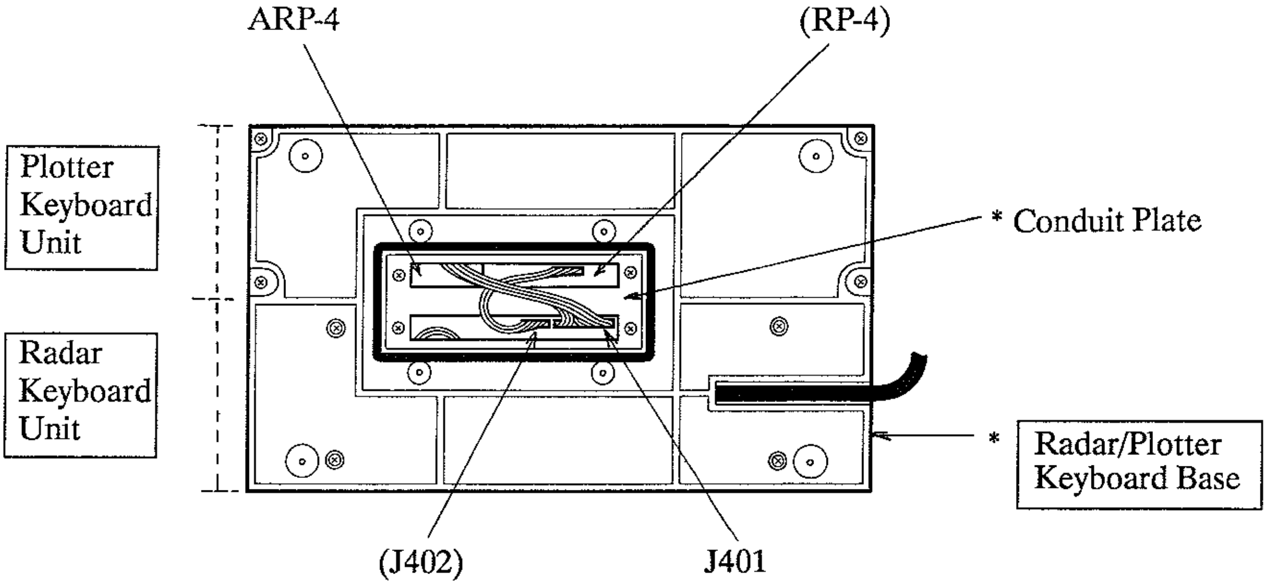

Blind Plate
Black Plastic

(2) Replace the blind panel on the plotter keyboard unit with the ARP-4 keyboard/pc board assembly. Plug the 13P connector assembly into J521 as illustrated below.

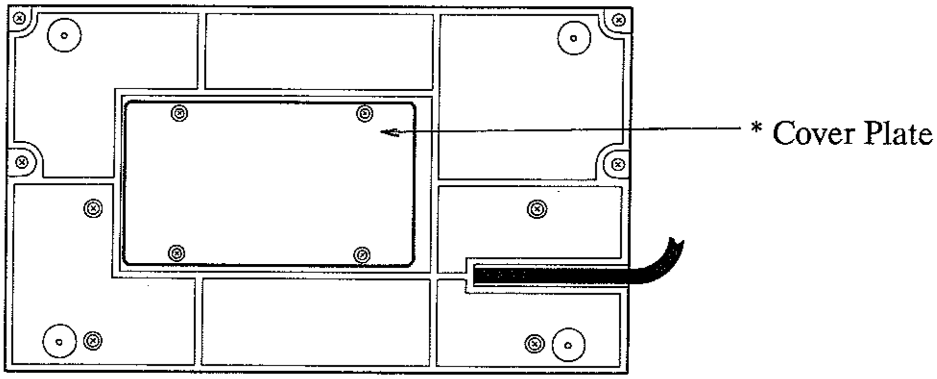

ARP-4
(RP-4)
* ARP-4 keyboard pc board assy.
J521
Plotter Keyboard Unit
* 13P Connector Assy.

(3) Fix both the radar and plotter keyboard units onto the radar/plotter keyboard base with the four M4 screws (supplied) respectively.

Fix the conduit plate. Plug the 13P connector in J401, which is located on the radar keyboard pcb.


ARP-4
(RP-4)
Plotter Keyboard Unit
* Conduit Plate
Radar Keyboard Unit
* Radar/Plotter Keyboard Base
(J402)
J401

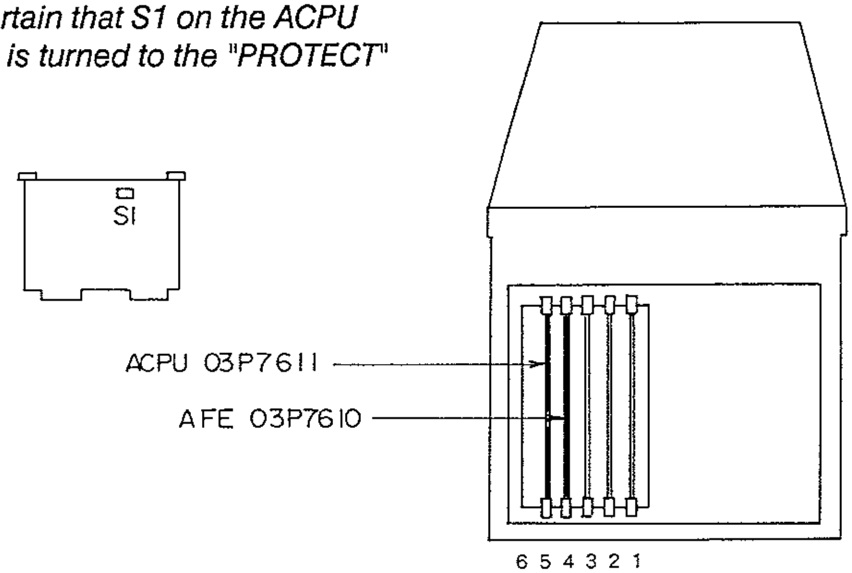
(4) Fix the cover plate as illustrated below.


* Cover Plate

Incorporating the pc boards

(1) Open the radar processor unit by loosing the eight screws securing it. Insert the ACPU 03P7611 and AFE 03P7610 boards into the pc card cage.

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

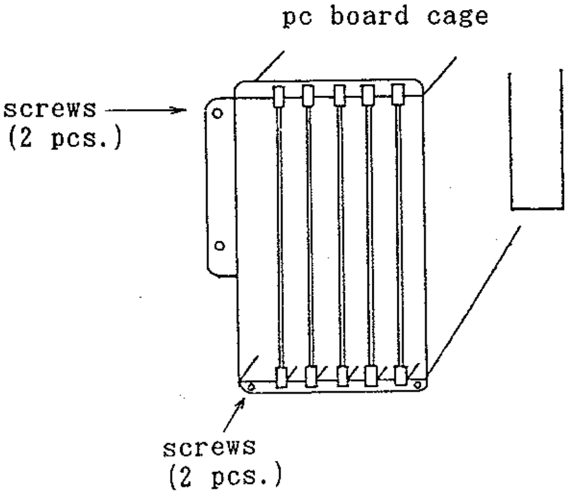


(2) Connection to Gyro Interface 03P6856

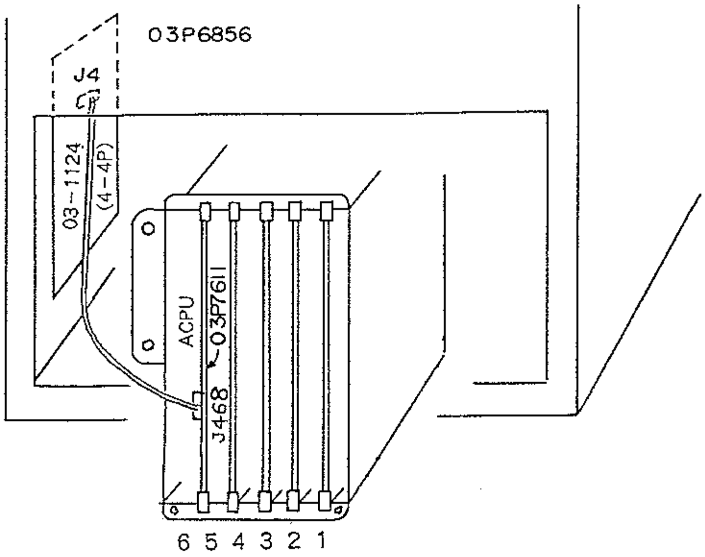
NOTE 1. The ARP-4 does not function without a heading sensor (gyrocompass). Even if a gyro is connected to the radar, the following connection is required additionally.

2. The AD-10S gyro converter may be used instead of the Gyro Interface as shown on page S-1. In this case, use the 25ms interval output indicated on the interconnection diagram.

a. Draw out the pc card cage to access the Gyro Interface board.

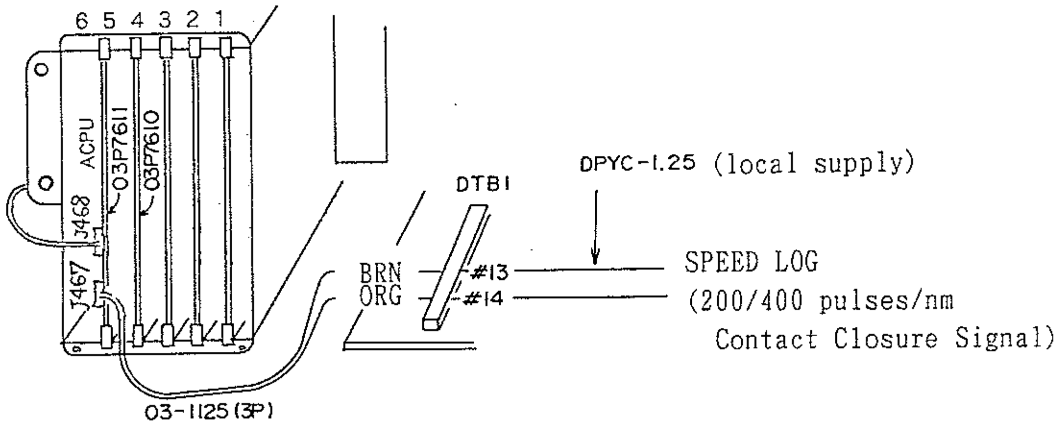


b. Connect between the ACPU board (J468) and the 03P6856 gyro interface (J4) with the NH-connector (cable) assembly 03-1124 (4-4P) supplied.


03P6856
J4
03-1124
(4-4P)
ACPU
03P7611
J468
6 5 4 3 2 1

c. Reinstall the pc card cage.

(3) Connect the ACPU 03P7611 board (J467) to the DTB-1 terminal board by using the NH-connector (cable) assembly 03-1125 (3P) supplied. Also, connect a speed log if available.

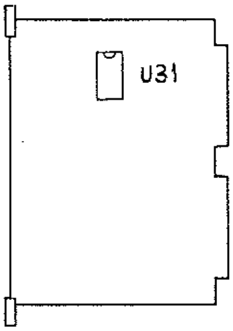

6 5 4 3 2 1
ACPU
03P7611
03P7610
J468
J467
DTB1
DPYC-1.25 (local supply)
BRN
ORG
#13
#14
SPEED LOG
(200/400 pulses/nm
Contact Closure Signal)
03-1125 (3P)

NOTE: Some speed log outputs pulses of which the pulse recurrence rate fluctuates even when the ship's speed is constant. If such a speed log is connected, the ARP-4 will malfunction. (For instance, Furuno's current indicator CI-30 can be used without problem, but the CI-20 can not be used.) To confirm compatibility, run the ship at a constant speed and check if the pulses are output at equal intervals.

Replacing ROM Chips

Replace the following ROM's with the ones supplied.

03P8004

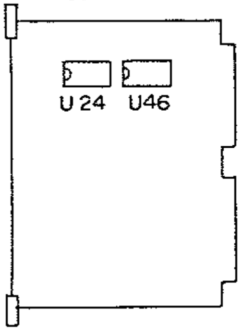


New Program No.

U31 : 03580921 * *
(Cursor Gyro Presentation
not supported.)

* * : Version No.
(03 or higher)

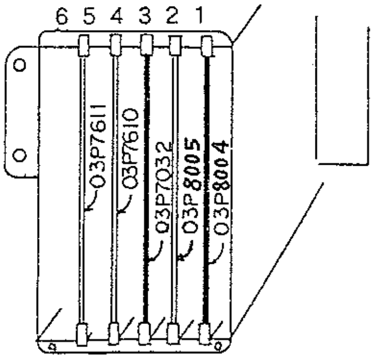
03P7032



New Program No.

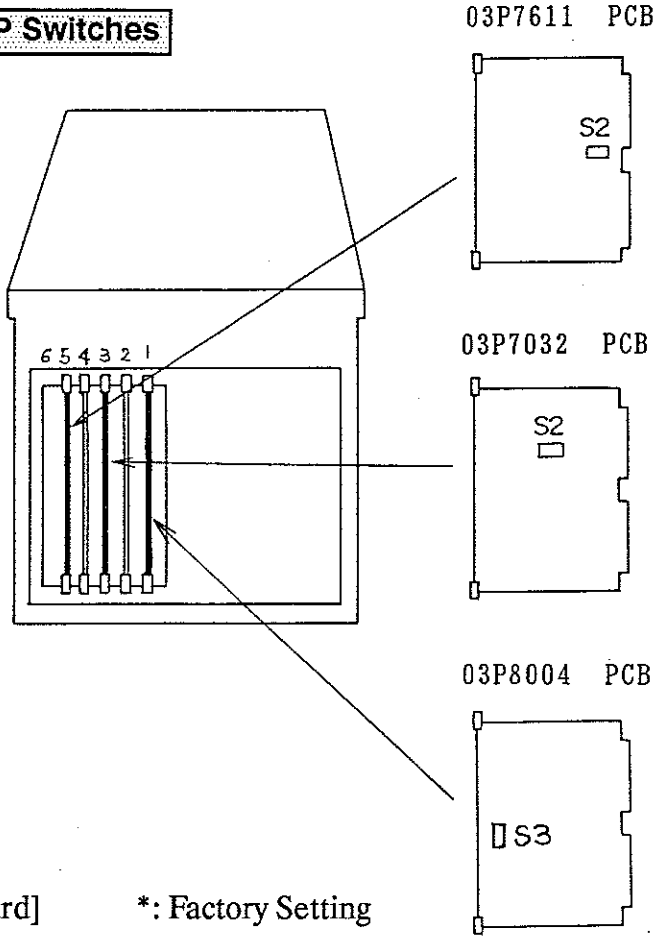
U24 : 03572111 * *
U46 : 03572112 * *

* * : Version No.
(17 or higher)


6
5
4
3
2
1
03P7611
03P7610
03P7032
03P8005
03P8004

Adjustment

Tailoring DIP Switches



[03P7032 Board] *: Factory Setting

S2 #1 Default Mode of Ship's Speed Entry
(The mode can be changed from the keyboard.)

* OFF : Automatic Ship's Speed Entry (from Speed Log)

ON : Manual Ship's Speed Entry (from Keyboard)

#2 Default Vector Mode
(The mode can be changed from the keyboard.)

* OFF : True Velocity Vector

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

ON : Relative Velocity Vector

Vector indicates velocity relative to the own ship velocity. It is influenced by own ship velocity.

#3	* OFF	ON	OFF	ON	
#4	* OFF	OFF	ON	ON	
	5	10	20	50	----- Number of Plotting Points Per Target (When many points are present on the screen, it takes longer for the unit to repaint the picture.)

#5
#6 — used by Radar.
#7

[03P7611 Board] *: Factory Setting

S2 #1 thru #6 : All OFF

#7	ON	* OFF	
#8	ON	* ON	
	400	200	----- Pulses Per Mile (Speed Log's Pulse Rate)

[03P8004 Board] *: Factory Setting

S3 #1 to #6 : Do not change the settings.

#7 * OFF: Normal

ON : N-type (Dutch Version)

#8 : Do not change the setting.

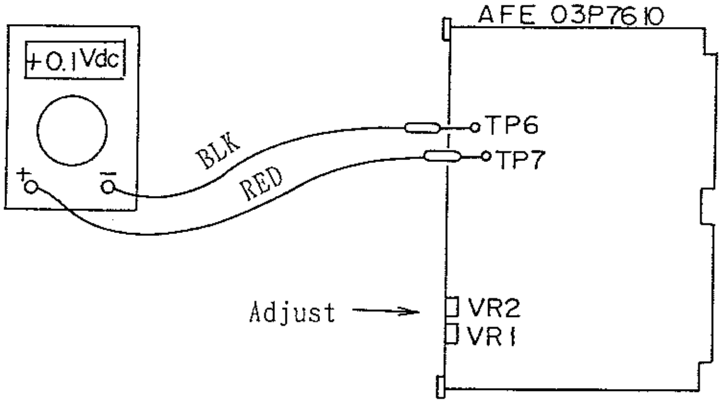
Adjusting AD Conversion Threshold Level

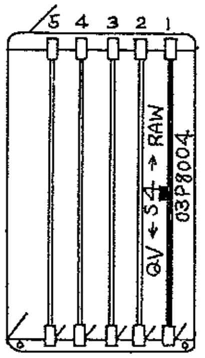
Do the following adjustment on the 12-mile range.

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.


AFE 03P7610
+0.1Vdc
+
−
BLK
RED
TP6
TP7
Adjust
VR2
VR1

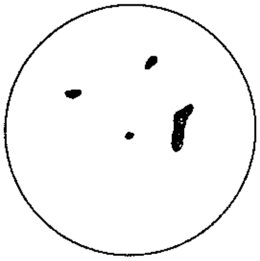

5 4 3 2 1
QV ← S4 → RAW
03P8004

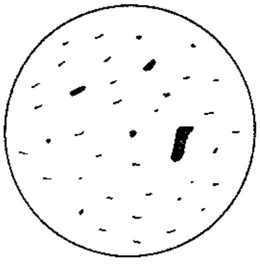
Threshold Level with Maximum Gain

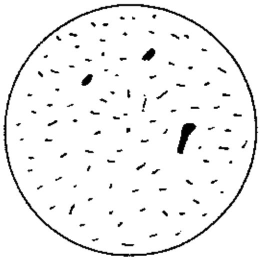
Conditions: [A/C RAIN].......... fully ccw
[A/C SEA]............ fully ccw
[GAIN] .... fully cw
[INT REJECT].... off

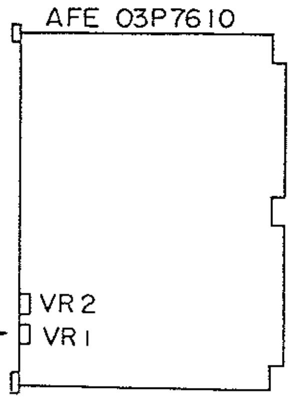
(1) Slide switch S4 on the 03P8004 board (shown above) to the "QV" (Quantum Video) side.

(2) Adjust VR1 on the 03P7610 board so that random noise faintly appears on the screen.


No noise


Proper


Too much noise


AFE 03P7610
VR2
VR1
Adjust

NOTE: Do not reduce noise excessively. Somewhat noisy condition is preferable.

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

Adjusting Track-mark/Vector Presentation Timing

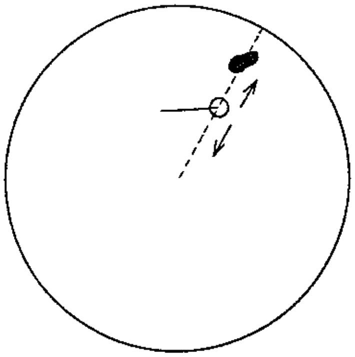
If a track mark position deviates from the target position, align it as follows.

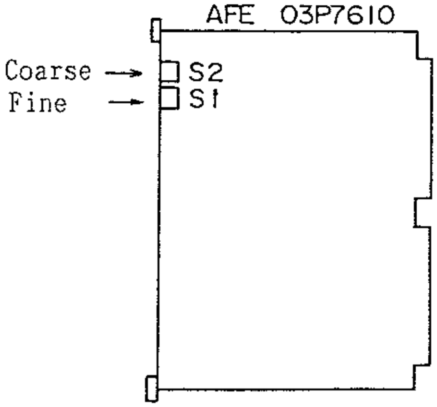
(1) Select the 6-mile range. Find a target within the 3 to 5 mile range of which the size is similar or smaller than the track mark.

(2) Adjust the mark/vector position by S1 and S2 on the AFE 03P7610 board.

NOTE

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



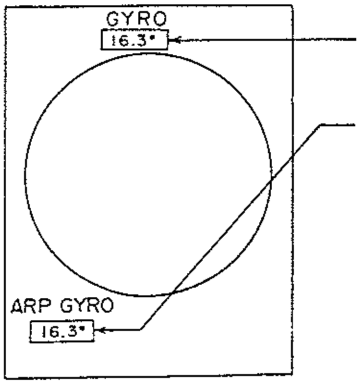


2. *Response to S2/S1 adjustment is slow due to smoothing processing by software. The mark/vector will change their positions about 30 seconds after adjusting the switches.*

3. *Do not set both S2 and S1 fully ccw.*

Checking Gyro Data Entry into ARP-4

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



The readout is updated every 0.3 sec.

The readout is updated every 1.5 sec. Confirm that proper heading is displayed. Note that the ARP-4 does not function if gyro signal is not fed to the ACPU board. See page AP-4.

ARP-4 LED STATUS CHART

P. C. Board	LED No.	Signal	Condition	Remarks
AFE 03P7610	CR13	TRIG	OFF	Lights when no Trigger for more than 34ms.
	CR14	HEAD	OFF	Lights when no Heading for more than 10 sec.
	CR15	BP	OFF	Lights when no Bearing Pulse for more than 34ms.
	CR16	VIDEO	OFF	Lights when no Video for more than 1 minute.
	CR20	Data	ON	
ACPU 03P7611	CR3	IOP	BLINK	
	CR4	DSP	BLINK	
	CR5	GYRO	ON	
	CR6	GSP	BLINK	
	CR7	LOG	ON	

A

B

C

ケ
C

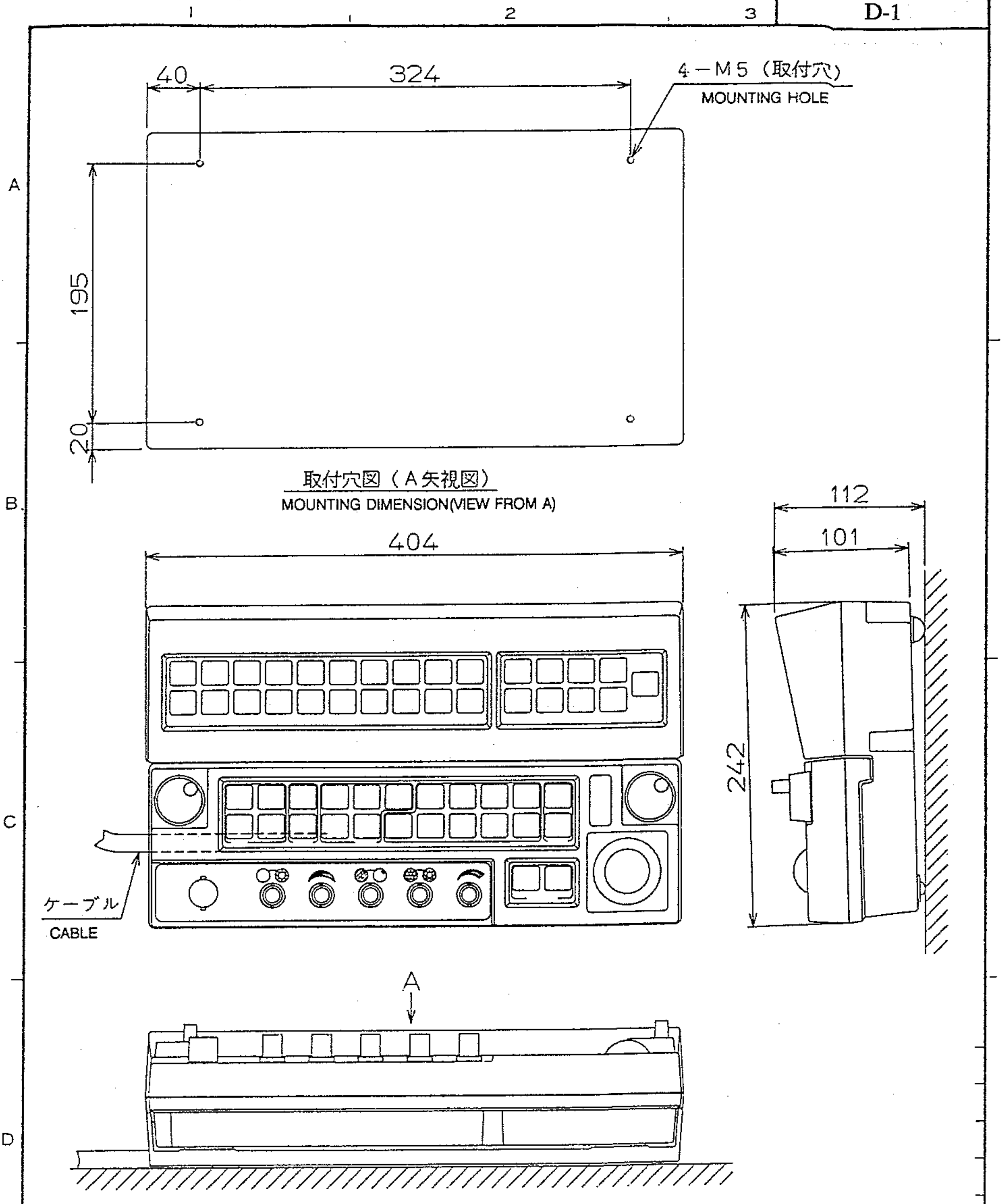
D

承
APP

検
CHE

FURUNO

D-1

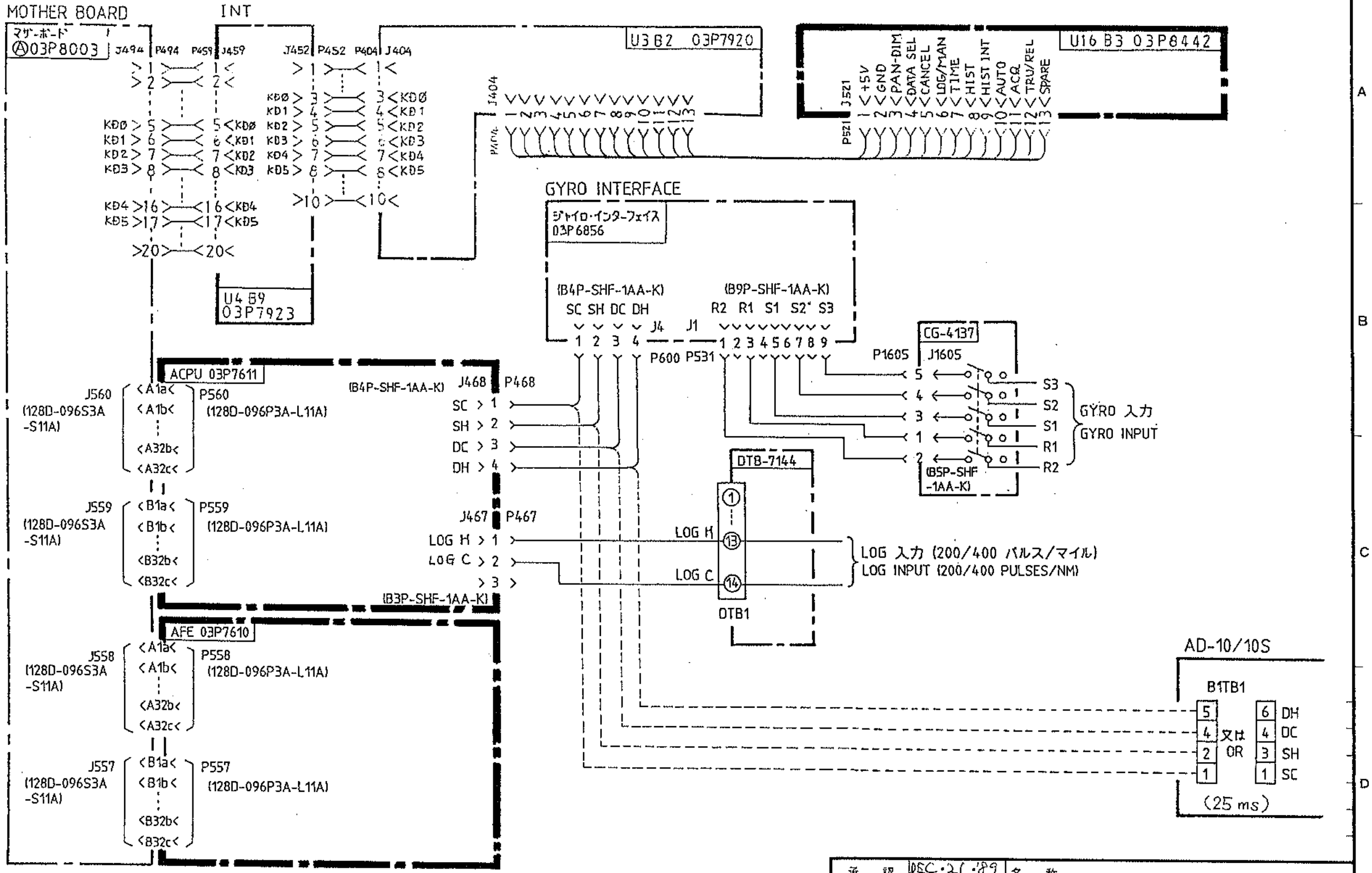


1
2
3
A
B
C
D
40
324
4－M5（取付穴）
MOUNTING HOLE
195
20
取付穴図（A矢視図）
MOUNTING DIMENSION(VIEW FROM A)
404
112
101
242
ケーブル
CABLE
A

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	JAN. 20. '90 T. NAKANO	三角法 THIRD ANGLE PROJECTION		名称 TITLE 操作部外寸図
検図 CHECKED	JAN. 18. '90 N. SAITO	尺度 SCALE	1/4	RP－4／ARP－4 OUTLINE DRAWING

FURUNO


MOTHER BOARD
マザーボード
Ⓐ03P8003
J494 P494 P459 J459
INT
J452 P452 P404 J404
U4 B9
03P7923
U3 B2 03P7920
U16 B3 03P8442
J521 P521
+5V
GND
PAN-DIM
DATA SEL
CANCEL
LOG/MAN
TIME
HIST
HIST INT
AUTO
ACQ
TRU/REL
SPARE
KD0 KD1 KD2 KD3 KD4 KD5
GYRO INTERFACE
ジャイロ・インターフェイス
03P6856
(B4P-SHF-1AA-K)
SC SH DC DH
J4 J1
(B9P-SHF-1AA-K)
R2 R1 S1 S2' S3
P600 P531
CG-4137
P1605 J1605
(B5P-SHF
-1AA-K)
S3 S2 S1 R1 R2
GYRO 入力
GYRO INPUT
ACPU 03P7611
(B4P-SHF-1AA-K)
J468 P468
SC SH DC DH
J467 P467
LOG H
LOG C
(B3P-SHF-1AA-K)
DTB-7144
DTB1
LOG 入力 (200/400 パルス/マイル)
LOG INPUT (200/400 PULSES/NM)
J560 (128D-096S3A-S11A)
P560 (128D-096P3A-L11A)
J559 (128D-096S3A-S11A)
P559 (128D-096P3A-L11A)
AFE 03P7610
J558 (128D-096S3A-S11A)
P558 (128D-096P3A-L11A)
J557 (128D-096S3A-S11A)
P557 (128D-096P3A-L11A)
A1a A1b A32b A32c
B1a B1b B32b B32c
AD-10/10S
B1TB1
5 4 2 1
文は
OR
6 DH
4 DC
3 SH
1 SC
(25 ms)

承 認 APPROVED	DEC. 21 '89 T. NAKANO	名 称 TITLE	ARP−4 相 互 結 線 図 INTERCONNECTION DIAGRAM
検 図 CHECKED	DEC. 21. '89 M. SAITO		
製 図 DRAWN	DEC. 12. '89 T. YUYAMA	図 番 DWG. NO.	C3028−K02−A

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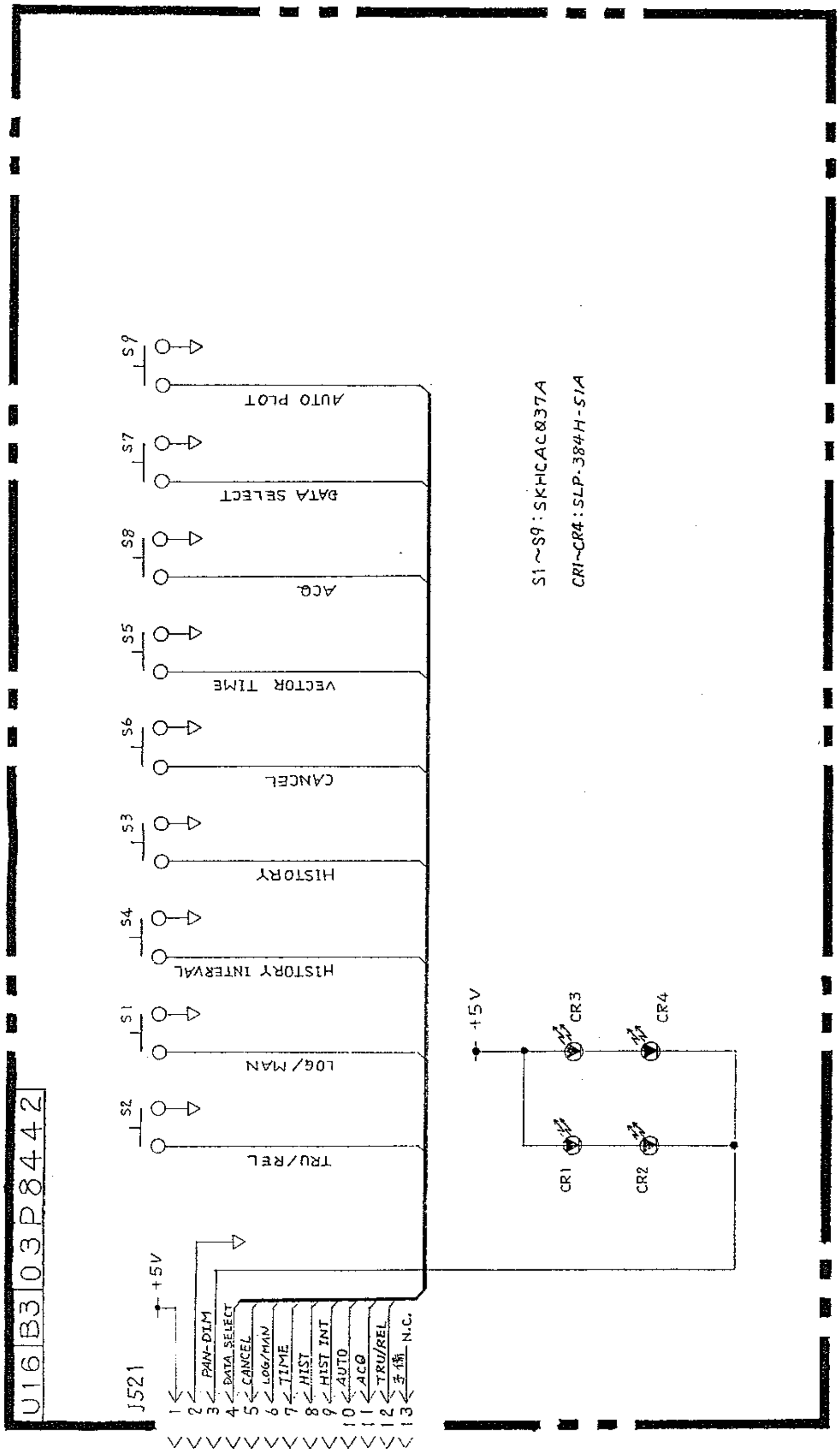
S-2


S1~S9 : SKHCAC037A
CR1~CR4 : SLP-384H-S1A
S9
AUTO PLOT
S7
DATA SELECT
S8
ACQ.
S5
VECTOR TIME
S6
CANCEL
S3
HISTORY
S4
HISTORY INTERVAL
S1
LOG/MAN
S2
TRU/REL
+5V
CR3
CR4
CR1
CR2
+5V
J521
1
2 PAN-DIM
3 DATA SELECT
4 CANCEL
5 LOG/MAN
6 TIME
7 HIST
8 HIST INT
9 AUTO
10 ACQ
11 TRU/REL
12 予備
13 N.C.
U16B3 03P8442

品番 ITEM	品　　名 NAME	材　質 MATERIAL	数　量 Q'TY	図　番 DWG.NO.	摘　要 REMARKS

承　認 APPROVED	DEC. 21. 89 T. NAKANO	三　角　法 THIRD ANGLE PROJECTION		名　称 TITLE ARP-4 キーボード ARP-4 KEYBOARD
検　図 CHECKED	DEC. 21. '89 N. SAITO	尺　度 SCALE	/	
	DEC. 12. '89			

FURUNO ELECTRIC CO., LTD.

No. 9-52, ASHIHARA-CHO,
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TELEX : 5644-325/326 FURUNO J

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